ITEM NO.	APPENDIX

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

B.E., ELECTRONICS AND INSTRUMENTATION ENGINEERING

REVISED REGULATIONS & SYLLABI

(Students Admitted From the Academic Year 2018-2019)

VISION

To nurture higher echelons of technology through participative education, innovative and collaborative research with a view to bring out employable graduates of International standard.

MISSION

M1 To establish state of the art facilities related to diverse dimensions in the field of Instrumentation Engineering

M2 To foster higher quality of education with equivocal focus in theory and practical areas of Electronics, Control and Instrumentation Engineering.

M3 To ensure that the dissemination of knowledge reaches the stakeholders and forge the opening of a fresh flair of human resources

M4 To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one's career

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

PE01 To nurture in a spirit of self-confidence, Tolerance and adaptability among the graduates pursuing this programme

PE02 To inculcate echelons of technical skill and academic excellence for enabling the graduates to choose their field of expertise.

PE03 To foster curricular and extra-curricular attributes with a perspective to ensure the graduates accomplish their professional career.

PE04 To promote awareness among graduates for lifelong learning and inculcate professional ethics.

PROGRAMME OUTCOMES (PO)

After the successful completion of the B.E. (Electronics and Instrumentation Engineering) degree programme, the students will be able to:

PO1	**Integration of knowledge** Apply the knowledge of mathematics, science and engineering fundamentals in analog and digital electronic systems, instrumentation and control engineering
PO2	**Problem analysis** Formulate, solve and analyze complex problems in electrical circuits, electronic systems, instrumentation and control engineering

PO3	**Design and development of solutions** Apply the acquired knowledge for designing systems/processes to address the specific needs and to pull off solution, with appropriate consideration for health, safety, and environmental issues
PO4	**Use of modern tools and techniques** Select and apply appropriate modern engineering tools including prediction and modelling software packages, Distributed Control System, Programmable Controllers and advanced processors.
PO5	**Collaborative and multidisciplinary approach** Gain exposure to attain knowledge and understand inter disciplinary and multidisciplinary engineering sciences
PO6	**Ethical practices** Acquire professional and intellectual integrity, professional code of conduct, ethics on professional practices, understanding responsibilities and norms for sustainable development of society.
PO7	**Communication skills** Interact with the engineering community and with society at large, regarding intricate engineering activities on technical perspectives and emerge as an efficient motivator.
PO8	**Project management** Understand the engineering and management concepts and demonstrate the knowledge as an entrepreneur or member/leader in teams and multidisciplinary tasks in their profession
PO9	**Lifelong learning** Appreciate the need for self preparation and life-long learning independently in the broadest context of technological challenges
PO10	**Engineer and society** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO11	**Conduct investigations of complex problems** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO12	**Individual and team work** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Mapping PO with PEO												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
PEO1	✓	✓	✓									
PEO2				✓	✓						✓	✓
PEO3					✓	✓	✓	✓				
PEO4						✓			✓	✓		

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS101	**BS-I**	Physics	3	1	0	25	75	100	4
ETBS102	**BS-II**	Mathematics – I	3	1	0	25	75	100	4
ETES103	**ES-I**	Basic Electrical Engineering	3	1	0	25	75	100	4
ETBP104	**BSP-I**	Physics Laboratory	0	0	3	40	60	100	1.5
ETSP105	**ESP-I**	Electrical Engineering Laboratory	0	0	2	40	60	100	1
ETSP106	**ESP-II**	Engineering Workshop/ Manufacturing Practices	1	0	4	40	60	100	3
						Total Credits			**17.5**
SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS201	**HS-I**	English	2	0	0	25	75	100	2
ETBS202	**BS-III**	Chemistry	3	1	0	25	75	100	4
ETES203	**ES-II**	Programming for Problem Solving	3	0	0	25	75	100	3
ETBS204	**BS-IV**	Mathematics – II	3	1	0	25	75	100	4
ETHP205	**HSP-I**	Communication Skills and Language Laboratory	0	0	2	40	60	100	1
ETBP206	**BSP-II**	Chemistry Laboratory	0	0	3	40	60	100	1.5
ETSP207	**ESP-III**	Computer Programming Lab	0	0	4	40	60	100	2
ETSP208	**ESP-IV**	Engineering Graphics and Drafting	1	0	4	40	60	100	3
						Total Credits			**20.5**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming III Semester.									

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETBS301	**BS-V**	Engineering Mathematics III	3	1	-	25	75	100	4
ETES302	**ES-III**	Environmental Studies	3	-	-	25	75	100	3
ETES303	**ES-IV**	Engineering Mechanics	3	-	-	25	75	100	3
EIES304	**ES-V**	Thermodynamics and Fluid Mechanics	2			25	75	100	2
EIPC305	**PC-I**	Electrical Circuit Analysis	3	-	-	25	75	100	3
EIPC306	**PC-II**	Analog Electronic Circuits	3	1		25	75	100	4
EISP307	**ESP-V**	Fluid Mechanics & Hydraulics Machinery Lab	-	-	3	40	60	100	1.5
EICP308	**PCP-I**	Electric Circuits Lab	-	-	3	40	60	100	1.5
EICP309	**PCP-II**	Analog Electronics Lab	-	-	3	40	60	100	1.5
ETIT310	**IT-I**	Internship Inter/ Intra Institutional Activities*	***Four*** *weeks during the summer vacation at the end of* ***II Semester***				100	100	**4.0**
For the ***Lateral entry students total credit for III Semester is ***23.5*** as they are exempted from internship during summer vacation of II semester.*						**Total Credits**			**27.5**

SEMESTER IV									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIBS401	**BS-VI**	Probability, Random Processes and Numerical Methods	3	-	-	25	75	100	3
EIES402	**ES-VI**	Electrical Technology	2	-	-	25	75	100	2
EIPC403	**PC-III**	Control Systems	3	-	-	25	75	100	3
EIPC404	**PC-IV**	Digital Electronics	3	-	-	25	75	100	3
EIPC405	**PC-V**	Electronic Instrumentation and Measurement Techniques	3	-	-	25	75	100	3
EIPC406	**PC-VI**	Transducers and Measurement Systems	3	-	-	25	75	100	3
EICP407	**PCP-III**	Control Systems Lab	-	-	3	40	60	100	1.5
EICP408	**PCP-IV**	Digital Electronics Lab	-	-	3	40	60	100	1.5
EICP409	**PCP-V**	Sensors and Signal	-	-	3	40	60	100	1.5

		Conditioning Lab							
						Total Credits			**21.5**

Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming V Semester.

SEMESTER V

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EIPC501	**PC-VII**	Industrial Instrumentation	3	-	-	25	75	100	3
EIPC502	**PC-VIII**	Signals and Systems	3	-	-	25	75	100	3
EIPC503	**PC-IX**	Process Control	3	-	-	25	75	100	3
EIPC504	**PC-X**	Microprocessors and Microcontrollers	3			25	75	100	3
EIPE505	**PE-I**	Professional Elective I	3	-	-	25	75	100	3
EIPE506	**PE-II**	Professional Elective II	3	-		25	75	100	3
EICP507	**PCP-VI**	Industrial Instrumentation Lab	-	-	3	40	60	100	1.5
EICP508	**PCP-VII**	Process Control Lab	-	-	3	40	60	100	1.5
EICP509	**PCP-VIII**	Microprocessors Lab	-	-	3	40	60	100	1.5
ETIT510	**IT-II**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four*** *weeks during the summer vacation at the end of* ***IV Semester***				100	100	**4.0**
						Total Credits			**26.5**

SEMESTER VI

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EIPC601	**PC-XI**	Digital Signal Processing	3	-	-	25	75	100	3
EIPC602	**PC-XII**	Instrumentation System Design	3	-	-	25	75	100	3
EIPE603	**PE-III**	Professional Elective - III	3	-	-	25	75	100	3
EIPE604	**PE-IV**	Professional Elective - IV	3	-	-	25	75	100	3
EIPE605	**PE-V**	Professional Elective –V	3	-	-	25	75	100	3
YYOE606	**OE-I**	**Open Elective - I (inter department - FEAT)**	3	-	-	25	75	100	3
EICP607	**PCP-IX**	Instrumentation System Design Lab	-	-	3	40	60	100	1.5
EICP608	**PCP-X**	Signal Processing and	-	-	3	40	60	100	1.5

		Embedded Systems Lab							
						Total Credits			**21.0**
Students must undergo Internship for 4 weeks during summer vacation which will be assessed in the forthcoming VII Semester.									
SEMESTER VII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
ETHS701	**HS-II**	Engineering Ethics	2	-	-	25	75	100	2
EIPC702	**PC-XIII**	Computer Control of Processes	3	-	-	25	75	100	3
EIPE703	**PE-VI**	Professional Elective-VI	3	-	-	25	75	100	3
EIPE704	**PE-VII**	Professional Elective-VII	3	-	-	25	75	100	3
YYOE705	**OE-II**	**Open Elective - II (inter department-Allied Branch)**	3	-	-	25	75	100	3
EICP706	**PCP-XI**	Industrial Automation Lab	-	-	3	40	60	100	1.5
ETIT707	**IT-III**	Industrial Training / Rural Internship/Innovation / Entrepreneurship	***Four*** *weeks during the summer vacation at the end of* ***VI Semester***				100	100	**4.0**
						Total Credits			**19.5**
SEMESTER VIII									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIOE801	**OE-III**	Open Elective – III **(from the same Department)**	3	-	-	25	75	100	3
EIOE802	**OE-IV**	Open Elective – IV **(from the same Department)**	3	-	-	25	75	100	3
EIPV803	**PV-I**	Project Work and Viva-Voce	-	**PR** 10	**S** 2	40	60	100	**6**
						Total Credits			**12**

L	No. of Lecture Hours	**PR**	No. of Hours for Discussion on Project work
T	No. of Tutorial Hours	**S**	No. of Seminar Hours on Industrial Training / Project
P	No. of Practical Hours	**FE**	Final Examination Marks
CA	Continuous Assessment Marks		
Credits	Credit points allotted to that course	**Total**	Total Marks

S.No.	COURSE CODE	LIST OF PROFESSIONAL ELECTIVES
1	EIPESCN	Virtual Instrumentation and Smart Sensors
2	EIPESCN	Analytical Instrumentation
3	EIPESCN	Biomedical Instrumentation
4	EIPESCN	Power Plant Instrumentation
5	EIPESCN	Unit Operations and Control
6	EIPESCN	Fluid Mechanics and Hydraulic Machinery
7	EIPESCN	Principles of Communication systems
8	EIPESCN	Digital System Design
9	EIPESCN	Real Time Operating Systems
10	EIPESCN	Computer Networks and DCS
11	EIPESCN	VLSI System Design
12	EIPESCN	Microcontroller Based System Design
13	EIPESCN	Embedded Systems
14	EIPESCN	Power Electronics, Drives and Control
15	EIPESCN	Soft Computing Techniques for Process Control
16	EIPESCN	Non-linear Control Systems
17	EIPESCN	Optimal Control
18	EIPESCN	Model Predictive Control
19	EIPESCN	Fault Detection and Diagnosis

S.No.	COURSE CODE	LIST OF OPEN ELECTIVES
1	EIOESCN	Transducer Engineering
2	EIOESCN	Test and Measuring Instruments
3	EIOESCN	Measurements in Process Industries
4	EIOESCN	Industrial Automation and Control
5	EIOESCN	Nano Materials and Nano Electronics

6	EIOESCN	Micro Electro Mechanical Systems
7	EIOESCN	Instrumentation in Petrochemical Industries

S.No.	COURSE CODE	LIST OF HONOUR ELECTIVES	CREDITS
1	EIHESCN	Advanced Topics in PID Control	4
2	EIHESCN	Industrial Safety	3
3	EIHESCN	Robotics & Automation	3
4	EIHESCN	Fiber Optics and Laser Instrumentation	3
5	EIHESCN	Process Data Analytics	4
6	EIHESCN	SCADA Systems and Application	3

S.No.	COURSE CODE	LIST OF MINOR ENGINEERING ELECTIVES	CREDITS
1	EIMISCN	Transducer Engineering	3
2	EIMISCN	Test and Measuring Instruments	3
3	EIMISCN	Measurements in Process Industries	3
4	EIMISCN	Essentials of Control Engineering	4
5	EIMISCN	Industrial Automation and Control	4
6	EIMISCN	Instrumentation in Petrochemical Industries	3

ETBS301	ENGINEERING MATHEMATICS III	L	T	P	C
		3	1	-	4

Course Objectives

- To learn, partial differential equations, Fourier series, Boundary value problems.
- To learn the transforms such as Sine, Cosine, Fourier transform and Z-transforms.
- To gain knowledge of the method to find the Solution of difference equations.

Unit–I : Partial Differential Equations

Formation of partial differential equations by eliminating arbitrary constants and arbitrary functions - Solution of standard type of first order partial differential equations - Lagrange's linear equation - Linear partial differential equations of second order with constant coefficients.

Unit–II : Fourier Series

Dirichle's conditions - General Fourier series - Odd and Even functions - Half range sine series - Half range cosine series - Complex form of Fourier series – Parseval's identity.

Unit–III : Boundary value problems

Solutions of one dimensional wave equation – One dimensional heat equation (without derivation) – Fourier series solutions in Cartesian co-ordinates.

Unit–IV : Fourier Transform

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem - Parseval's identity.

Unit–V : Z – Transform and difference equations

Z -transform – Elementary properties – Inverse Z – transform - Convolution theorem – Solution of difference equations using Z – transform.

TEXT BOOKS

1. Kandasamy P , Tilagavathy K and Gunavathy K, "Engineering Mathematics",6th edition., (Vol I & II) S.Chand& Co Ltd. 2006, New Delhi.
2. Ventakataraman M K, "Engineering Mathematics", The National Publishing Co.,Chennai,2003.

REFERENCES

1. Veerarajan T, "Engineering Mathematics", 3 rd edition, TataMcGraw Hill Pub., 2005.
2. Singaravelu A, "Engineering Mathematics", Meenakshi Publications, Chennai, 2004.

COURSE OUTCOMES

At the end of the course the students will be able to acquire knowledge on

1. Partial differential equations.
2. Fourier series.
3. Fourier transform.
4. Z-transforms and the methods of solving them.
5. Solving boundary value problems.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓								✓	
CO2	✓		✓									
CO3	✓		✓								✓	
CO4	✓		✓								✓	
CO5	✓		✓								✓	

		L	T	P	C
ETES302	**ENVIRONMENTAL STUDIES**	**3**	**-**	**-**	**3**

COURSE OBJECTIVES

- To realize the importance of environment for engineering students.
- To understand the basis of ecosystems

- To make aware the student about global environmental problems and natural disasters.
- To give the ideas about advance technologies of Engineering that will useful to protect environment.

Unit–I

Introduction - Multidisciplinary nature of environmental studies - Definition, scope and importance - Need for public awareness.

Natural resources - Forest resources: use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification - Role of an individual in conservation of natural resources.- Equitable use of resources for sustainable lifestyles.

Unit–II

Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological - pyramids - Introduction, types, characteristic features, structure and function of the following ecosystem - Forest ecosystem, Grassland ecosystem, Desert ecosystem, Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit–III

Introduction – Definition: genetic, species and ecosystem diversity - Bio geographical classification of India - Value of biodiversity : consumptive use, productive use, social, ethical, aesthetic and option values - Biodiversity at global, National and local levels - India as a mega-diversity nation - Hot-spots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts - Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit–IV

Definition - Cause, effects and control measures of Air pollution - Water pollution - Soil pollution - Marine pollution- Noise pollution - Thermal pollution - Nuclear hazards- Solid waste Management: Causes, effects and control measures of urban and industrial wastes - Role of an individual in prevention of pollution - Disaster management : floods, earthquake, cyclone and landslides. Sustainable development - Urban problems related to energy - Water conservation, rain water harvesting, and watershed management - Resettlement and rehabilitation of people; its problems and concerns. - Environmental ethics: Issues and possible solutions -

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Wasteland reclamation - Consumerism and waste products - Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act - Issues involved in enforcement of environmental legislation.

Unit–V

Population growth, variation among nations - Population explosion – Family Welfare Programme - Environment and human health - Human Rights - Value Education - HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health -Case Studies.

Field work

Visit to a local area to document environmental assets-river/forest/grassland hill/mountain - Visit to a local polluted site-Urban/Rural/Industrial/Agricultural - Study of common plants, insects, birds -Study of simple ecosystems-pond, river, hill slopes, etc. **(Field work Equal to 5 lecture hours)**

TEXT BOOKS

1. Agarwal, K.C. Environmental Biology, Nidi Publ, Ltd. Bikaner, 2001
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad – 380 013, India, Email:mapin@icenet.net

REFERENCES

1. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480p.
2. Clark R.S., Marine Pollution, Clanderson Press Oxford
3. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
4. De A.K., Environmental Chemistry, Wiley Eastern Ltd.
5. Down to Earth, Centre for Science and Environment
6. Gleick, H.P. 1993. Water in crisis, Pacific Institute for Studies in Dev., Environment & Security. Stockholm Env. Institute Oxford Univ. Press. 473p.
7. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay
8. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. press 1140p.
9. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284 p.
10. Mckinney, M.L. & School, R.M. 1996. Environmental Science systems & Solutions,Web enhanced edition. 639p.
11. Mhaskar A.K., Matter Hazardous, Techno-Science Publication
12. Miller T.G. Jr. Environmental Science, Wadsworth Publishing Co.
13. Odum, E.P. 1971. Fundamentals of Ecology. W.B. Saunders Co. USA, 574p
14. Rao M N. & Datta, A.K. 1987. Waste Water treatment. Oxford & IBH Publ. Co. Pvt. Ltd. 345p.

15. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut Survey of the Environment, The Hindu (M)
16. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science.
17. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media.
18. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication.
19. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p.

COURSE OUTCOMES

At the end students can able to

1. Understand the importance of environment.
2. Analyze the importance of environment in engineering.
3. Apply their own ideas and demonstrate advanced technologies that will be useful to protect environment.
4. Employ awareness among the society about environmental problems and natural disasters.
5. Practice according to the present and future environmental issues.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓									
CO2	✓	✓	✓								✓	
CO3		✓	✓									
CO4		✓										
CO5	✓										✓	

ETES303	**ENGINEERING MECHANICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To introduce the fundamentals of forces and their effects with their governing laws.
- To understand the definitions of particle, body forces and their equilibrium conditions.
- To understand dynamics and its related motions.

UNIT I

Introduction to Engineering Mechanics covering, Force Systems Basic concepts, Particle equilibrium in 2-D & 3-D; Rigid Body equilibrium; System of Forces, Coplanar Concurrent Forces, Components in Space – Resultant- Moment of Forces and its Application; Couples and Resultant of Force System, Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems; Static Indeterminancy

UNIT II

Basic Structural Analysis covering, Equilibrium in three dimensions; Method of Sections; Method of Joints; How to determine if a member is in tension or compression; Simple Trusses; Zero force members; Beams & types of beams; Frames & Machines

Centroid and Centre of Gravity covering, Centroid of simple figures from first principle, centroid of composite sections; Centre of Gravity and its implications; Area moment of inertia- Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections; Mass moment inertia of circular plate, Cylinder, Cone, Sphere, Hook.

UNIT III

Friction covering, Types of friction, Limiting friction, Laws of Friction, Static and Dynamic Friction; Motion of Bodies, wedge friction, screw jack & differential screw jack

Virtual Work and Energy Method- Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.

UNIT IV

Review of particle dynamics- Rectilinear motion; Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion; Relative and constrained motion; Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy.Impulse-momentum (linear, angular); Impact (Direct and oblique).

UNIT V

Introduction to Kinetics of Rigid Bodies covering, Basic terms, general principles in dynamics; Types of motion, Instantaneous centre of rotation in plane motion and simple problems; D'Alembert's principle and its applications in plane motion and connected bodies; Work energy principle and its application in plane motion of connected bodies; Kinetics of rigid body rotation

Mechanical Vibrations covering, Basic terminology, free and forced vibrations, resonance and its effects; Degree of freedom; Derivation for frequency and amplitude of free vibrations without damping and single degree of freedom system, simple problems, types of pendulum, use of simple, compound and torsion pendulums;

Tutorials from the above modules covering, To find the various forces and angles including resultants in various parts of wall crane, roof truss, pipes, etc.; To verify the line of polygon on various forces; To find coefficient of friction between various materials on inclined plan; Free body diagrams various systems including block-pulley; To verify the principle of moment in the disc apparatus; Helical block; To draw a load efficiency curve for a screw jack

TEXT BOOKS

1. Palanichamy, M.S and Nagan, S, "Engineering Mechanics (Statics and Dynamics*)"*, Tata McGraw Hill Publishing Company, Ltd., New Delhi, 2010.
2. Natesan,S.C, "Engineering Mechanics (Statics and Dynamics)", first edition, Umesh Publications, New Delhi, 2002.

REFERENCES

1. Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall
2. F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II, – Dynamics, 9th Ed, Tata McGraw Hill
3. R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4. Andy Ruina and Rudra Pratap (2011), Introduction to Statics and Dynamics, Oxford University Press
5. Shanes and Rao (2006), Engineering Mechanics, Pearson Education,
6. Hibler and Gupta (2010),Engineering Mechanics (Statics, Dynamics) by Pearson Education
7. Reddy Vijaykumar K. and K. Suresh Kumar(2010), Singer's Engineering Mechanics
8. Bansal R.K.(2010), A Text Book of Engineering Mechanics, Laxmi Publications
9. Khurmi R.S. (2010), Engineering Mechanics, S. Chand & Co.
10. Tayal A.K. (2010), Engineering Mechanics, Umesh Publications

COURSE OUTCOMES

At the end, Students can able to

1. Explain the forces and its related laws of mechanics in static and dynamic conditions.
2. Analyse the forces and its motions on particles, rigid bodies and structures.
3. Solve the moment of inertia of any sections and masses for the structural members.
4. Understand the principles of kinetics and dynamics.
5. Understand the concept of particle dynamics in motion.

Mapping of COs with POs												
COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓									✓	✓
CO2		✓	✓	✓						✓		
CO3					✓		✓		✓			
CO4						✓			✓		✓	
CO5						✓			✓			

EIES304	THERMODYNAMICS AND FLUID MECHANICS	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

- The principles of work and energy, design principles and analysis of thermo-fluid systems.
- The physical properties of fluids and their consequences on fluid flow.
- The conservation principles of mass, linear momentum, and energy for fluid flow.
- The basic forces and moments acting on simple profiles and shapes in an inviscid, steady fluid flow.

Unit–I

Basic concepts of thermodynamics: Thermodynamic equilibrium, quasi-static process, zeroth law, work and heat interactions, first law for a cycle and a process, steady flow processes, second law statements, reversibility, Carnot theorem, Clausius inequality, entropy principle. Available energy: Availability and irreversibility, properties of pure substances, phase equilibrium diagrams, Rankine cycle, reheat and regenerative cycle, properties of ideal gas, Stirling and Ericson cycles.

Unit–II

Heat engines: Otto, diesel and dual cycles, Brayton cycle with regeneration, inter cooling and reheat, Joule-Thompson effect.

Unit–III

Fundamentals of Fluid mechanics: Classification of fluids and their physical properties, Fluid statics, manometers, pressure on submerged bodies. Ideal fluid - velocity field - stream line, streak line and path line, continuity equation - Rotational and irrotational flow, stream function and potential function, Euler's equations of motion, Bernoulli's equation and its application. Classification of open channel flows - measurement of discharge using rectangular and V-notches. Dimensional analysis – Rayleigh's method - Buckinghan Theorem and its applications. Laminar flow – Losses – Hagen-Poiseuille equation – Turbulent pipe flow – Friction.

Unit–IV

Darcy Weisbach equation – Moody's diagram, minor losses – Boundary layer and its basic concepts.

Unit–V

Fluid machinery: Centrifugal pumps, Reciprocating pumps, Hydraulic ram, Impulse turbine, Reaction turbine.

TEXT BOOKS

1. Zemansky, Heat and Thermodynamics, 7th edition, McGraw Hill, New York, 1997.
2. Ojha C.S.P., Berndtsson R., Chandramouli P.N., Fluid Mechanics and Machinery, Oxford University Press,2010.

REFERENCES

1. Van Wylen G.A., Fundamentals of classical Thermodynamics, 4thEdition, John Wiley and Sons,1994.
2. Cengal Y.A., Bogles M.A., Micheal Boles, Thermodynamics, 2nd edition, McGraw Hill Book Company, 1994.
3. Streeter V.L. and Wylie E.B., 'Fluid Mechanics', 9 th edition, McGraw Hill, New York, 1997.
3. Nag P.K., Engineering Thermodynamics, 2nd Edition, Tata McGraw Hill, 1995.
4. Crowe C.T., Elger D.F., Williams B.C., Roberson J.A., Engineering Fluid Mechanics 9th Edition, John Wiley & Sons, 2009.

COURSE OUTCOMES

By the end of this course, the students will be able to:

1. Understand the basics of thermodynamics (Unit I)
2. Understand various thermodynamic cycles and apply them to heat engines. (Unit II)
3. Quantify the properties of fluids. (Unit III)
4. Familiarize the equations relating boundary layer and concepts (Unit IV)
5. Know the principles of operation of some of the widely used fluid machinery. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			✓	✓	✓					✓		✓
CO2			✓		✓							✓
CO3	✓	✓			✓						✓	
CO4	✓										✓	
CO5		✓									✓	✓

EIPC305	**ELECTRICAL CIRCUIT ANALYSIS**	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**

COURSE OBJECTIVES

- To analyze electrical circuits using KCL and KVL.
- To learn network theorems and apply them for circuit analysis.
- To study resonance and coupled circuits.
- To study transient analysis of RC, RL, RLC circuits.

Unit-I : Network Theorems

Superposition theorem, Thevenin theorem, Norton theorem, Maximum power transfer theorem, Reciprocity theorem, Compensation theorem. Analysis with dependent current and voltage sources. Node and Mesh Analysis. Concept of duality and dual networks.

Unit-II : Solution of First and Second order networks

Solution of first and second order differential equations for Series and parallel RL, RC, RLC circuits, initial and final conditions in network elements, forced and free response, time constants, steady state and transient state response.

Unit-III : Sinusoidal steady state analysis

Representation of sine function as rotating phasor, phasor diagrams, impedances and admittances, AC circuit analysis, effective or RMS values, average power and complex power. Three-phase circuits. Mutual coupled circuits, Dot Convention in coupled circuits, Ideal Transformer.

Unit-IV : Electrical Circuit Analysis Using Laplace Transforms

Review of Laplace Transform, Analysis of electrical circuits using Laplace Transform for standard inputs, convolution integral, inverse Laplace transform, transformed network with initial conditions. Transfer function representation. Poles and Zeros. Frequency response (magnitude and phase plots), series and parallel resonances

Unit-V : Two Port Network and Network Functions

Two Port Networks, terminal pairs, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters and hybrid parameters, interconnections of two port networks.

TEXT BOOKS

1. Sudhakar and Shyammohan S. Palli, "Circuits and Networks: Analysis and Synthesis", McGraw Hill Education; Fifth edition, 2015.
2. W. H. Hayt and J. E. Kemmerly, “Engineering Circuit Analysis”, McGraw Hill Education, 2013.

REFERENCES

1. C. K. Alexander and M. N. O. Sadiku, “Electric Circuits”, McGraw Hill Education, 2004.
2. P. Rameshbabu, “Electric Circuit Analysis”, New Scitech Publications (India) Pvt Limited, 2010.
3. Mahmood Nahvi & Joseph Edminister, “Electric Circuits”, Schaum’s Outline Series, McGraw Hill Education; Sixth edition, 2014.
4. R.L. Boylestad, “Introductory Circuit Analysis”, 13th edition, Pearson (23 March 2015).
5. D. Roy Choudhury, “Networks and Systems”, New Age International Publications, 1998.
6. M. E. Van Valkenburg, “Network Analysis”, Third Edition, Pearson Education India of India, 2015.

COURSE OUTCOMES

At the end of this course, students will demonstrate the ability to

1. Apply network theorems for the analysis of electrical circuits.(Unit I)
2. Obtain the transient and steady-state response of electrical circuits.(Unit II)
3. Analyse circuits in the sinusoidal steady-state (single-phase and three-phase).(Unit III)

4. Analyse two port circuit behavior.(Unit IV)
5. Acquire engineering analytic techniques and skills.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓						✓			
CO2	✓	✓	✓	✓					✓			
CO3		✓	✓	✓	✓						✓	
CO4		✓		✓	✓						✓	
CO5		✓	✓	✓					✓			✓

EIPC306	**ANALOG ELECTRONIC CIRCUITS**	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**

COURSE OBJECTIVES

- To study the qualitative and quantitative exposition of fundamental concepts of silicon and germanium semiconductor devices.
- To understand the principle, operation and characteristics of diode, bipolar junction transistor and metal oxide field effect transistor.
- To study the characteristics of operational amplifiers and its applications

Unit-I: Diode circuits

P-N junction diode, I-V characteristics of a diode; review of half-wave and full-wave rectifiers, Zener diodes, clamping and clipping circuits.

Unit-II : BJT circuits

Structure and I-V characteristics of a BJT; BJT as a switch. BJT as an amplifier: small-signal model, biasing circuits, current mirror; common-emitter, common-base and common collector amplifiers; Small signal equivalent circuits, high-frequency equivalent circuits.

Unit-III : MOSFET circuits

MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common-source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, transconductance, high frequency equivalent circuit.

Unit-IV : Differential, multi-stage and operational amplifiers

Differential amplifier; power amplifier; direct coupled multi-stage amplifier; internal structure of an operational amplifier, ideal op-amp, non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit-V : Linear & Nonlinear applications of op-amp

Idealized analysis of op-amp circuits. Inverting and non-inverting amplifier, differential amplifier, instrumentation amplifier, integrator, active filter, P, PI and PID controllers and lead/lag compensator using an op-amp, voltage regulator, oscillators (Wein bridge and phase shift). Analog to Digital Conversion, Hysteretic

Comparator, Zero Crossing Detector, Square-wave and triangular-wave generators, Precision rectifier, peak detector, Astable Multivibrator.

TEXT BOOKS

1. P. R. Gray, R. G. Meyer and S. Lewis, “Analysis and Design of Analog Integrated Circuits”, John Wiley & Sons, 2001.
2. Theodore F Bogart, Jeffrey S. Beasley, Guillermo Rico, "Electronic Devices and Circuits", Sixth Edition, Pearson Education India, 2004.

REFERENCES

1. A. S. Sedra and K. C. Smith, “Microelectronic Circuits”, New York, Oxford University Press, 1998.
2. J. Millman and A. Grabel, “Microelectronics”, McGraw Hill Education, 1988.
3. M.K. Achuthan and K.N. Bhat, “Fundamentals of Semiconductor Devices”, Tata McGraw-Hill Publishing Company Limited, 2007.
4. J. V. Wait, L. P. Huelsman and G. A. Korn, “Introduction to Operational Amplifier theory and applications”, McGraw Hill U. S., 1992.
5. P. Horowitz and W. Hill, “The Art of Electronics”, Cambridge University Press, 1989.
6. Behzad Razavi, Design of Analog CMOS Integrated Circuits, McGraw Hill International Edition, 2001.

COURSE OUTCOMES

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

1. Understand the characteristics of transistors.(Unit II)
2. Design and analyse various rectifier and amplifier circuits. (Unit I)
3. Understand the fundamental concepts of MOSFETs and their applications for analog electronics circuits. (Unit III)
4. Understand the functioning of OP-AMP. (Unit IV)
5. Understand the design OP-AMP based circuits. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓								✓			
CO2	✓	✓	✓	✓	✓				✓		✓	
CO3	✓			✓	✓				✓			
CO4	✓	✓	✓		✓				✓		✓	✓
CO5	✓	✓	✓								✓	✓

EISP307	**FLUID MECHANICS & HYDRAULICS MACHINERY LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To understand the properties of fluids and fluid statics, methods for determination of co-efficient of discharged are to be explained and computed practically.
- To study of the characteristic features of pumps and turbines using experiments in envisaged.
- To understand the significance and role of such utilities in their further course of study.

LIST OF EXPERIMENTS

1. Determination of Co-efficient of discharge of Mouth Piece
2. Determination of Co-efficient of discharge of Venturimeter
3. Determination of Co-efficient of Head loss due to Sudden Change in Section
4. Determination of Co-efficient of Head loss due to Friction in Pipe
5. Determination of Co-efficient of discharge of Rectangular Notch
6. Determination of Co-efficient of Impact of Jet on Vanes
7. Study of Performance characteristics of Elmo Pump (Centrifugal Pump)
8. Study of Performance characteristics of Sump Pump (Centrifugal Pump)
9. Study of Performance characteristics of Submersible Pump (Centrifugal Pump)
10. Study of Performance characteristics of Gould's Pump (Reciprocating Pump)
11. Study of Performance characteristics of Pelton Turbine (Constant Speed method)
12. Study of Performance characteristics of Francis Turbine (Constant Head method)
13. Determination of Metacentric Height of a floating vessel (Demo Only)
14. Study on Flow through Open Channel (Demo Only)
15. Determine the properties of fluids, pressure and their measurements
16. Measure flow in pipes and determine frictional losses

COURSE OUTCOMES

Make the students understand

1.After completion of this course, a student will be able to:

2.Compute forces on immersed plane and curved plates applying continuity equation and energy equation in solving problems on flow through conduits

3.Develop Characteristics of pumps and turbines.

EICP308	ELECTRIC CIRCUITS LAB	L	T	P	C
		-	-	3	1.5

COURSE OBJECTIVES

1. To study & verify the circuit theorems practically
2. To understand the significance of the circuit theorems and their applications
3. To understand the significance of resonance conditions in series and parallel circuits

LIST OF EXPERIMENTS

1. Analysis of DC resistive circuits and verification of Kirchhoff's Laws.
2. Verification of Maximum power transfer theorem.
    a. Verification of Thevenin's theorem.
    b. Verification of Norton's Theorem.
    c. Verification of Superposition Theorem.
    d. Verification of Tellegen's Theorem.
3. Steady State sinusoidal response of RLC series circuit.
4. Analysis of DC resistive circuit using EWB software. [Study of ORCAD software (Application to circuit analysis).]
5. Experimental determination of time constant of series R-C electric circuits
6. Design and Simulation of series resonance/parallel resonance circuits.
7. Design of low pass and high pass passive filters.
8. Study of CRO and measurement of sinusoidal voltage, frequency and power factor.
9. Calibration of single phase energy meter.
10. Determination of two port network parameters.
11. Experimental determination of power in three phase circuits by two-watt meter method.

COURSE OUTCOMES

Make the students understand

1. The significance of the theorem and the practical verification of theorems.
2. The usage of the theorem in the analysis of the circuits.
3. The way of trouble shooting the circuit connection and to test the devices.
4. The circuit connections and testing points of the circuit by simulation and implementation.
5. The significance of resonance conditions in series and parallel circuits.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			✓		✓				✓			
CO2	✓	✓	✓		✓				✓			✓
CO3	✓		✓	✓					✓		✓	
CO4	✓		✓		✓						✓	
CO5	✓				✓							✓

EICP309	**ANALOG ELECTRONICS LAB**	**L**	**T**	**P**
		-	**-**	**1.5**

COURSE OBJECTIVES

- To obtain the characteristics graphically of each mentioned circuit devices
- To understand the significance of the circuit devices with their applications.
- To analyse the need of each device.
- To analyse frequency response of circuit components by simulation and experimentation

LIST OF EXPERIMENTS

1. Ampere-Volt (I-V) characteristics of P-N junction semiconductor diode and Zener Diode.
2. Input and output characteristics of BJT and determination of its h-Parameters.
3. Transfer and drain characteristics of JFET and determination of its parameters.
4. Steady State sinusoidal response of RLC series circuit.
5. I-V characteristics of Silicon Controlled Rectifier.
6. Frequency response of RC coupled amplifier.
7. Simulation of simple operational amplifier configurations using Electronic Work Bench (EWB) software.
8. Design of multivibrator circuits using 555 timer IC.
9. Design of low pass and high pass filter circuits.
10. Design of precision full wave rectifier circuit.
11. Design of instrumentation amplifier circuit.

COURSE OUTCOMES

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

1. Observe the characteristics of the devices and to find various practical parameters like input impedance, trans-conductance, pinch-off voltage etc., related to their applications.
2. Understand the circuit connections and testing points of the circuit by simulation and implementation.
3. Design of various electronic circuits using the fundamental concepts for industrial applications.

4. Simulate various electronic circuits using Electronic Work Bench Software without the use of physical electronic components so that it is possible to reduce the time, energy and cost.
5. Troubleshoot the malfunctioning of electronic circuits and to identify the compatibility of system components in the design of Integrated Circuit.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓				✓			
CO2	✓	✓	✓						✓		✓	✓
CO3	✓	✓			✓			✓	✓		✓	
CO4	✓	✓		✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓			✓	✓		✓	✓

EIBS401	**PROBABILITY, RANDOM PROCESSES AND NUMERICAL METHODS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students to probability, random processes, and statistical methods designed
- To contribute them to the process of making scientific judgments in the face of uncertainty and variation.
- To develop the skills of the students in numerical mathematics - using method of finite difference interpolation, finding numerical solution of algebraic and transcendental equations, and finding numerical solution of ordinary and partial differential equations.

Unit–I : Probability and Random Variables

Definition – Types of random variables - probability distribution function - probability density function – expectation and moments – moment generating functions –joint probability distribution -marginal probability distribution function – joint probability density function – marginal probability density function – conditional probability density function.

Unit–II : Random Processes

Classification of random processes – methods of description of a random process – special classes of random processes – Average values of random process - stationarity –Autocorrelation function and its properties - cross correlation function and its properties.

Unit–III : Test of Significance

Hypothesis, testing – Large sampling tests – small sampling test based on t, F and chi-square distributions – interval estimates of mean, standard deviation and proportion.

Unit–IV : Interpolation

Gregory Newton forward and backward interpolation formula; Stirling's central difference formula; Lagrange's interpolation formula for unequal interval.

Numerical differentiation: Using Newton's forward and backward interpolation formula.

Numerical integration: Trapezoidal rule, Simpson's one-third and three-eight rule.

Unit–V :

Solution of algebraic and transcendental equations: Bolzano's bisection method, Regula-falsi method, Newton–Raphson method.

Solution of simultaneous algebraic equation: Gauss elimination method, Crout's method, Gauss – Seidel iteration method.

Solution of ordinary differential equations: Taylor series method, Runge–Kutta fourth order method, Milne's - Predictor corrector method.

TEXT BOOKS

1. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Probability and random processes, S.Chand & Co. Ltd.
2. Veerarajan. T., Probability theory and Random Process, Tata McGraw – Hill Co., Ltd. New Delhi 2005.

REFERENCES

1. Venkataraman M.K., Numerical method in science and Engineering, National publishing Co., Chennai - 2003.
2. Lipschutz..S and Schiller. J, Schaums‟s outlines – introduction to probability and statistics McGraw Hill, New Delhi, 1998.
3. Kandasamy.P, Thilagavathy.K, and Gunavathy.K, Numerical Methods, S.Chand & Co. Ltd., New Delhi. 2004.

COURSE OUTCOMES

At the end of the course, the students would

1. Acquire skills in handling situations to solve problems for engineers using numerical methods.
2. Understand random variables and random processes
3. Understand numerical differentiation and integration
4. Give numerical solution for algebraic and transcendental equations.
5. Give numerical solution for ordinary differential equation.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓	✓	✓						✓	✓
CO2	✓	✓			✓				✓			
CO3	✓	✓	✓	✓	✓			✓	✓		✓	
CO4	✓	✓	✓	✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓			✓	✓		✓	✓

EIES402	ELECTRICAL TECHNOLOGY	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

- To know the different types of AC and DC machines and their applications.
- To motivate the students to gain knowledge about the basic principles and the laws governing the operation of electrical measuring instruments.
- To familiarize the students about the functioning of different types of instruments.
- To understand the concepts of various measuring techniques.

Unit–I Power and Energy measurement

Power measurement – Ammeter and Voltmeter method - Electrodynamic wattmeter, errors and compensation, thermal type wattmeter, single and 3- phase power measurements.

Energy measurement - Induction type energy meter, principle, construction, errors and compensation.Calibration of wattmeters and energymeters.

Potentiometers: AC potentiometers - Drysdale potentiometer, Gall potentiometer , DC potentiometers - Leeds and Northrup potentiometer, Brooks deflection potentiometer

Unit–II AC and DC bridges

Resistance Measurement - Series and shunt type ohmmeter. Wheatstone bridge, Kelvin bridge, Megger.

AC bridges - Maxwell bridge, Wien bridge, Anderson bridge, Hays bridge, Schering bridge - Campbell bridge to measure mutual inductance - detectors in bridge measurements.

Unit–III DC Machines

Construction details of machine - operation of DC generators - EMF equation - characteristics of different types of DC generators - commutation - armature reaction - operation of DC motors - torque equation - characteristics of different types of DC motors. Starters - breaking and speed control of DC motors.

Unit–IV Induction Machines

Three phase - types - constructional features - equivalent circuit - slip - torque characteristics - starters - breaking and speed control methods. Principle of operation, types and applications of single phase induction motors.

Unit–V Magnetic circuit

Magnetomotive force - magnetic field strength - permeability of free space-relative permeability - reluctance - comparison of electric and magnetic circuits - composite magnetic circuit - magnetic leakage and fringing - Kirchoff's laws for the magnetic circuit - magnetization curve - hysteresis loop - current-ring theory of magnetism - hysteresis loss - minimum volume of a permanent magnet - load line of a permanent magnet - magnetic field of a long solenoid - magnetic energy in a non-magnetic medium - magnetic pull. Inductance of a coil and factors determining inductance of a coil.

TEXT BOOKS

1. Theraja and Theraja., A Text book of Electrical Technology - Vol.II, AC and DC Machines,23rdRevisedEdition,S.Chand&Co.,Ltd.2002.
2. A.K. Sawhney, Electrical and Electronics Measurements and Instrumentation, DhanpathRai& Co (P) Ltd, 2004.

REFERENCES

1. R.Muthusubramanian, S. Salivahanan and K.A.Muraleedharan, Basic ElectricalElectronics and Computer Engineering, Tata McGraw – Hill Publishing Company Limited, 2000.
2. I.J.Nagrath and D.P.Kothari, Electric Machines, Second Edition, Tata McGraw – Hill Publishing Company Limited, 1997.
3. J.B.Gupta, A Course in Electronic and Electrical Measurements and Inst rumentation,S.KKataria & Sons, Delhi, 2003.
4. H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 2004.

COURSE OUTCOMES

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

1. Understand the practical application of Wattmeters and Energy meters.(Unit-I)
2. Construct and determine the circuit parameters using AC and DC bridges.
3. Get the knowledge of electrical DC machines (Unit-III)
4. Understand the practical application of Induction machines.(Unit-IV)
5. Acquire knowledge on magnetic circuits. (Unit-II)

Mapping of COs with Pos												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓				✓			
CO2		✓	✓								✓	✓
CO3	✓	✓	✓		✓						✓	
CO4		✓	✓	✓	✓						✓	✓
CO5	✓		✓		✓				✓		✓	

EIPC403	**CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To provide a sound knowledge in the basic concepts of linear control theory and design.
- To acquire knowledge in the basics of control system and its components.
- To understand the time response and frequency response analysis.
- To study about stability analysis.
- To understand the design of compensators.

Unit-I : Introduction to Control Problem

Open-Loop and Closed-loop systems: Generalized Block Diagram of a Feedback System: Benefits of Feedback-Block diagram algebra- Signal Flow Graph and the Mason's Gain Rule. Transfer function models of linear time-invariant systems- Mathematical models of physical systems -.

Unit-II : Time Response Analysis

Standard test signals-Time response of first and second order systems for standard test inputs- - steady state error and error constants- steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness of control systems.. Design specifications for second-order systems based on the time-response. Proportional, Integral and Derivative Controllers.

Unit-III : Stability Analysis

Concept of stability: Necessary conditions for Stability-BIBO Stability – Routh-Hurwitz Criterion. Root locus concept: Guidelines for sketching root loci – Root locus plots for continuous-time systems. Introduction to design - lag, lead and lag-lead configurations: Effects on system response and their realization - design of cascade compensators in the time domain -Root-locus method of feedback controller design.

Unit-IV : Frequency Response Analysis

Relationship between time and frequency response, Polar plots, Bode plots, Nyquist stability criterion-Relative stability using Nyquist criterion-gain and phase margin. Controller Design specifications in frequency domain - design of cascade compensators in the frequency domain.

Unit-V : State Variable Analysis

Concepts of state variables, State space model, Diagonalization of State Matrix-Solution of state equations- Eigen values and Stability Analysis-Concept of controllability and observability - Pole-placement by state feedback - State-space models of linear discrete-time systems.

TEXT BOOKS

1. J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New Age International (P) Ltd., Publishers, 2009.
2. M. Gopal, Control Systems Principles and Design, McGraw-Hill Education, Fourth edition, 2012.

REFERENCES

1. B. C. Kuo, Automatic Control Systems, Prentice Hall of Indian, Sixth Edition, 1991.
2. K. Ogata, Modern Control Engineering, Prentice Hall India Learning Private Limited, Fifth Edition, 2010.
3. K. Ogata, Solving Control Engineering Problems with MATLAB, Prentice Hall, 1994.

COURSE OUTCOMES

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

1. Understand the basics of control system for the design and analysis (Unit I)
2. Understand the issues related to time response analysis. (Unit II)
3. Perform frequency response and stability analysis. (Unit III)

4. Design compensators in time and frequency domain. (Unit IV)
5. Understand the concept of stability and its assessment for linear-time invariant systems.(Unit V)

Mapping Cos with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓							
CO2		✓		✓				✓	✓			
CO3		✓		✓				✓	✓			✓
CO4		✓		✓				✓	✓		✓	
CO5		✓										

EIPC404	**DIGITAL ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES:

- To impart a thorough understanding of the fundamental concepts and techniques used in digital electronics.
- To gain an intuitive understanding of the role of digital logic levels and application of knowledge to understand digital logic families.
- To understand, analyze and design digital systems using combinational and sequential logic.
- To introduce the concept of memories and programmable logic devices.

Unit I :Fundamentals of Digital Systems and logic families

Digital signals, digital circuits, AND, OR, NOT, NAND, NOR and Exclusive-OR operations, Boolean algebra, examples of IC gates, number systems-binary, signed binary, octal hexadecimal number, binary arithmetic, one's and two's complements arithmetic, codes, error detecting and correcting codes, characteristics of digital ICs, digital logic families, TTL, Schottky TTL and CMOS logic, interfacing CMOS and TTL, Tri-state logic.

Unit II : Combinational Digital Circuits

Standard representation for logic functions, K-map representation, simplification of logic functions using K-map, minimization of logical functions. Don't care conditions, Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, elementary ALU design, popular MSI chips, digital comparator, parity checker/generator, code converters, priority encoders, decoders/drivers for display devices, Q-M method of function realization.

Unit III : Sequential circuits and systems

One-bit memory, the circuit properties of bistable latch, the clocked SR flip flop, JK, T and D types flip flops, applications of flip flops, shift registers, applications of shift registers, serial to parallel converter, parallel to serial converter, ring counter, sequence generator, ripple (Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters.

Unit IV : A/D and D/A Converters

Digital to analog converters: weighted resistor/converter, R-2R Ladder D/A converter, specifications for D/A converters, examples of D/A converter ICs, sample and hold circuit, analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.

Unit V : Semiconductor memories and Programmable logic devices.

Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), content addressable memory (CAM), charge decoupled device memory (CCD), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic, complex Programmable logic devices (CPLDS), Field Programmable Gate Array (FPGA).

TEXT BOOKS

1. M. Morris Mano, "Digital Logic and Computer Design", Pearson Education India, 2016.
2. Ananda Natarajan R, Digital Design, Second edition, Eastern Economy Editions, PHI Learning Pvt. Ltd., 2015.

REFERENCES

1. A. Kumar, "Fundamentals of Digital Circuits", Prentice Hall India, 2016.
2. R.P. Jain, Modern Digital Electronics, Fourth edition, Tata McGraw Hill, 2010.
3. M. Morris Mano, Digital Design, Fourth Edition, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. S.Salivahanan and S. Arivazhagan, Digital Circuits and Design, Fourth Edition, Vikas Publishing House Pvt. Ltd, New Delhi, 2012.
5. Donald P.Leach and Albert Paul Malvino, Digital Principles and Applications, Sixth Edition, Tata McGraw Hill, 2003.
6. John F Wakerly, "Digital Design:Principles and Practices", Third Edition, Pearson Education India, 2016.

COURSE OUTCOMES

At the end of this course, students be able to

1. Understand working of logic families and logic gates.(Unit I)
2. Design and implement Combinational logic circuits. (Unit II)
3. Design and implement Sequential logic circuits (Unit III)
4. Understand the process of Analog to Digital conversion and Digital to Analog conversion. (Unit IV)
5. Be able to use PLDs to implement the given logical problem.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2		✓										✓
CO3		✓									✓	✓
CO4		✓	✓								✓	
CO5		✓	✓								✓	✓

EIPC405	**ELECTRONIC INSTRUMENTATION AND MEASUREMENT TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To introduce different types of electronic meters, different types of waveform generators, analyzers.
- To provide knowledge of digital instruments, intelligent instruments, cathode ray oscilloscope, other display devices & their applications.
- To introduce different types of recorders and to educate interference and screening.
- To introduce computer controlled system and to give exposure on virtual instrumentation.

Unit–I : Measurement of Voltage and Current

Electronic analog meters: DC and AC voltmeters - true R.M.S. voltmeters - differential voltmeters - a.c. current measurements – analog multimeters.

Component measuring instruments

Q-meter - vector impedance meter - Power meter.

Signal sources and Wave analyzers

Basic standard Signal generator (sine wave) – Square and pulse generator, Sweep generator. Wave analyzer - harmonic distortion analyzer- spectrum analyzer.

Unit–II : Digital Measurements

Digital methods of measuring frequency, period, phase difference, pulse width, time interval, total count, AC and DC voltage and current, true r.m.s voltage. DMM, DPM. Comparison between analog and digital techniques of measurement.

Introduction to intelligent instruments. Digital displacement transducers, incremental and absolute types – measurement of velocity, acceleration- Moire fringe transducer.

Unit–III : Oscilloscope and Display devices

Cathode Ray oscilloscopes: Block diagram of oscilloscope - CRT screen characteristics - vertical, horizontal amplifiers, input coupling - time base: synchronization, free run, auto and single sweep modes – multiple trace display: alternate, chop, X-Y modes of operation - sweep trigger sources, coupling - delayed sweep, delay lines. Special probes - high frequency considerations- Sampling oscilloscope - digital storage oscilloscope. Specifications of DSO-Typical measurements using CRO and DSO.

LED, LCD – annunciators, numeric, alphanumeric, graphics.

Unit–IV : Recorders and Interference Effects

Recorders - moving coil, potentiometric, event recorders - X-Y plotters - U.V. recorders - digital recording.

Interference and screening - component impurities and their effects on signals - electrostatic and electromagnetic interference - multiple earths and earth loops. Practical aspects of interference reduction.

Unit–V : Computer Controlled Test Systems and Virtual Instrumentation

Computer-Controlled test Systems: Testing an audio amplifier - Instruments used in Computer Controlled Instrumentation - IEEE Electrical Interface and Specifications - Block Diagram of an IEEE-488 bus Connected System and Digital Control Description.

Virtual Instrumentation: Definition, flexibility – Block diagram and architecture of virtual instruments – VI vs traditional instruments. Software in virtual instrumentation. Instrument Control - Instrument Drivers - VXI Bus.

TEXT BOOKS

1. A.K.Sawhney, A course in Electrical & Electronic measurements & Instrumentation, Dhanpat Rai & co., 2013.
2. W.D.Cooper and A.D.Helfrick, Electronic Instrumentation and Measurement Techniques, Prentice-Hall of India, 2009.

REFERENCES

1. H.S.Kalsi, Electronic Instrumentation, Tata McGraw Hill, 1995.
2. A.J.Bouwens, Digital Instrumentation, McGraw Hill, 2001.
3. LabVIEW basics, Vol.1&2 manuals, National Instruments, 2006.
4. D.F.A.Edwards, Electronic measurement techniques, Elsevier, 2014.
5. George.C.Barney, Intelligent Instrumentaion, Prentice Hall of India, 1998.
6. Jovitha Jerome, VI using LabVIEW, Prentice Hall of India, 2010.

COURSE OUTCOMES

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

1. Understand different types of electronic meters and their applications. (Unit I)
2. Understand different types of waveform generators, analyzers and their applications. (Unit I)
3. Understand digital instruments and intelligent instruments. (Unit II)
4. Gain knowledge of cathode ray oscilloscope, recorders and other display devices with their applications. (Unit III & IV)
5. Understand computer controlled system and virtual instrumentation. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓										
CO2	✓	✓									✓	
CO3	✓	✓									✓	
CO4	✓	✓									✓	
CO5	✓	✓	✓	✓	✓						✓	✓

EIPC406	TRANSDUCERS AND MEASURMENT SYSTEMS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To learn about the science of measurement system and its properties.
- To acquire knowledge about characteristics of measurement systems subjected to time invariant and time variant inputs .
- To understand the principle and characteristics of resistive, capacitive and inductive transducers.
- To study about characteristics and applications of fiber optics, MEMS based transducers and transducers governed by other principles such as hall effect and piezo electric effect.

Unit–I : Science of Measurements

Methods of measurement - Generalized scheme of a measurement system - Errors in measurement - types of errors- limiting error-probable error- Statistical analysis of measurement data – mean and standard deviation- Probability of errors - Gaussian distribution- Reliability of measurement systems.

Unit–II : Performance Characteristics

Static and dynamic characteristics of measurement system - transfer function – characteristics of zero, first and second order type of instruments - impulse, step, ramp and frequency responses of the above types of instruments.

Unit–III : Resistance Transducers

Transducer- Difference between sensor and transducer- basic requirements of a transducer-classification of transducers-selection of transducer.

Resistance potentiometer – types of potentiometers - Loading effect – strain gauges - gauge factor - types of strain gauges - strain measuring circuits – temperature compensation and error cancellation techniques in strain measurement system.

Principle of RTD, Thermocouple and Thermister- Hot wire anemometer - constant current and constant temperature operation.

Unit–IV : Capacitance and Inductance Transducers

Capacitive transducers - variable area type - variable air gap type - variable permitivity type - signal conditioning circuit- capacitor microphone.

Variable inductance and Variable reluctance transducers – LVDT – RVDT - Eddy current non contacting transducers.

Unit–V : Other Types of Transducers

Introduction to fibre optic sensors -types of configurations-application in temperature, pressure, flow and displacement measurements. Hall effect transducers - IC sensor for temperature and pressure measurement-Piezoelectric transducers - piezoelectric crystals, Charge amplifier-Silicon Micro sensors-Smart sensors-characteristics and applications.

TEXT BOOKS

1. E.O.Doeblin, Measurement Systems, Application and Design, McGraw-Hill, 1998.
2. A.K. Sawhney, A course in Electrical and Electronics measurement and instrumentation, Dhanpatrai and sons, 1996.

REFERENCES

1. John B.Bentley, Principles of Measurment Systems, Longman Publishers, 2000.
2. R.K Jain, Mechanical and Industrial Measurement, Khanna Publishers, 1990.
3. D. Patranabis, Sensors and Transducers, Prentice Hall of India, 2nd edition, 2003.
4. B.C.Nakra and K.K Chaudhry, Instrumentation measurement and analysis, TMH, Third edition, 2009.
5. D.A. Krohn, Fiber Optic Sensors – Fundamentals and Applications, ISA publication, 2nd edition, 1992.
6. J.B Gupta, A course in Electronics and Electrical measurements and instrumentation, S.K.Kataria & Sons, New Delhi, Fifth Edition, 2010.

COURSE OUTCOMES

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

1) Select a measurement system to meet the requirements. (Unit I)
2) Knowledge about characteristics of system based on the type of input. (Unit II)
3) Choose among the various types of resistance transducers for particular application.(Unit III)
4) Choose among the various types of capacitive and inductive transducers depending on the principle, range, cost and commercial availability. (Unit IV & V)
5) Understand the recent trends in the development of transducers and the engineering involved in it. (Unit V)

Mapping of COs with POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓										✓	
CO2	✓	✓	✓								✓	
CO3	✓	✓	✓								✓	✓
CO4	✓		✓	✓							✓	✓
CO5	✓		✓	✓							✓	✓

EICP407	**CONTROL SYSTEMS LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To understand the different methods of system representation and obtain the model of the system in time and frequency domains.
- To impart necessary knowledge in the time domain response and steady state response.
- To give basic knowledge in obtaining the open loop and closed loop time and frequency responses.

LIST OF EXPERIMENTS

1. Determination of transfer function of a DC Servomotor and its speed control.
2. Solving Control Engineering problems using MATLAB software.
3. Study of DC Position control system.
4. Design and implementation of a Phase Lead Compensator using MATLAB software.
5. Identification of a given system using frequency response characteristics.
6. Characteristics of Sample and Hold circuit.
7. Simulation of a Sampled data control system.
8. Sensitivity analysis of open loop and closed loop systems using Process Control Simulator.
9. Stability characteristics of feedback systems using Process Control Simulator.
10. Time response analysis of a Second order type-0 and type-1 system using Process Control Simulator.

COURSE OUTCOMES

After successful completion of this course, the students should be able

1. to identify the model of any system using various techniques and investigate its performances in open and closed loops.
2. To obtain desired performance by designing and implementing suitable compensators for the taken up system.
3. To identify any type of control system with respect to system stability in time domain as well as frequency domain.
4. To understand the concept of sensitivity and stability characteristics of open loop and closed loop control systems.
5. To obtain the time response analysis of type-0 and type-1 systems.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓		✓						✓	
CO2	✓	✓	✓									
CO3	✓	✓	✓								✓	✓
CO4	✓	✓			✓						✓	✓
CO5	✓	✓	✓								✓	✓

EICP408	**DIGITAL ELECTRONICS LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- Simplification of complex logic functions using reduction techniques.
- Design of analog and digital electronic circuits for industrial applications.
- Study of Electronic Work Bench Software to simulate various electronic circuits.

- Identification of malfunctioning of circuits/components and to troubleshoot the same.

LIST OF EXPERIMENTS

1. Verification of logic gates using integrated circuits.
2. Simplification of logic expressions using Karnaugh map techniques.
3. Implementation of half adder and full adder circuits using logic gates.
4. Design and Realization of one bit, two bit and magnitude comparators.
5. Design and verification of parity generator circuits.
6. Design and verification of electronic pendulum circuit.
7. Design and simulation of 3 bit synchronous counter usig EWB software.
8. Implementation of Digital to Analog converter.
9. Verification of Multiplexer/Demultiplexer.
10. Implementation of i) priority encoders and ii) LED decoder driver circuit.

COURSE OUTCOMES

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

1. Test and understand the logic gates using their truth tables which is very useful in the design of Integrated Circuits.
2. Simplify the complex logic function into simplest one so that it is possible to reduce the size of the circuit.
3. Design of various electronic circuits using the fundamental concepts in digital electronic systems for various industrial applications.
4. Simulate various electronic circuits using Electronic Work Bench Software without the use of physical electronic components so that it is possible to reduce the time, energy and cost.
5. Troubleshoot the malfunctioning of electronic circuits and to identify the compatibility of system components in the design of Integrated Circuit.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2		✓	✓		✓						✓	✓
CO3		✓	✓		✓							✓
CO4		✓	✓	✓	✓						✓	✓
CO5	✓										✓	✓

EICP409	**SENSORS AND SIGNAL CONDITIONING LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To familiarize the students with principle and characteristics of various transducers.
- To design and implement signal conditioning circuits for temperature, pressure and displacement.
- To impart knowledge about the design and implementation of analog and digital filters using Matlab software

- To learn the design and development procedure for V/I and I/V convertors and implementation using EWB software.

LIST OF EXPERIMENTS

1. Characteristics of Potentiometer and Potentiometer as error detector.
2. Characteristics of Synchro and application of Synchro as error detector.
3. Simulation of signal conditioning circuit for LVDT.
4. Design of Analog and Digital filters using MATLAB software.
5. Characteristics and Transfer function of RTD and Thermocouple.
6. Design, construction and testing of a signal conditioning circuit for temperature Measurement using RTD.
7. Simulation of Voltage to Current converter and its practical implementation.
8. Simulation of Current to Voltage converter and its practical implementation.
9. Measurement of pressure using strain gauge.
10. Design and testing of signal conditioning circuits using EWB software.

COURSE OUTCOMES

At the end of the practical course the students will be able to

1) Select and use the proper transducer for the required application.
2) Have a knowledge of characteristics of various sensors
3) Obtain the Transfer function model for sensors
4) Design and implement signal conditioning circuits for process variables such as temperature, pressure and displacement.
5) Apply the MATLAB and EWB software packages for the design and verification of signal conditioning circuits.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓						✓	
CO2	✓	✓	✓		✓							
CO3	✓		✓	✓	✓						✓	✓
CO4	✓	✓	✓					✓		✓	✓	✓
CO5	✓	✓		✓							✓	

EIPC501	**INDUSTRIAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To understand load cell, strain gauge and torque measurement.
- To understand pressure measuring devices like Manometers, Bourdon gauge and vacuum pressure measurement.
- To analyze the concept of temperature sensors like RTD, Thermocouple and Pyrometers.
- To study the variable head type and variable area type flow meters.

- To understand air purge system and boiler drum level measurement.

Unit–I : Measurement of Force, Torque and Speed

Electric balance - Load cell - Hydraulic, Pneumatic, strain gauge-Magnetoelastic and Piezoelectric load cells - Torque measurement- Relative angular twist-Speed measurement-Capacitive tacho-Drag cup type tacho-D.C and A.C tachogenerators - Stroboscope.

Unit–II : Pressure Measurement

Units of pressure - Manometers, different types, Elastic type pressure gauges, Bourdon tube, bellows and diaphragms - Electrical methods- Elastic elements with LVDT and strain gauges - Capacitive type pressure gauge - Piezo resistive pressure sensor-Resonator pressure sensor - Measurement of vacuum-McLeod gauge-Thermal conductivity gauge-Ionization gauges - Cold cathode type and hot cathode type - Calibration of pressure gauges - Dead weight tester.

Unit–III : Temperature Measurement

Definitions and standards - Primary and secondary fixed points - Calibration of thermometers - Different types of filled in system thermometers - Sources of errors in - filled in systems and their compensation - Bimetallic thermometers - RTD - characteristics and signal conditioning-3 lead and 4 lead RTDs – Thermistors- Thermocouples - Laws of thermocouple- Commercial circuits for cold junction compensation - Response of thermocouple, Radiation methods of temperature measurement - Total radiation pyrometers - Optical pyrometers.

Unit–IV : Flow Measurement

Expression for flow rate through restriction -Orifice plate – Cd variation – pressure tappings – Venturi tube – Flow nozzle – Dall tube – Pitot tube - averaging pitot tube – installation and applications of head flow meters - Positive displacement flow meters – Nutating disc, Reciprocating piston and Oval gear flow meters – Turbine flow meter – Variable Area flow meter– Rotameter – Mass flow meter - Coriolis type mass flow meters – Calibration of flow meters- Electromagnetic flow meter – Ultrasonic flow meters – Laser Doppler anemometer – Vortex shedding flow meter – Guidelines for selection of flow meter – Open channel flow measurement – Solid flow rate measurement.

Unit–V : Level Measurement

Float gauges - Displacer type – Air purge level system – Electrical types – Conductivity level sensors – Capacitive sensors – Nucleonic gauge - Ultrasonic gauge – Boiler drum level measurement – Hydrastep method - Solid level measurement. Miscellaneous Measurement:Viscosity - Saybolt viscometer-Rotameter type viscometer, Humidity: Dry and wet bulb psychrometers – Resistive and capacitive type hygrometers – Dew cell –Moisture – Moisture measurement in solids-Conductivity sensor.

TEXT BOOKS

1. D. Patranabis, Principles of Industrial Instrumentation, 3rd Edition, Tata McGraw Hill, New Delhi, 2010.
2. S.K. Singh, Industrial Instrumentation and Control, 3rd Edition, Tata McGrawHill Education Pvt. Ltd., New Delhi, 2009.

REFERENCES

1. E.O.Doebelin and D. N.Manik, Measurement Systems -Application and Design, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd., 2007.
2. A.K. Sawhney and Puneet Sawhney, A Course in Mechanical Measurements and Instrumentation and Control, Dhanpat Rai & Sons, New Delhi, 1997.
3. D.P. Eckman, Industrial Instrumentation, Wiley Eastern Limited, 1990.
4. B.G. Liptak, Instrumentation Engineers Handbook (Measurement), CRC Press, 2005.
5. R.K. Jain, Mechanical and Industrial Measurements, Khanna Publishers, Delhi, 1999.

COURSE OUTCOMES

At the end of the course the student attains the

1. Ability to understand Load cell, strain gauge, Speed measurement (Unit I)
2. Ability to understand and apply Manometers, Bourdon tube, Mcleod gauge, Piezo resistive, Ionization gauge, dead weight tester to pressure measurement. (Unit II)
3. Ability to understand temperature sensors like thermometers, RTD, thermistors, thermocouple and pyrometers. (Unit III)
4. Ability to understand and apply variable head type, variable area type flow meters, electromagnetic, ultrasonic, laser Doppler and solid type to flow measurement. (Unit–IV)
5. Ability to understand level sensors like float type, air purge, Capacitive, Nucleonic and Ultrasonic gauge, boiler drum level and viscosity, humidity and moisture measurement. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓									
CO2	✓	✓	✓							✓		
CO3	✓	✓	✓									
CO4	✓	✓	✓									✓
CO5	✓	✓	✓									

EIPC502	**SIGNALS AND SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To learn about continuous and discrete time signals and system properties.
- To acquire knowledge about the analysis of continuous and discrete time systems.
- To understand the need for frequency transformation and to learn the difference between various representations for continuous and discrete time signals.

Unit-I : Introduction to Signals and Systems

Signal properties: periodicity, absolute integrability, determinism and stochastic character. Some special signals of importance: the unit step, the unit

impulse, the sinusoid, the complex exponential, some special time-limited signals; continuous and discrete time signals, continuous and discrete amplitude signals. System properties: linearity: additivity and homogeneity, shift-invariance, causality, stability, realizability. Examples.

Unit-II : Behavior of continuous and discrete-time LTI systems

Review of the Laplace Transform for continuous time signals and systems, system functions, poles and zeros of system functions and signals, Laplace domain analysis, solution to differential equations and system behavior. Impulse response and step response, convolution, input-output behavior with aperiodic convergent inputs, cascade interconnections. Characterization of causality and stability of LTI systems. System representation through differential equations and difference equations. State-space Representation of systems. State-Space Analysis, Multi-input, multi-output representation. State Transition Matrix and its Role. Periodic inputs to an LTI system, the notion of a frequency response and its relation to the impulse response.

Unit-III : Frequency Domain Analysis of Continuous time signals and systems

Fourier series representation of periodic signals, Waveform Symmetries, Calculation of Fourier Coefficients. Fourier Transform, convolution/multiplication and their effect in the frequency domain, magnitude and phase response, Fourier domain duality.

Unit-IV : Analysis of Discrete time signals and systems

The Discrete- Time Fourier Transform (DTFT) and the Discrete Fourier Transform (DFT). Parseval's Theorem. The z-Transform for discrete time signals and systems, system functions, poles and zeros of systems and sequences, z-domain analysis.

Unit-V : Sampling and Reconstruction

The Sampling Theorem and its implications. Spectra of sampled signals. Reconstruction: ideal interpolator, zero-order hold, first-order hold. Aliasing and its effects. Relation between continuous and discrete time systems. Introduction to the applications of signal and system theory: modulation for communication, filtering, feedback control systems.

TEXT BOOKS

1. H. P. Hsu, “Signals and systems”, Schaum’s series, McGraw Hill Education, 2010.
2. S. Haykin and B. V. Veen, “Signals and Systems”, John Wiley and Sons, 2007.

REFERENCES

1. V. Oppenheim and R. W. Schafer, “Discrete-Time Signal Processing”, Prentice Hall, 2009.
2. M. J. Robert “Fundamentals of Signals and Systems”, McGraw Hill Education, 2007.
3. P. Lathi, “Linear Systems and Signals”, Oxford University Press, 2009.
4. P.RameshBabu and R.Ananda Natarajan: Signals and Systems, Scitech Publications(India) Pvt. Ltd, Fourth Edition, Chennai 2010.
5. Sanjay Sharma, Signals and Systems, Seventh Edition, S.K.Kataria & Sons New Delhi, 2011.

COURSE OUTCOMES

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

1. Understand the concepts of continuous time systems (Unit I)
2. Understand the concepts of discrete time systems.(Unit II)
3. Analyse continuous time systems in complex frequency domain.(Unit III)
4. Analyse discrete time systems in complex frequency domain.(Unit IV)
5. Understand sampling theorem and its implications. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓								✓		✓	
CO2	✓	✓							✓			
CO3	✓	✓	✓						✓			
CO4	✓	✓	✓						✓			✓
CO5	✓	✓	✓							✓		

EIPC503	**PROCESS CONTROL**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To introduce the dynamics of various processes and modelling of physical process using first principles.
- To educate the effect of various control actions and the methods of tuning the controller.
- To study about the construction, and characteristics of control valves.
- To introduce the concept of various complex control schemes.

Unit–I : Mathematical Modelling of Processes

Process variables – degrees of freedom – mathematical model of first order liquid process, gaseous process, flow process, thermal process, mixing process – batch process and continuous process – self-regulation – inverse response.

Unit–II : Controllers and Final Control Elements

Characteristics of On-Off, proportional, single speed floating, integral and derivative control modes – composite control modes – P+I, P+D and P+I+D control modes – response of controller for different types of test inputs – integral windup – auto/manual transfer – Non linear PID Controller – selection of control mode for different processes – typical control schemes for level, flow, pressure and temperature.

Control valve – characteristics of control valves – valve positioned.

Unit–III : Optimum Controller Settings

Tuning of controllers by process reaction curve method – continuous cycling method – damped oscillation method – Ziegler-Nichol's tuning – 1/4 decay ratio.

Feed Forward control – Ratio control – Cascade control – Averaging control.

Unit–IV : Piping and Instrumentation Diagram

Piping and Instrumentation Diagram of control loops. Complete air–supply system for pneumatic control equipment – major components and their functions.

Instrument line symbols- General Instrument Symbols-General function symbols-SAMA diagramming system-ISA instrumentation diagramming symbols-Examples of SAMA instrumentation diagramming symbols - Example of P&ID of temperature, level, flow control systems

Unit–V : Case Study

Distillation column – control of top and bottom product compositions – reflux ratio – control of chemical reactor – control of heat exchanger. Steam boiler-drum level control and combustion control. Complete air–supply system for pneumatic control equipment – major components and their functions.

TEXT BOOKS

1. George Stephanopoulos, "Chemical Process Control: An Introduction to Theory and Practice", First edition, Prentice Hall of India, 2008.
2. D.R. Coughanowr and Steven LeBlanc, "Process Systems Analysis and Control", Third Edition, McGraw Hill, 2009.

REFERENCES

1. Donald P Eckman, "Principles of Industrial Process Control", Second Edition, J. Wiley & sons, 1965.
2. Peter Harriott, "Process Control", First Edition, Tata McGraw-Hill Education, 2001.
3. M. Gopal, "Control Systems: Principles and Design", Fourth Edition, Tata McGraw Hill, 2012.
4. TUTSIM Simulation Language Manual, TUTSIM Products Ltd., U.S.A.
5. K.Krishnasamy and M.PonniBala, Power Plant Instrumentation, PHI, Second edition, 2013

COURSE OUTCOMES

At the completion of this course, students will be able to:

1. Understand basic principles and importance of process control in industrial process plants.(Unit I)
2. Acquire knowledge of dynamic modeling, system behavior and tuning of controllers. (Unit II)
3. Specify the required instrumentation and final control elements to ensure well-tuned control. (Unit III)
4. Gain the knowledge of Piping and Instrumentation Diagram (Unit IV)
5. Apply the control system in various complex processes. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓	✓								
CO2		✓	✓	✓							✓	
CO3		✓	✓	✓							✓	
CO4		✓	✓	✓								✓
CO5	✓	✓	✓	✓	✓							✓

EIPC504	MICROPROCESSORS AND MICROCONTROLLERS	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study the architecture of 8085 microprocessor and its programming.
- To learn the design aspects of I/O and memory interfacing circuits.
- To study interfacing devices like 8255, 8253, 8259 and 8251
- To study the architectures of 8051 microcontroller.
- To learn about the 8085 and 8051 based applications.

Unit–I : 8085 Microprocessor

Microprocessor architecture and assembly language - Organization of 8085 microprocessor – memory and I/O devices -Memory mapping-Memory interfacing-Instructions set-Instruction format, Addressing modes, counters and time delays - Stack – subroutine - interrupts - Assembly Language Programming.

Unit–II : Peripherals

8255 programmable peripheral interface - 8253 programmable interval timer-8259 programmable interrupt controller - direct memory access (DMA) and 8257 DMA controller -8279 programmable keyboard display interface -8251 and serial I/O and data communication.

Unit–III : 8051 Microcontroller

Microcontrollers Vs Microprocessors – 8051 Architecture – memory organization - register bank and stack-Special function register(SFR's)-Instruction set - Addressing Modes - Assembly language programming.

Unit–IV : 8051 Peripherals

I/O port programming – Timer programming – serial port programming – Interrupt programming –Interfacing to external memory – keyboard interfacing – ADC,DAC and sensor interfacing.

Unit–V : Applications of Microprocessor and Microcontroller

Stepper motor control- DC motor position/speed measurement and control-Data transfer between two Microprocessor/Microcontrollers- Interfacing LCD display – Temperature ON/OFF control – Traffic light control.

TEXT BOOKS

1. Ramesh Gaonkar, Microprocessor Architecture Programming and Application with the 8085/8080a, Fifth edition, Penram International Publishing (India), 2011.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi,Rolin D.Mc Kinlay "The 8051 Microcontroller and Embedded Systems", PHI Learning, 2011.

REFERENCES

1. Badri Ram, Fundamentals of Microprocessor and MicroComputer, Dhanpat Rai and Sons, 1988.
2. Kenneth J. Ayala, The 8051 Microcontroller Architecture, Programming & Applications, Penram International Publishing (India), Mumbai, 1996.
3. 16 Bit Embedded Controllers Hand Book,Intel Corporation, New York, 1990.

4. Mazidi and D.MacKinlay, 8051 Microcontroller and Embedded Systems using Assembly and C, 2006 Pearson Education Low Price Edition.
5. A.Nagoor Kani, Microprocessors and Microcontrollers, First Edition Jan 2005, RBA Publications.

COURSE OUTCOMES

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

1. Learn basic concept of microprocessor and architecture nd implement programs on 8085 microprocessor. (Unit I)
2. Design of peripheral interfacing circuits. (Unit II)
3. Understand architecture of microcontrollers and develop simple assembly language progarm. (Unit III)
4. Programming the on-chip peripherals of microcontroller. (Unit–IV :)
5. Understand the recent trends and make use of microprocessor and microcontroller for different applications. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓									✓
CO2	✓							✓			✓	
CO3	✓	✓						✓		✓		
CO4	✓							✓			✓	
CO5	✓			✓				✓				✓

EICP507	**INDUSTRIAL INSTRUMENTATION LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To study the characteristics of convertors, square root extractor and transmitters
- To design and implement ON/OFF control, single speed floating control and averaging control
- To study the P&I diagram
- To study pneumatics
- To design and implement pH measurement system
- To linearize thermocouple using LABVIEW software

LIST OF EXPERIMENTS

1. Study of characteristics of I/P and P/I convertors.
2. Study of characteristics of Square root extractor.
3. Design and implementation of ON/OFF temperature control system.

(a) Characteristics of Single speed floating control.
(b) Study of P & I Diagram

4. Characteristics of strain measurement system using cantilever beam set up.

(a) Design & simulation of Averaging Control.
(b) Study of Pneumatics.

5. Determination of characteristics of capacitive level transmitter.

6. Design and Determination of characteristics of temperature transmitter.
7. Design and implementation of pH measurement system.
8. Study of Linearization of Thermocouple using Lab View.

COURSE OUTCOMES

1. Ability to design components of control system like transmitters, convertors and controllers
2. Ability to analyze and design the characteristics of ON/OFF, single speed floating and averaging control.
3. Ability to design signal conditioning circuits.
4. Ability to use both software and hardware tools.
5. Familiarize with the linearization of sensors and transducers

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓									
CO2	✓	✓	✓							✓		✓
CO3	✓	✓	✓									
CO4				✓							✓	
CO5	✓		✓									✓

EICP508	**PROCESS CONTROL LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To impart knowledge about the modelling principle of level process and the characteristics of final control element and Controller.
- To design and implement tuning techniques of PID controller and verify in Matlab/Simulink environment.
- To design and implement closed loop control for processes like Air temperature, Air flow and Level.
- To familiarize the students with design and simulate cascade control for the given process.
- To study the applications of Programmable Logic Controller.

LIST OF EXPERIMENTS

1. Modelling and simulation of a Level process using TUTSIM.
   (a) Study of Control Valve characteristics.
   (b) Study of P&I Diagram
2. Controller tuning using Process Reaction Curve method.
3. Determination of characteristics of a PID controller using Matlab (Simulink) software.
4. Design and simulation of Cascade control system using Matlab (Simulink) software
5. Determination of Transfer function (Experimental model) of Level process.
6. Controller tuning using Continuous Cycling method.
7. Control of Air flow Process.
8. Design and Implementation of P and PI controller for an Air temperature control system.

9. Study of Programmable Logic Controller and its applications.

COURSE OUTCOMES

At the end of the practical course the students will be able to

1. To model and design controllers for different processes.
2. To design and implement advanced control techniques.
3. Familiarize with TUTSIM and MATLAB software for process control applications.
4. Familiarize with PLC software and its applications for process control operations
5. To design and implementation of control techniques for various process control applications

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓									
CO2	✓	✓	✓						✓		✓	
CO3				✓								
CO4		✓						✓				
CO5	✓											✓

EICP509	**MICROPROCESSOR LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To become familiar with the architecture and Instruction set of Intel 8085 microprocessor.
- To provide practical hands on experience with Assembly Language Programming.
- To provide solid foundation on interfacing the external devices to the 8085 microprocessor according to the user requirements and solutions for the real time problems.

LIST OF EXPERIMENTS

1. Multiplication by repeated addition and subtraction.
2. Multibyte Decimal addition and subtraction.
3. Code conversion.
4. Finding Smallest/Largest number from an Array of 'n' numbers.
5. Sorting an array of numbers in Ascending/Descending order.
6. Block movement of data.
7. Interrupt using RST 5.5.
8. Switches and LED Interface.
9. ADC and DAC Interface with microprocessor.
10. 8253 Timer Interface.
11. 8259 programmable Interrupt controller.
12. Kit to Kit data transfer using USART 8251.

13. Stepper motor Interface.

COURSE OUTCOMES

Understand the architecture of 8085.

1. Familiarize with the assembly level programming and impart the knowledge about the instruction set.
2. Work with standard microprocessor interfaces like Timers, Programmable peripheral interface, Programmable Interrupt controller, serial ports, digital-to-analog converters and analog-to-digital converters etc.
3. An in-depth knowledge of applying the concepts on real- time applications.
4. Interfacing devices with PC using assembly language programming

	Mapping of COs with POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1		✓		✓	✓	✓						
CO2		✓		✓	✓	✓						✓
CO3		✓		✓	✓	✓				✓	✓	
CO4		✓		✓	✓	✓			✓			
CO5												✓

EIPC601	**DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

Course Objectives

- To learn about discrete time signals and system properties.
- To acquire knowledge in the design of digital filters.
- To understand the need for frequency transformation and to implement the same by efficient computational algorithm.

Unit-I : Discrete-time signals and systems

Discrete time signals and systems: Sequences; representation of signals on orthogonal basis; Representation of discrete systems using difference equations, Sampling and reconstruction of signals - aliasing; Sampling theorem and Nyquist rate.

Unit-II : Z-transform

Z-Transform, Region of Convergence, Analysis of Linear Shift Invariant systems using Z transform, Properties of Z-transform for causal signals, Interpretation of stability in Z-domain, Inverse Z-transforms.

Unit-III : Discrete Fourier Transform

Frequency Domain Analysis, Discrete Fourier Transform (DFT), Properties of DFT, Convolution of signals, Fast Fourier Transform Algorithm, Parseval's Identity, Implementation of Discrete Time Systems.

Unit-IV : Design of Digital filters

Design of FIR Digital filters: Window method, Park-McClellan's method - Design of IIR Digital Filters: Butterworth, Chebyshev and Elliptic Approximations; Low-pass, Band-pass, Band-stop and High-pass filters.

Effect of finite register length in FIR filter design - Parametric and non-parametric spectral estimation.- Introduction to multi-rate signal processing.

Unit-V : Applications of Digital Signal Processing

Correlation Functions and Power Spectra, Stationary Processes, Optimal filtering using ARMA Model, Linear Mean-Square Estimation, Wiener Filter.

TEXT BOOKS

1. Mitra S. K., "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.
2. John G. Proakis and Dimitris G. Manolakis, "Digital Signal Processing - Principles, Algorithms and Applications", Fourth Edition, Pearson India, 2007.

REFERENCES

1. Oppenheim A.V and Schaffer R.W, "Digital Signal Processing", First edition, Prentice Hall India, 2015.
2. Ludeman L.C, "Fundamentals of Digital Signal Processing", First edition, Wiley India, 2009.
3. Emmanuel C. Ifeachor and Barrie W. Jervis, "Digital Signal Processing: A Practical Approach", Second edition, Pearson Education, 2002.
4. Johnson J.R, "Introduction to Digital Signal Processing", First edition, Prentice Hall of India, New Delhi, 2009.
5. P.Ramesh Babu, "Digital Signal Processing", Sixth edition, Scitech Publications, 2014.

Course OUtComes

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

1. Represent signals mathematically in continuous and discrete-time, and in the frequency domain.(Unit I)
2. Analyze discrete-time systems using z-transform.(Unit II)
3. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.(Unit III)
4. Design digital filters for various applications.(Unit IV)
5. Apply digital signal processing for the analysis of real-life signals.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓							✓	✓		✓
CO2	✓	✓			✓							
CO3	✓	✓		✓	✓							
CO4	✓	✓		✓	✓				✓		✓	
CO5	✓	✓		✓					✓			✓

EIPC602	INSTRUMENTATION SYSTEM DESIGN	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To impart knowledge about the design methods using orifice and rotameter type of flow transducers for flow control system.
- To understand the basics of transmitter, design principles of signal conditioning circuits for RTD and thermocouple based temperature transmitter, methods of designing cold junction compensation circuit for thermocouple.
- To study about the design of bourdon tube for the measurement of pressure and factors governing its sensitivity and to learn the design procedures of air purge pressure measurement system.
- To learn the principle behind PID controllers and the design aspects for various types of control systems.
- To understand the principle and characteristics of control valves, positioners and pumps and the design criteria involved.
- To study about the design features of alarm circuits, interlocks and micro processor based data acquisition and implementation of PID control system.

Unit–I

Analog and Digital signal conditioning – signal level and bias changes – linearization – conversion -filtering and impedance matching – concept of loading – Op-Amp circuits in instrumentation- design specifications of ADC, DAC – sample and hold circuit.

Unit–II

Orifice meter - design of orifice for given flow condition - design of rotameter - design of signal conditioning circuit for RTD based temperature transmitter - design of cold junction compensation circuit for thermocouple based temperature transmitter - zero and span adjustment in D/P transmitters and temperature transmitters.

Unit–III

Bourdon gauges - factors affecting sensitivity - design of Bourdon tube -design of Air purge system for level measurement. Electronic P+I+D controllers - design - adjustment of setpoint, bias and controller settings.

Unit–IV

Control valves - design of actuators and positioners - types of valve bodies - valve characteristics - materials for body and trim - sizing of control valves - selection of body materials and characteristics of control valves for typical applications. Types of pumps - pipe work calculation - selection of pumps. I/P and P/I converters- complete air supply system for pneumatic control equipments.

Unit–V

Design of logic circuits for alarm and annunciator circuits, interlocks-annunciator sequences - design of microprocessor based system for data acquisition - design of microprocessor based P+I+D controller.

TEXT BOOKS

1. C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India, 8th Edition, 2015.
2. N.A.Anderson, Instrumentation for Process Measurement and Control, Berlin: Springer, 3rd Edition, 2000.

REFERENCES

1. D.M.Considine, Process Instruments and Controls Handbook ,McGraw-Hill., 5th Edition, 1997.
2. R.H.Warring, Pumping Manual, Gulf Publishing Co., 1984.
3. J.P.Bentley, Principles of Measurement Systems, Pearson Education Asia Pvt. Ltd., New Delhi, 3rd Edition, 2000.

COURSE OUTCOMES

At the end of the course the student attains the

1. Ability to design signal conditioning circuit for Instrumentation systems.(Unit I)
2. Ability to design and develop flow measurement system using orifice & rotameter and to design signal conditioning circuit for temperature transmitters using RTD & thermocouple. (Unit II)
3. Ability to design and develop air purge type of level measurement system and to design electronic PID controllers. (Unit III)
4. Ability to design and select control valves and pumps for typical control applications. (Unit–IV :)
5. Ability to design alarm circuits, interlocks & the ability to develop microprocessor based data acquisition system and PID control system. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓		✓					✓		✓
CO2	✓	✓	✓									
CO3	✓	✓	✓								✓	
CO4	✓	✓	✓									
CO5	✓	✓	✓							✓		✓

EICP607	**INSTRUMENTATION SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To impart knowledge about the implementation of Auto/Manual switch in PID controller.
- To study and implement anti-reset windup scheme and various practical forms of PID controller

- To design and implement an electronic PID controller
- To design and implement signal conditioning circuits for various process.
- To learn the design and development procedure of cold junction compensation scheme using RTD

LIST OF EXPERIMENTS

1. Implementation of Auto/Manual switch in PID controller
2. Design of an Annunciator circuit using PLC
3. Implementation of anti-reset windup scheme
4. Implementation of practical forms of PID controller
5. Design and implementation of electronic PID controller
6. Realization of first order and second order systems with dead time using electronic circuits
7. Design and implementation of cold junction compensation scheme using RTD
8. Design and simulation of two position controller for a Thermal process
9. using Electronic Work Bench (EWB) software
10. Design of Alarm circuit using Logic gates.
11. Design of Signal conditioning circuit for the given process
12. Design of control valve sizing
13. Design of an orifice

COURSE OUTCOMES

At the end of the practical course the students will be able

1. To implement the Auto/Manual switch in PID controller
2. To design practical forms of PID and anti reset windup scheme.
3. To design and implement electronic PID controller
4. To familiarize with cold junction compensation for Thermocouple using RTD.
5. To design of process control components

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓				✓			✓
CO2	✓	✓		✓	✓				✓			
CO3	✓	✓		✓	✓				✓			
CO4			✓		✓						✓	
CO5	✓			✓	✓					✓		

EICP608	**SIGNAL PROCESSING AND EMBEDDED SYSTEMS LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To understand the basic concepts of embedded system

- To become familiar with the architecture and Instruction set of Intel 8051 and PIC microcontroller.
- To develop skill in simple program writing for 8051 and PIC microcontroller
- To develop and demonstrate how to accomplish a given task using Assembly and "C" language on a microcontroller
- To familiarize the interfacing of various peripheral devices with 8051 and PIC microcontroller.

LIST OF EXPERIMENTS

1. Implementation of arithmetic operations using TMS 320F/C240 Digital signal processor.
2. Matlab simulation of discrete signals in time domain and frequency domain representation.
3. Design and Matlab implementation of FIR and IIR filter using windowing techniques.
4. Arithmetic Exercises in 8051 using RIDE package (Assembly Language Program).
5. Simple programs in PIC Microcontroller using MPLAB.
6. Interfacing switches and LED with 8051 Microcontroller.
7. Interfacing Push button and Buzzer with 8051 Microcontroller.
8. Programming the on-chip Timer of 8051 Microcontroller.
9. Stepper motor control using 8051 Microcontroller.
10. Programming the on-chip ADC and PWM of PIC Microcontroller using MPLAB.
11. Implementation of Logic Gates and MUX/DEMUX in FPGA.

COURSE OUTCOMES

1. Understand the architecture of 8051 and PIC microcontroller.
2. Familiarize with the assembly level programming, Embedded C and impart the knowledge about the instruction set.
3. Develop software for embedded system using Cross compliers like RIDE , MPLAB.
4. Students will have the knowledge through hands-on experimentation the Xilinx tools for FPGA.
5. Design as well as the basics of VHDL to design, simulate and implement the digital systems.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓						✓	✓
CO2		✓			✓				✓			
CO3		✓	✓	✓	✓					✓		✓
CO4			✓	✓	✓						✓	
CO5			✓	✓	✓				✓			

ETHS701	ENGINEERING ETHICS	L	T	P	C
		2	-	-	2

COURSE OBJECTIVES

- To understand the moral and ethical dimensions in engineering.
- To take balanced decisions.

Unit–I

Senses of 'Engineering Ethics' – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Uses of Ethical Theories.

Unit–II

Engineering as Experimentation – Engineers as responsible Experimenters – Research Ethics - Codes of Ethics – Industrial Standards - A Balanced Outlook on Law – The Challenger Case Study.

Unit–III

Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk - Chernobyl Case Studies and Bhopal.

Unit–IV

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination.

Unit–V

Multinational Corporations – Business Ethics - Environmental Ethics – Computer Ethics - Role in Technological Development – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Honesty – Moral Leadership – Sample Code of Conduct.

TEXT BOOKS

1. Govindarajan, M., Natarajan, S. and Senthilkumar, V.S., "Professional Ethics And Human Values", PHI Learning, New Delhi, 2013.
2. Mike Martin and Roland Schinzinger, "Ethics in Engineering", McGraw Hill, New York, 2005.

REFERENCES

1. Charles E. Harris, Michael S. Pritchard and Michael J. Rabins, "Engineering Ethics – Concepts and Cases", Thompson Learning, 2000.
2. Charles D. Fleddermann, "Engineering Ethics", Prentice Hall, New Mexico, 1999. John R Boatright, "Ethics and the Conduct of Business", Pearson Education, 2003.
3. Edmund G. Seebauer and Robert L. Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, 2001.
4. David Ermann and Michele S. Shauf, "Computers, Ethics and Society", Oxford University Press, (2003).

COURSE OUTCOMES

1. Understand the relationship between the engineer and the society.
2. Learn the importance of codes in engineering practice.
3. Acquire knowledge on the legal, moral and ethical aspects in engineering.
4. Learn about the MNCs and their practices.
5. Understand the ethical dimensions in engineering

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1						✓	✓	✓	✓			
CO2						✓						
CO3						✓						
CO4								✓				
CO5						✓		✓				

EIPC702	**COMPUTER CONTROL OF PROCESSES**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To understand the need for computers in process control.
- To study the fundamentals required for computer control of a process.
- To expose the students the stability analysis of discrete time system.
- To design and analyze digital controllers.
- To study some of the methods to identify the process.
- To know about programmable logic controller.

Unit–I : Introduction to Computer Control System

Need for computer in a control system- Building blocks of a computer control system, Representation and analysis of Sampled data control systems-Pulse Transfer function-Zero Order Hold and First Order Hold- Sampling Theorem-Sampling frequency Consideration- stability analysis: Jury's test and bilinear transformation. Modified Z transform of systems with dead time.

Unit–II : Digital Control Algorithms

Design for Set point and load changes: Deadbeat Algorithm - Dahlin's method - Kalman's approach - ringing phenomenon in digital controller- discrete PID controller algorithms - tuning techniques - selection of sampling time - dead-time compensation: Smith Predictor algorithm.

Unit–III : System Modeling and Identification

Mathematical model for processes: first order, second order processes with and without delay - higher order systems-process modeling from step test data - pulse testing for process identification - time-domain identification-linear least square algorithm.

Unit–IV : Programmable Logic Controllers (PLCs)

PLC Hardware components: discrete, analog and digital I/O modules: typical input and output field devices and their modules - I/O signal types and typical

signal conditioning circuits - common electrical devices and symbols - intelligent I/O modules - Communication I/O modules- network communication module - distributed I/O - Central Processing Unit-

Unit–V : PLC Programming

Programming Languages: Ladder Diagram(LD) - Function Blocks Diagram (FBD) - Sequential Function Chart (SFC) - Instruction List (IL) - Structured Text (ST). programming devices: hand-held programmer - personal computer based programmer - Memory types used in PLCs - memory map - assigning I/O address and internal address - scan sequence.-Basic Programming: Relay-Type Instruction-Internal Relay instruction- timers-counters- program control instruction-data manipulation instruction-math instruction-sequencer and shift register instruction-development of programmes for typical applications -PLC Installation and maintenance.

TEXT BOOKS

1. P.B. Deshpande and R.H. Ash, Elements of Computer Process Control, Instrument Society of America, 1981.
2. Frank D.Petruzella, Programmable Logic Controllers, McGraw Hill Education India Private Limited, Fourth edition, 2016.

REFERENCES

1. C.D. Johnson, Process Control Instrumentation Technology, 8th Edition, Pearson, 2005.
2. Stuart Bennet, Real Time Computer Control, Second Edition,Pearson Education, 2005.
3. C.L. Smith, Digital Computer Process Control, Intext Educational Publishers, 1972.
4. Donald R.Coughnowr, Process Systems Analysis and Control, Mc-Graw Hill Education, Third Edition,2008.
5. W.Bolton, Programmable Logic Controllers, Elsevier Newnes,2006

COURSE OUTCOMES

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

1. Analyze a system in discrete domain using Z-transform and modified Z-transform. (Unit I)
2. Design and develop algorithms for sampled data control system. (Unit II)
3. Understand various system identification and modeling techniques in time domain and in frequency domain.(Unit III)
4. Appreciate the application and hardware parts of a Programmable Logic Controller. (Unit–IV)
5. Develop and implement logical programs in PLC and trouble shoot, install and maintain a PLC system. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓										
CO2		✓	✓	✓							✓	
CO3		✓	✓	✓								
CO4				✓						✓		✓
CO5		✓	✓	✓	✓			✓				✓

EICP706	**INDUSTRIAL AUTOMATION LAB**	**L**	**T**	**P**	**C**
		-	**-**	**3**	**1.5**

COURSE OBJECTIVES

- To understand the need for computers in process control and fundamentals required for computer control of processes with MATLAB software.
- To study and implement an algorithm to identify the process parameters.
- To design and implement digital controllers using TUTSIM software.
- To study programmable logic controller with GE Fanuc make.
- To study data acquisition system using LABVIEW software.

LIST OF EXPERIMENTS

1. Open loop and closed loop response of the discrete time system.
2. Design of sampled data control system with Dead-beat controller using TUTSIM.
3. Design of Dead-time compensator using smith predictor algorithm and simulation using SIMULINK.
4. Process identification using Least Square Estimator algorithm using MATLAB.
5. Design and simulation of Kalman's Controller using TUTSIM.
6. Design and realization of digital filter.
7. Design of sampled data control system with Dhalin's controller and simulation using TUTSIM.
8. Study of LABVIEW software and Data acquisition using Lab View.
    a) Design of inverse response compensator and simulation using SIMULINK.
    b)Study of Bio signals.
9. Study of PLC (GE Fanuc make).

COURSE OUTCOMES

1. Able to design and implement a closed loop system in discrete domain.
2. Able to understand and develop ladder logics PLC.
3. Ability to use the software tools like MATLAB and TUTSIM.
4. Ability to use the software tool LABVIEW and data acquisition using LABVIEW.
5. Ability to identify process using LSE algorithm

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓									
CO2	✓	✓	✓								✓	
CO3				✓						✓		
CO4		✓										✓
CO5	✓		✓								✓	

EIPV803	PROJECT WORK AND VIVA VOCE	L	PR	S	C
		-	10	2	6

COURSE OBJECTIVES

- To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
- To train the students in preparing project reports and to face reviews and viva voce examination.

METHOD OF EVALUATION

1. The students in a group of 3 to 4 works on a topic approved by the Head of the Department under the guidance of a faculty member and prepare a comprehensive project report after completing the work to the satisfaction of the supervisor.
2. The progress of the project is evaluated based on a minimum of three reviews. The review committee will be constituted by the Head of the Department.
3. A project report is required at the end of the semester.
4. The project work is evaluated based on oral presentation and the project report jointly by external and internal examiners constituted by the Head of the Department.

COURSE OUTCOMES

1. On Completion of the project work students will be in a position to take up any challenging practical problems and find solution by formulating proper methodology
2. Carrying out any experimental works on chosen topics.
3. Understand the modelling, analysis, design and control aspects.

Mapping of COs with POs												
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓	✓			✓		✓				
CO2	✓	✓	✓			✓		✓	✓	✓	✓	✓
CO3	✓	✓	✓			✓		✓	✓	✓	✓	✓

PE - PROFESSIONAL ELECTIVES

EIPESCN	VIRTUAL INSTRUMENTATION & SMART SENSORS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To understand the basic components of Virtual Instrumentation system.
- To learn to develop VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.
- To know about various VI Tool sets.
- To impart knowledge pertaining to Data Acquisition System.

Unit–I : Introduction

Review of Digital Instrumentation, Concept of Virtual Instrumentation- Historical perspective - need of VI advantages- definition of VI- Block diagram and architecture of a Virtual Instrument – Traditional Instruments versus Virtual Instruments - dataflow techniques, graphical programming in data flow, VI Debugging Techniques.

Unit–II : Data Acquisition and Communication Hardware

PC based data acquisition- Typical on board DAQ card- Organisation of the DAQ VI system-Data acquisition interface requirements – Embedded system buses- Selection of Data acquisition cards–Buffered data acquisition - VI Chassis requirements.

Data acquisition cards with serial and parallel communication system controllers. Ethernet - Networking basics for office & Industrial applications - VI customization-Instrument Drivers.

Unit–III : Programming Techniques

VIs and sub- VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formulae nodes, local and global variables, State machine, string and file I/O, Publishing measurement data in the web, Internet Connectivity.

Unit–IV : Analysis Tools and Application of VI

Analysis tools- Signal Processing Tool set- Fourier transforms, power spectrum, correlation methods, windowing and filtering. Math Toolsets, Hybrid Programming Concept, Control and Simulation Toolkit, On-Off controller, PID Control, Fuzzy algorithms.

Application of VI in process control designing of equipments like oscilloscope, Multimeter, Design of digital Voltmeters with transducer input- Applications of VI for Process Control and Instrumentation.

Unit–V : Smart Sensors

Definition – Sensor classification- General architecture of smart sensors- Description of smart sensor architecture- Block level design consideration for smart sensor-Importance and adoption of smart sensor-Types of smart sensors-compensation.

TEXT BOOKS

1. Gary Johnson, LabVIEW Graphical Programming, McGraw Hill, 2006.
2. Skolkoff, Basic concepts of LABVIEW 4, PHI, 1998.

REFERENCES

1. Paul Bates, Practical Digital and Communications, Prentice-Hall, 1987.
2. J.B.Dixit, AmitYadav, “Intelligent Instrumentation for Engineers”, University Science Press2012.
3. Lisa .K, Wells and Jeffrey Travis, LABVIEW for Everyone, Prentice Hall, 2009.
4. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newnes, 2000.

5. Jovitha Jerome, Virtual Instrumentation using LabVIEW, Eastern Economy edition, PHI learning private Ltd., 2010.
6. Gupta. S, Gupta. J.P, PC Interfacing for Data Acquisition and Process Control, ISA, 1994.

COURSE OUTCOMES

At the end of the course, students should be able to

1. Engineering Knowledge on VI. (Unit I)
2. Data acquisition using DAQ VI's. (Unit II)
3. Understand the Virtual Instruments basis concepts. (Unit III)
4. Incorporate various VI Toolsets based on the application. (Unit–IV)
5. Get the knowledge of Smart Sensors. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓						✓			
CO2	✓	✓	✓	✓								
CO3	✓	✓	✓	✓								
CO4	✓	✓	✓	✓	✓				✓		✓	✓
CO5	✓	✓	✓	✓	✓						✓	

EIPESCN	**ANALYTICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the students understand basic theory and importance of instrumental analysis.
- To motivate the students learn the principles and the laws governing the operation of analytical instruments.
- To familiarize the students about the functioning of different types of analytical instruments.

Unit–I

Electromagnetic radiations - different regions - their wave lengths, frequencies and energies - interaction of EM radiations with matter - Principle of spectroscopy - emission, absorption, fluorescence spectroscopy - components of analytical instruments – radiation sources, variety and its types - monochromator - filters - detectors – photo emissive tube, PMT, photo diodes.

Unit–II

IR absorption spectroscopy – IR detectors – thermal detectors – golay pneumatic detector – sample handling techniques – Attenuated Total Reflectance – Lambert's, beer's law – single and double beam instruments – double beam spectrophotometer- non dispersive type.

Unit–III

NMR spectroscopy - Fourier Transform NMR spectroscopy – ESR spectroscopy – basic principles – instrumentation techniques and applications – principle of mass spectrometry – instrumentation techniques and applications – single focusing and double focusing mass analyzer – Quadra pole mass analyzer – TOF spectrometer.

Unit–IV

X-ray Spectroscopy – X-ray spectrometer - Production of X-rays - detection of X-rays and nuclear radiations- ionization chamber – principle of counters - proportional counter, GM counter, scintillation counter - solid state detector - gamma ray spectrometer – isotope dilution and tracer techniques for quantitative estimation and analysis.

Unit–V

Electrochemical methods - electrical conductivity of liquids – sulphur-di-oxide monitor – principle of pH measurement – Technique to measure pH – Oxygen analyzers. Principles of gas and liquid chromatography - High Performance Liquid Chromotography – Super critical fluid chromatography.

TEXT BOOKS

1. Skoog, Holler &Nicman, Principles of Instrumental Analysis. Fifth Edition – Saunders College Publishers, Harcourt Brace College Publishing, 1998.
2. H.H.Willard, L.L.Merrit, J.A. Dean and F.A. Settle, Instrumental methods of Analysis. Seventh edition – CBS, Publishers & Distributors, 1995.

REFERENCES

1. D.A. Skoog and D.M.West, Principles of Instrumental Analysis, Second Edition, Holt–Saunders, 1980.
2. Douglas A.Skoog and James J. Leary, Principles of instrumental Analysis, Fourth Edition – Saunders College Publishing, 1992.
3. Khandpur.R.S, Handbook of Analytical Instruments, TMH,2003.
4. Bella,G.Liptak Process Measurements and Analysis, CRC press,LLP,2000.

COURSE OUTCOMES

1. Gain adequate knowledge about the analytical tools, principles and types of spectroscopy. (Unit I).
2. Importance and applications of IR spectroscopy (Unit II).
3. Importance and applications of Magnetic resonance spectroscopy and mass analyzer (Unit III).
4. Importance and applications of X-ray spectroscopy and dilution tracer analysis (Unit–IV).
5. Separation of similar materials using Chromatograph. (Unit V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓	✓								✓
CO2	✓		✓	✓								
CO3	✓		✓	✓								
CO4	✓		✓	✓								
CO5	✓		✓	✓							✓	

EIPESCN	**BIOMEDICAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the physical foundations of biological systems and the various electrodes used in medical field.
- To have a detailed understanding about the various electro physiological measurements in the human body.
- To gain knowledge on the measurement of non-electrical parameter in the human body.
- To understand the basic concepts of various medical imaging techniques and their applications.
- Understand medical assisting and therapy equipments.

Unit–I

Introduction, generalized medical instrumentation system, components of instrumentation system, physiological systems of the body, cardiovascular system. Respiratory system, Nervous system, CNS, PNS, generation of bioelectric potentials, Action potential, Resting potential, Neuronal communication.

Unit II

The electrode – electrolyte interface, Polarization, Ag/Agcl Electrodes, Body surface electrodes, Internal Electrodes. Transducers in general, Pressure Transducers, Temperature transducers, pulse sensors, Basic recording system, Direct Writing recorder, UV recorders, Thermal array recorders, Electrostatic recorder, Instrumentation Tape recorder

Unit–III

Information content of an image, Modulation transfer function, Noise – equivalent bandwidth, generation of X-rays, X-ray machine, computed Tomography, Magnetic Resonance Imaging – Principle, Image reconstruction techniques, Basic NMR components, Ultrasonic Imaging systems – Types of ultrasound imaging, Applications of different scan, Bio Telemetry.

Unit IV

Electrocardiogram, Effects of artifacts on ECG recordings, ECG recorder Principles, EEG & EMG recorders, ERG, Phonocardiogram, stethoscope, BP measuring Instrument - Sphygmomanometer and cardiac catheterization,

ultrasonic blood flow meter, Principle of Photoelectric calorimeter, computerized patient monitoring system. Respiratory rate – Gas volume – Flow rate of CO_2, O_2 in exhaust air - PH of blood, ESR, GSR measurements – Plethysmography.

Unit–V

Pacemaker systems – Different pacing modes of operation, Transcutaneous Electrical Nerve stimulation (TENS) – Stimulation modes & application techniques, surgical diathermy, Heart lung machine, Hemo Dialysis, Lithotripsy, Laser applications in medicine, and introduction to electrical safety.

TEXT BOOKS

1. Leshie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, Biomedical Instrumentation and Measurements, Third Edition, PHI, 2011.
2. R.Anandanatarajan, Biomedical Instrumentation, PHI Learning, 2009.

REFERENCES

1. Prof.Venkataram.S.K, Bio-Medical Electronics & Instrumentation, Galgotia Publications, 2000.
2. R.S. Khandpar, Hand Book of Biomedical Instrumentation and measurement, McGraw Hill publishing Co., 1990.
3. Aston, Principles of Biomedical Instrumentation and measurements, McGraw Hill publishing Co., 1990.
4. M. Arumugam, Biomedical Instrumentation, Anuradha Agencies Publishers, VidayalKaruppar, 612 606, Kumbakonam, R.M.S: 1992.
5. John. Can. Brown, Introduction to Bio Medical Equipment Technology, Pearson Education of ASIA, 2001.

COURSE OUTCOMES

1. To educate students on the various physiological systems of the human body.(Unit-I)
2. To impart knowledge on the electrodes and allied recorders so as to obtain measurements from the human body. (Unit-II)
3. To provide insight into advanced imaging systems. (Unit-III)
4. To study the various bio signals along with the principles of measurement. (Unit-IV).
5. To provide an exposure to the medical equipments/instruments used in various departments and laboratories of a hospital. (Unit-V)

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓	✓								✓		
CO2			✓									
CO3			✓	✓								
CO4			✓	✓							✓	
CO5			✓	✓					✓	✓		✓

EIPESCN	POWER PLANT INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce students to the general layout of thermal power plant and also construction and principle of operation of the different sensing and indicating devices used at thermal power plants.
- The combustion chemistry of boiler and its efficiency calculation will be explained to students and to study about the various control techniques used in thermal power plant.
- To explain the function of steam turbine and its associated parameter measurement and to elaborate different types of safety methods involved in thermal power plant.
- To introduce students the functions of nuclear power plant and also construction and principle of operation of the different sensing devices and control systems employed at nuclear power plants.

Unit–I : Overview of Thermal Power Generation and its Instrumentation

General layout of a typical thermal power plant-Feed water and steam flow circuit-cooling water circuit- Fuel-ash circuit-Air-flue gas circuit. Piping and Instrumentation diagram of a thermal power plant, basic processes in boilers. Fuel measurement- Review of pressure and temperature measurement- steam and water flow measurement. Instrument applications in power stations-Review of indicating and recording instruments, water level gauges for boiler drums, closed circuit television instruments, gas analysis meters, smoke measurement, dust monitor-measurement of impurities in feed water and instruments-instrument maintenance aspects.

Unit–II : Boiler Combustion Process and its Efficiency Calculation

Boiler control objectives- combustion of fuels (gaseous, liquid and solid), excess air requirement, combustion chemistry and products of combustion, requirement for excess combustion air – calculation of efficiency of boilers: input/output method, heat loss method.

Various Control methods employed in water circuit

Controls in water circuit-Boiler drum level control-Superheated steam temperature control- superheaters-steam temperature control-water side steam temperature control-strategies of steam temperature control and de-superheaters-fire side steam temperature control-Steam pressure control.

Unit–III : Various Control Methods Employed in Air-Fuel Circuit

Control in air-fuel circuit-Combustion control and Furnace draft control. Flue gas analysis trimming of combustion control systems-combustion control for liquid and gaseous fuel boilers- coal or solid fuel stokers- combustion control for stoker fired boilers-pulverised coal burning systems- combustion control for pulverised coal fired boilers.

Unit–IV : Instrumentation & Control System Used for Turbine and Safety Aspects of Boiler

Turbine monitoring and control: speed, vibration, shell temperature monitoring-lubrication for Turbo-alternator- Turbo-Alternator cooling system. Intrinsic and Electrical safety- Interlocks for Boiler operation-Computer based control and data logging systems- Application of DCS in thermal power plant.

Unit–V : Nuclear Power Plant Instrumentation

Important components in instrumentation and control for nuclear power plant-Sensors and measurement systems for nuclear power plant-nuclear reactor control systems- Digital architectures in nuclear power plant-Radiation protection and monitoring.

TEXT BOOKS

1. K.Krishnasamy and M.PonniBala, Power Plant Instrumentation, PHI, second edition, 2013.
2. B.G.Liptak, Instrumentation in Process industries, Vol. I and II, Chilton Book Co.,1973.

REFERENCES

1. Sam.G.Dukelow, The control of boilers, Instrument society of America Press,1986.
2. Swapanbasu and Ajay debnath, Power Plant Instrumentation and Control Handbook: A Guide to Thermal Power Plants, Academic press, 2014.
3. Duncan Richardson, Plant Equipment & Maintenance Engineering Handbook, McGraw-Hill Education, 2014.

COURSE OUTCOMES

1. Ability to understand the function of boiler and also P&ID of thermal power plant.(Unit I)
2. Ability to understand the types of measuring equipment used in thermal power plant. (Unit–I and II)
3. Ability to identify and analyze the specific features of different types of control techniques used in Boilers.(Unit III)
4. Ability to understand the function of turbine and its lubrication method and understand the various safety methods involved in the proper functioning of thermal power plant. (Unit–IV)
5. Ability to understand the function of nuclear power plant, various sensors, control loops and safety measures employed in nuclear power plant. (Unit V)

Mapping of COs with POs

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	✓				✓						✓	
CO2		✓									✓	
CO3			✓	✓	✓						✓	
CO4					✓						✓	
CO5											✓	

EIPESCN	UNIT OPERATIONS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

The objectives of this course are to:

- Cover issues related to the definitions and principles of unit operations and unit systems.
- Discuss about the heat transfer and its applications elaborately.
- Explain the concepts of mass transfer and its applications in detail.
- Learn thoroughly the concepts of control systems with multiple loops and plant wide control strategy and its implementation to the unit systems.

Unit–I : Fundamentals of Unit Operations

Definitions and principles: Unit Operations - Unit Systems - Dimensional analysis-Basic concepts-Fluid Mechanics: Fluid statics and its applications: Hydrostatic Equilibrium-Application of fluid statics – Fluid flow phenomena: Laminar flow, Shear rate and Shear stress- Rheological properties of fluids – Turbulence – Boundary layers - Basic equations of fluid flow: Mass balance in flowing fluid; continuity – Differential momentum balance; Equations of motion.

Unit–II : Heat Transfer and its Applications

Heat transfer by conduction: Basic law of conduction - Steady state conduction – Unsteady state conductions- Principles of heat flow in fluids: Typical heat exchange equipment – Energy balances - Heat flux and heat transfer coefficients - Rate of heat transfer – Heat exchange Equipments: Types of heat exchangers, condensers and evaporators – Performance of tubular evaporators – Vapour recompression.

Unit–III : Mass Transfer and its Applications

Mass transfer theories – Mass transfer coefficients - Distillation: Flash distillation - Continuous distillation with reflux – Reflux ratio - Batch distillation – Definition of leaching and extractions: Leaching equipment – Liquid extraction equipment – Supercritical fluid extraction method – Drying of solids: Principles of drying – Drying equipments – Membrane separation process: Separation of gases – Separation of liquids.

Unit–IV : Control Systems with Multiple Loops

Cascade control: Cascade control for jacketed CSTR, Heat exchanger, Distillation column, Process furnace – Dynamic characteristics of cascade control – Selective control systems: Override control – Protection of boiler system, compressor system and steam distribution system –Auctioneering control and its examples – Split range control: Chemical reactor and Steam header.

Unit–V : Plant Wide Control

Plant wide control: Introduction – Block diagram descriptions only: Steady-state and dynamic effects of recycle- Unit operations: Supply side Vs Demand side – Compressor control – Heat exchangers – Adiabatic plug flow reactors – The control

and optimization hierarchy – Petroleum refining example - Case Study: Reactor / Flash unit plant and Distillation columns.

TEXT BOOKS

1. Warren L. McCabe, Julian C. Smith, Peter Harriot, Unit operations of Chemical Engineering, 7th edition, McGraw Hill publication, 2014.
2. George Stephanopoulous, Chemical Process Control: Introduction to Theory and Practice, Pearson Education, 2015.

REFERENCES

1. B. Wayne Bequette, Process Control: Modelling, Design and Simulation, Prentice Hall of India, 2004.
2. Dale E. Seborg, Thomas.F.Edgar, Duncan A.Mellichamp, Process Dynamics and Control, 3rd Edition Wiley India Publication, 2010.
3. H.ScottFogler, Elements of Chemical Reaction Engineering, 3rd Edition, Prentice Hall of India, 2015.
4. I.J. Nagrath and M. Gopal, Control Systems Engineering, New Age International Publication, 2013.
5. Gade Pandu Rangaiah and Vinay Kariwala, Plantwide Control: Recent Developments and Applications, Wiley Publications, 2012.
6. William L. Luyben, Bjorn D.Tyreus, Michael L.Luyben, Plantwide Process control, McGraw Hill, 1999.
7. Christie John Geankoplis, Transport Processes and Separation Process Principles, Pearson Education, 4th Edition, 2003.

COURSE OUTCOMES

At the end of the course the student will be able to:

1. Understand the definitions and basic principles of unit operations and unit systems.(Unit I)
2. Acquire a thorough knowledge of fluid mechanics and its types of flow.(Unit II)
3. Gain sound knowledge on heat transfer and its applications.(Unit III)
4. Imbibe the concepts of mass transfer and master its applications.(Unit IV)
5. Analyze the significance of control systems with multiple loops and plant wide control strategy.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2	✓				✓						✓	
CO3	✓				✓							
CO4	✓				✓							
CO5	✓	✓	✓								✓	

EIPESCN	FLUID MECHANICS AND HYDRAULIC MACHINERY	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To understand the physical properties of fluids, fluid pressure and its measurement.
- To derive the equation of conservation of mass and its application.
- To solve problems of fluid kinematics and dynamics specifically flow through pipes and open channel flow.
- To use important concepts of continuity equation, Bernoulli's equation and apply the same to problems.
- To study the performance of Turbines, Radial flow, Reaction turbines and governing of turbines.
- To study the characteristics of Centrifugal pumps and reciprocating pumps.

Unit–I : Properties of Fluids, Fluid Pressure and its Measurement

Mass density, specific weight, specific volume, specific gravity, viscosity - Newton's law of viscosity - compressibility - surface tension and capillarity - real and ideal fluids.

Pressure - atmospheric and vacuum pressures - measurement of pressure by manometers and pressure gauges - total pressure and center of pressure – Buoyancy - metacentre - simple problems.

Unit–II : Dynamics of Fluid Flow

Kinematics of flow - types of fluid flow - continuity equation - Euler's equation of motion - Bernoulli's equation - practical applications - venturimeter, orificemeter and pitot tube. Simple treatment of orifices, mouthpieces, notches and weirs.

Flow through pipes - loss of energy due to friction - minor energy losses - hydraulic gradient and total energy line - flow through pipes in series - Flow through parallel pipes - power transmission through pipes - flow through nozzles.

Unit–III : Flow in Open Channels

Classification of flow in channels - Chezy's and Manning's formulae - most economical Rectangular, Trapezoidal and Circular sections of channel.

Non-uniform flow through open channels - specific energy and specific energy curve - critical depth - critical velocity - critical, supercritical and subcritical flows - alternate depths.

Unit–IV : Impact of Jet and Turbines

Impact of jets - force exerted by a fluid on stationary and moving flat plates held in various positions - force exerted on curved plates - concept of velocity triangles.

Turbines: General layout of a hydroelectric power plant - Classification of turbines - velocity triangles for turbines - work done and efficiency, specific speed - Impulse turbine - Pelton Wheel – Reaction turbine - Francis turbine - simple problems - selection of turbines.

Unit–V : Pumps

Centrifugal pumps - main parts - work done - definitions of heads and efficiencies - multistage pumps - specific speed - priming - cavitation.

Reciprocating pumps - main parts - working principle – slip - indicator diagrams - effects of acceleration and friction on indicator diagrams - maximum speed of a reciprocating pump - study of air vessels.

TEXT BOOKS

1. Dr. P.N. Modi & Dr. S.M. Seth, "Hydraulics and Fluid Mechanics Including Hydraulics Machines", 20th Edition, Standard Book House, New Delhi, 2015.
2. Dr. R.K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines" Laxmi Publications (P) Ltd, Chennai, 2011.

REFERENCES

1. Dr. Jagdish Lal, "Fluid Mechanics and Hydraulics with Computer Applications", Metropolitan Book Company, **Ninth Edition,** New Delhi, 2014.
2. Dr. K.L. Kumar, "Engineering Fluid Mechanics" Eurasia Publishing House (P) Ltd. 8th Edition, New Delhi, 2014.
3. Dr. V.P. Vasandani, "Theory and Design of Hydraulic Machines including Basic Fluid Mechanics", Khanna Publishers, 11th Edition, New Delhi, 2016.

COURSE OUTCOMES

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

1. Apply the basic knowledge of fluid mechanics in finding fluid properties, performance parameters of hydraulic turbines and pumps.
2. Use fluid dynamics for study of flow through pipes and flow in open channels.
3. Present hydraulic design for the construction of efficient hydraulic turbines and pumps.

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓					✓		
CO2			✓		✓							
CO3			✓	✓	✓						✓	✓

EIPESCN	**PRINCIPLES OF COMMUNICATION SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- To introduce the principles of analog and digital communication systems involving different modulation and demodulation schemes.

Unit I

Amplitude modulation: AM, generation of AM waves, demodulation, DSBSC, SSB, VSB, FDM, AM receivers, Optical Communication, Microwave communications and Satellite Communications

Unit II

Angle modulation: Phase and Frequency modulation, Single-tone, narrow band, wide band and multi tone FM, generation and demodulation of FM, FM receivers.

Unit III

Pulse Analog modulations: Sampling theorem, Time Division Multiplexing, PAM, Pulse time modulation.

Unit IV

Pulse Digital modulation: PCM, Measure of Information, Channel capacity, DPCM, DM, Digital multiplexers.

Unit V

Noise: SNR, Noise in AM and FM receivers, Noise in FM reception, FM Threshold effect, Preemphasis and de-emphasis, Noise in PCM system, Destination SNR in PCM system with quantization and channel noise, output SNR in DM system.

TEXT BOOKS

1. H.Taub & D.Schilling, Principles of Communication System, 3rd Edition, Tata McGraw Hill, 2007
2. J.S.Beasley&G.M.Miler, Modern Electronic Communication, 9th Edition, Prentice-Hall, 2008.

REFERENCES

1. B.P.Lathi,Modern Analog And Digital Communication systems, 3rd Edition, Oxford University Press, 2007
2. B.Carlson, Communication Systems, 3rd Edition, McGraw Hill Book Co., 1986.
3. Sam Shanmugam, Digital and analog Communication Systems, John Wiley, 1985.

COURSE OUTCOMES

Student can able to

1. Develop an understanding of need for modulation and generation & detection of Analog modulation techniques (Unit-I).
2. Explore AM and FM Super heterodyne receiver working principle (Unit-II).
3. Discuss the techniques for generation and detection of pulse Analog modulation Techniques (Unit-III)
4. To understand the basic operation involved in PCM like sampling, quantization & encoding and are able to calculate and derive entropy and channel capacity (Unit-IV).
5. To compare different communication system with various modulation techniques in the presence of noise by analytically (Unit-V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓				✓	✓		
CO2	✓			✓								
CO3			✓	✓					✓			✓
CO4		✓		✓					✓			
CO5	✓				✓	✓			✓		✓	✓

EIPESCN	DIGITAL SYSTEM DESIGN	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To review digital design fundamentals and to emphasize VHDL in Digital design.
- To give an overview of PLD, CPLD & FPGA and basic principles in the construction of these programmable devices.
- To present several design examples with synthesizable VHDL code describing them at different levels.
- To present issues related to implementation of a digital system in FPGA.
- To introduce advanced features of VHDL, hardware testing of combinational and sequential logic and design for testability.

Unit–I : Logic Design Fundamentals

Review of logic design fundamentals - combinational logic - flip-flops and latches - Mealy sequential circuit design - Moore sequential circuit design - sequential circuit timing - tri-state logic and busses.

Unit–II : VHDL

Introduction to VHDL - VHDL description of combinational circuits - sequential statements and VHDL processes - modeling flip-flops using VHDL processes - processes using wait statements - VHDL delays - compilation, simulation and synthesis of VHDL code - VHDL data types and operators - VHDL libraries - behavioral and structural VHDL - variables, constants and signals - arrays and loops in VHDL - assert and repeat statements.

Unit–III : PLD

Introduction to Programmable Logic Devices (PLDs): overview of PLDs - simple PLDs - complex PLDs - FPGAs. Design Examples: BCD to seven segment display decoders - BCD adder - traffic light controller - state graphs for control circuits - scoreboard and controller - synchronization and de bouncing - ADD and shift multipliers.

Unit–IV : FPGA

State Machine (SM) charts - derivation of SM charts - binary multiplier design - realization of SM charts - implementation of binary multiplier controller. Designing with FPGAs: Implementing functions in FPGAs - Shanon's decomposition - carry chains - cascade chains - logic blocks in commercial FPGAs - dedicated memory in FPGAs - dedicated multipliers in FPGAs - FPGA capacity - design translation, mapping, placement and routing.

Unit–V : Design and Testing

VHDL functions - VHDL procedures - attributes - multi valued logic and signal resolution - IEEE 9-valued logic system - Generics. Hardware testing and design for testability: testing combinational logic - testing sequential logic - scan testing - boundary scan - built-in self test.

TEXT BOOKS

1. Charles H. Roth, Lizy Kurian John, Digital System Design using VHDL, Second Edition, Thomson Learning Inc., 2008.
2. Ian Grout, Digital Systems Design with FPGAs and CPLDs, Newnes imprint of Elsevier Ltd., 2010.

REFERENCE BOOKS

1. K.C. Chang, Digital Systems Design with VHDL and Synthesis - An Integrated Approach IEEE Computer Society, 1999.
2. J. Bhasker, A VHDL Primer, Third Edition, Prentice Hall of India, 1999.

COURSE OUTCOMES

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

1. Design of various digital communication systems (Unit I).
2. Develop VHDL code describing them at various levels (Unit II).
3. Implement the designed digital system using programmable devices (Unit III).
4. Utilize advanced features of VHDL with FPGA in their system design (Unit IV)
5. Develop digital system with testability (Unit V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓	✓							✓	
CO2		✓	✓									
CO3		✓	✓	✓			✓				✓	
CO4				✓			✓		✓	✓		✓
CO5				✓			✓		✓	✓		✓

EIPESCN	**REAL TIME OPERATING SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students to the fundamentals of interaction of OS with a computer and user computation.
- To teach the fundamental concepts of how process are created and controlled with OS.
- To study on programming logic of modeling Process based on range of OS features.
- To compare types and Functionalities in commercial OS.
- To discuss the application development using RTOS.

Unit–I : Review of Operating Systems

Basic Principles - Operating System structures – System Calls – Files – Processes – Design and Implementation of processes – Communication between processes – Introduction to Distributed operating system – issues in distributed system: states, events, clocks-Distributed scheduling-Fault &recovery.

Unit–II : Overview of RTOS

RTOS Task and Task state –Multithreaded Premptive scheduler- Process Synchronisation- Message queues– Mail boxes -pipes – Critical section – Semaphores – Classical synchronisation problem – Deadlocks.

Unit–III : Real Time Models and Languages

Event Based – Process Based and Graph based Models – Real Time Languages – RTOS Tasks – RT scheduling - Interrupt processing – Synchronization – Control Blocks – Memory Requirements.

Unit–IV : Real Time Kernel

Principles – Design issues – Polled Loop Systems – RTOS Porting to a Target – Comparison and Basic study of various RTOS like – VX works – Linux supportive RTOS – C Executive.

Unit–V : RTOs Application Domains

Case studies-RTOs for Image Processing – Embedded RTOs for Network communication – RTOs for fault-Tolerant Applications – RTOs for Control Systems.

TEXT BOOKS

1. Silberschatz,Galvin,Gagne, Operating System Concepts,6th ed,John Wiley,2003.
2. Raj Kamal, Embedded Systems- Architecture, Programming and Design, Tata McGraw Hill, 2006.

REFERENCES

1. Herma K., Real Time Systems – Design for distributed Embedded Applications, Kluwer Academic, 1997.
2. Charles Crowley, Operating Systems-A Design Oriented approach, McGraw Hill 1997.
3. C.M. Krishna, Kang, G.Shin, Real Time Systems, McGraw Hill, 1997.
4. Raymond J.A.Bhur, Donald L.Bailey, An Introduction to Real Time Systems, PHI 1999.
5. MukeshSighal and N G Shi,Advanced Concepts in Operating System, McGraw Hill 2000.
6. D.M.Dhamdhere, Operating Systems,A Concept-Based Approch,TMH,2008.

COURSE OUTCOMES

1. Will get to know the fundamentals of interaction of OS with a computer and User computation. (Unit–I : & II)
2. Will get to know the programming logic of modeling Process based on range of OS features. (Unit–III : & IV)
3. To help the students to come with design and development of solutions using RTOS. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓		✓	✓		✓		✓		
CO2	✓		✓		✓	✓		✓	✓		✓	
CO3	✓		✓		✓	✓		✓	✓		✓	✓

EIPESCN	**COMPUTER NETWORKS AND DCS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To provide fundamental knowledge about computer networks.
- To provide comprehensive knowledge about the methods of internetworking.
- To give basic knowledge in the architecture and local control unit of distributed control system.
- To give adequate information in the interfaces used in DCS.
- To give basic knowledge about HART (Highway Addressable Remote Transducer) and field bus technology.

Unit–I : Data Acquisition Systems (DAS)

Review of A/D Converters - different Configurations of DAS - Multiplexing - Data Communication - transmission lines and digital signals - Practical line interface circuits – RS232, RS 485 – GPIB - USB.

Unit–II : Introduction to network

MODEM - Data coding methods - Error detection, correction and encryption -. Introduction to Networks - Network topology and media - Transmission Characteristics of network - Open System interconnection model of ISO - Data link Control protocol: HDLC.

Unit–III : Network protocols

Media access protocol: Command/response - Token passing - CSMA/CD, TCP/IPBridges - Routers - Gateways - Standard ETHERNET configuration – Industrial ETHERNET- Special requirement for networks used for Control - Networking of PLC- Introduction to SCADA.

Unit–IV : DCS

Methods of Computer Control of Processes, their configuration and comparison: direct digital control, supervisory digital control and Distributed Control System (DCS). DCS - Local Control Unit (LCU) and architecture - LCU languages - Process interfacing issues. Operator interface - Requirements - displays - alarms and alarm management. Engineering interface - requirements. Factors to be considered in selecting a DCS.

Unit–V : HART and Field bus

HART: Introduction - Evolution of Signal standard - HART Communication protocol - Communication modes – HART networks - Control System interface -

HART Commands – HART field Controller implementation - HART and the OSI model.

Field Bus: General Field bus architecture - basic requirements of field bus standard - Field bus topology - Interoperability – Interchangeability - CAN bus.

TEXT BOOKS

1. Behrouz A. Forouzan, Data communications and Networking, Tata Mcgraw Hill, 2004.
2. Michale P. Lucas, Distributed Control Systems,VanNostrand Reinhold Co., 1986.

REFERENCE BOOKS

1. William L. Schweber, Data Communications, McGraw-Hill, 1988.
2. A.S. Tanenbaum, Computer Networks, Second Edition, Prentice-Hall of India, 2004.
3. Romilly Bowden, HART Application Guide, HART Communication Foundation, 1999.
4. Paul Bates, Practical Digital and Communications, Prentice-Hall, 1987.
5. LawerenceM.Thompson, Industrial data Communications, ISA Press, 1997.

COURSE OUTCOMES

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

1. Understand the basic principle of communication and the modes of data transmission. (Unit I)
2. Understand the various types of bus devices used for data communication in industry.(Unit II)
3. Implement the automation concepts in a process industry. (Unit II)
4. Understand about profibus for data communication. (Unit III)
5. Use HART and FiledBus protocols for process industries. (Unit–IV and V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓									
CO2		✓				✓						
CO3				✓	✓						✓	
CO4			✓	✓								
CO5				✓				✓		✓		✓

EIPESCN	**VLSI SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To provide a survey of VLSI design, emphasize on Intellectual property (IP) based design, introduce basic concepts and tools for layout design.
- To learn the basic model, optimization, implementation, verification and testing methods for sequential machine design.

- To acquire the knowledge of floor plan design methodologies, chip-level layout and circuit design with area, delay and power optimization.
- To learn about register transfer design, architecture design for low power systems and IP components in architecture design.

Unit–I : Digital Systems and VLSI Design

Applications and advantages of VLSI systems- A survey of VLSI manufacturing and Design- CMOS technology-Integrated circuit design techniques-Intellectual property (IP) based design.

Unit–II : Layout Design and Logic Gates

Fabrication processes-Transistors- Wires and vias- Fabrication theory and practice- Layout design and tools. Combinational logic functions-static complementary gates-switch logic-Alternative Gate circuits-Low power gates- Delay through resistive interconnect- Delay through Inductive Interconnect- Gates as IP.

Unit–III : Combinational Logic Networks and Sequential Machines

Standard cell-based Layout - Combinational network delay - Logic and interconnect design - power optimization - switch logic networks. Latches and Flip-flops-sequential systems and clocking disciplines- Performance analysis - clock generation - Sequential system design- power optimization - design validation and sequential testing.

Unit–IV : Subsystem Design and Floor Planning

Introduction - Combinational Shifters - Adders - ALUs - Multipliers - High density memory - Image sensors - FPGAs - PLAs - Buses and networks On-chips - Data paths - Subsystems as IP. Introduction - Floor planning methods - Global interconnects - Floor Plan design - Off-chip connections.

Unit–V : Architecture Design

Register Transfer Design- Pipelining - High level synthesis- Architectures for low power design - GAL systems - Architecture testing - IP components - Design methodologies- Multiprocessor system-on-chip design.

TEXT BOOKS

1. Wayne Wolf, Modern VLSI Design, Fourth Edition, Prentice Hall India, 2010.
2. Douglas A.Pucknell and Kamran Eshraghian, Basic VLSI Design, Third Edition, Prentice Hall of India, 2011.

REFERENCES

1. Neil H. E. Weste and David Harris, Principles of CMOS VLSI Design, Fourth Edition, Addison Wesley, 2010.
2. Caver Mead and Lynn Conway, Introduction to VLSI Systems, BS Publications, 2008.
3. M. John and S. Smith, Application-Specific Integrated Circuits, Addison-Wesley, 1997.
4. Neil H. E. Weste, Kamran Eshraghian, and Micheal John Sebastian Smith, Principles of CMOS VLSI Design - A Systems Perspective, Addison Wesley, 2001.

COURSE OUTCOMES

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

1. Perform IP based design. (Unit I)
2. Handle technology dependent parameters in the fabrication process effectively. (Unit II)
3. Perform delay analysis and testability properties of combinational logic networks including both interconnect and gates.(Unit–III & Unit–IV)
4. Design an architecture that executes the desired function and that meets area, performance and testability constraints.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓										
CO2		✓	✓									✓
CO3		✓	✓	✓								
CO4			✓	✓					✓		✓	✓

EIPESCN	**MICROCONTROLLER BASED SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To study architecture of ARM processor.
- To introduce the concept assembly programming for ARM using THUMB instruction set.
- To understand the concept of interfacing of memory and peripherals to ARM PROCESSOR.
- To design operating system for ARM.

Unit–I : ARM Architecture

ARM architecture - RISC processor - ARM programming model - ARM development tools – Arm organization and implementation - 3 stage and 5 stage pipeline ARM organization – ARM instruction execution - ARM implementation – ARM co processor interface.

Unit–II : ARM Assembly Programming

ARM assembly programming - data processing and transfer instructions – control flow instructions – conditional execution –branch instructions - Co processor instructions – data operations – register transfer –break point instruction – memory faults –Arm architecture variants - writing simple assembly language programs .

Unit–III : THUMB Instruction Set

The THUMB Instruction set - Thumb programmer's model – Thumb branch instruction – Thumb software interrupt and data processing instructions – Thumb single and multiple register data transfer instructions – Thumb implementation – Thumb applications.

Unit IV System Development

Architectural support for system development – ARM memory interface – advanced microcontroller bus architecture - ARM reference peripheral specification – hardware system prototyping tools – ARMualtor – JTAG boundary scan test architecture – embedded trace – signal point support –ARM processor cores – ARM7TDMI – ARM 8.

Unit V Operating System

Architectural support for operating system – ARM system control coprocessor – CP15 protection unit registers – ARM protection unit – CP15 MMU registers – ARM MMU architecture - synchronization – context switching – Embedded ARM applications – VLSI ruby II advanced communication processor – VLSI ISDN subscriber processor.

TEXT BOOKS

1. Furber,S., ARM System on Chip Architecture Addison Wesley trade Computer Publication, 2000.

REFERENCES

2. David seal,ARM architecture reference model, Addison Wesley, 2003.
3. Andrew sloss,Dominicsymes and chris wright, ARM system developers guide Morgan Kaufmann.

COURSE OUTCOMES

1. Understand the basis of RSIC processor. (Unit I)
2. Programming the ARM processors.(Unit II)
3. Design of operating system for advanced microcontrollers.(Unit III)
4. By the end of this course, the students will be able to know about the functions and operations of the ARM processor (Unit IV)
5. Develop assembly code for various applications.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2	✓										✓	
CO3	✓		✓								✓	
CO4	✓			✓							✓	✓
CO5	✓			✓							✓	✓

EIPESCN	**EMBEDDED SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To study the basis of embedded system components
- To learn concept of embedded networking and various buses
- To study embedded programming using embedded C
- To study basis RTOs
- To design embedded system for real time applications

Unit–I : Introduction to Embedded Systems

Definition and Classification – Overview of Processors and hardware units in an emedded system – Embedded Systems on a Chip (SoC) –memory organization-structural units in a processor-processor selection for an embedded system-memory selection -interfacing processor ,memories and I/O devices-Development and debugging-Embedded network-Distributed embedded architectures – networks for embedded systems – I^2C bus – CAN bus.

Unit–II : PIC Microcontroller

Overview of PIC 18 family- PIC 18 architecture – Pin configuration – RSIC architecture - Instruction set – Addressing modes - I/O port programming – Timer – serial port – Interrupt programming.

Unit–III : Embedded Programming

Embedded programming – modular and C code construction – creating and accessing data in C – C programming structures – programming elements – queues – stacks - list and order lists - C Cross compilers – introduction RAID and KEIL – writing simple programs in embedded C.

Unit–IV : Real Time Operating System

Real Time operating system- operating system services – network operating system - multiple tasks and multiple processes – processes – context switching – scheduling polices – Interprocess communication mechanisms – evaluating operating system performance – power optimization strategies for process –use of Micro C/OS-II and Vx Works.

Unit–V : System Design Techniques

System design techniques – design methodologies – requirement analysis – specifications – quality assurance – design example – telephone PBX – Ink jet printer – set top boxes – smart card.

TEXT BOOKS

1. Rajkamal, Embedded Systems Architecture, Programming and Design, Tata McGraw Hill,2004.
2. Muhammad ali mazidi, Rolin Mckinlay and Danny Causey,PIC Microcontroller and Embedded system, Pearson eduction,2008.

REFERENCES

1. Steve Heath, Embedded Systems Design, Newnes.
2. David E. Simon, An Embedded Software Primer, Pearson Education.
3. Wayne Wolf, Computers as Components: Principles of Embedded Computing System Design, Harcourt India, Morgan Kaufman Publishers
4. Todd D.Morton,' Embedded microcontroller' pearson education - 2003
5. Frank Vahid and Tony Givargis,Embedded Systems Design- A Unified Hardware/ Software Introduction, John Wiley & Sons.

COURSE OUTCOMES

1. Understand the basis of embedded system and embedded networking.(Unit I)
2. Learn the architecture and programming of PIC18.(Unit II)
3. Design of embedded networking.(Unit III)

4. Design of embedded system using Embedded C and RTOS.(Unit–IV)
5. By the end of this course, the students will be able to formulate design and analyze any embedded system for real time applications. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2	✓											
CO3	✓		✓								✓	
CO4	✓		✓	✓							✓	
CO5	✓			✓				✓				✓

EIPESCN	**POWER ELECTRONICS DRIVES AND CONTROL**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To learn about semi-conductor power devices.
- To acquire knowledge about the power converters for various loads.
- To implement the power converters for the drives by efficient control algorithms.
- To understand the need for the series & parallel connections and protection circuits.
- To study about the generation of control pulses for power electronic converters and their applications.

Unit–I : Semiconductor Power Devices

SCR characteristics - Two transistor analogy - Methods of turning on and turning off - Other members of SCR family - Series and parallel connection of SCRs - Thyristor protection. Other semiconductor devices: Power transistors, Power MOSFETs, GTOs, IGBT. Generation of control pulses for power electronic converters.

Unit–II : Phase Controlled Rectifiers

Single phase controlled rectifiers - Half wave controlled rectifier with i) R load ii) R,L load iii) R,L load and free wheel diode iv) R,L load and battery - Full wave controlled rectifier- half controlled bridge rectifier and fully controlled bridge rectifier with the above four types of loads. Three phase controlled rectifiers: Half controlled bridge - Fully controlled bridge.

Unit–III : Single Phase Inverter

Series , Parallel & Bridge inverters - Current source inverter.

DC choppers

Various types - Step-up, step down & step up/down chopper, chopper configuration – AC Chopper. AC voltage controller. Single phase Cycloconverter.

Unit–IV : DC Motor Control

Schemes for DC motor speed control, Single phase and three phase SCR drives - reversible SCR drives - chopper controlled DC drives. Closed loop control of DC drives.

Unit–V : AC Motor Control

Speed control methods for induction motor - controlled slip system - slip power recovery scheme - braking of induction motor. Synchronous motor control.

TEXT BOOKS

1. M.D. Singh, K.B. Khanchandani, Power Electronics, Tata McGraw Hill, 2003.
2. Vedam Subrahmanyam, "Electric Drives-Concept & Applications", Second edition, TataMcGraw Hill, 2011.

REFERENCES

1. M.H. Rashid, Power Electronics, Prentice-Hall, 1988.
2. C.N.Pauddar, Semi conductor Power Electronics (Devices and circuits), Jain Brothers, New Delhi, 1999.
3. S.N. Singh, Text Book of Power Electronics, DhanpathRai & Co., New Delhi, 2000.
4. P.S. Bhimbhra, Power Electronics, Khanna Publishers, Third Edition, New Delhi, 2005.
5. M. Ramamoorthy, An Introduction to Thyristors and their Applications, East West Press,1991.

COURSE OUTCOMES

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

1. Understand the characteristics & applications of power semi-conductor devices. (Unit I)
2. Understand the AC to DC, DC to AC, and DC to DC converters. (Unit II)
3. To design a firing circuit that solves the specific control problem. (Unit III)
4. Understand the issues related implementation of drives & control. (Unit–IV and V)
5. Understand the recent trends in power converter technology. (Unit–I to V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓										
CO2		✓										
CO3		✓	✓								✓	
CO4				✓	✓					✓		✓
CO5				✓		✓		✓		✓		

EIPESCN	SOFT COMPUTING TECHNIQUES FOR PROCESS CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To expose the students to the concepts of Neural Networks, Fuzzy Logic andGenetic Algorithm.
- To provide adequate knowledge of application of neural network and Fuzzy logic controllers to real time systems.
- To expose the ideas of GA in optimization and control.

Unit–I

Motivation for the development of neural networks - Biological neural networks- Artificial neural networks - Application areas- Common activation functions-Biases and thresholds- Linear seperability- Data representation- Types of learning-Basic Learning laws: Hebb's rule - Delta rule -Widrow and Hoff LMS learning rule.

Unit–II

Architecture, Algorithm, Applications: McCulloch-Pitts Neuron-Hebb Net-Perceptron-Hopfield Neural net -Standard Back Propagation Neural Net.

Unit–III

Neural Networks based on Competition: Fixed-weight competitive nets - Kohonen self-organizing Maps - Adaptive Resonance Theory. Neural Network for Control: Neuro controller - Functional block diagram - Inverse dynamics – System identification. Case studies: Neuro controller for DC motor speed control - Neuro controller for a Temperature Process.

Unit–IV

Introduction to Fuzzy Logic: Fuzzy sets- Properties of Fuzzy sets- Operations on Fuzzy sets-Fuzzy relations: Operations- Properties. Fuzzy Cardinality- Fuzzy tolerance and Equivalence relations- λ - cuts for fuzzy relations-Fuzzification - Membership functions- Membership value assignments- Linguistic variables - Linguistic approximation-Fuzzy statements: Assignment statements - conditional statements- unconditional statements. Fuzzy rule base: Canonical rule formation-decomposition of compound rules. Defuzzification methods.

Unit–V

Fuzzy logic Control system- Fuzzy logic Controller for a temperature process-Introduction to neuro-fuzzy and fuzzy-neuro control systems-Introduction to GA.

TEXT BOOKS

1. LaureneFausett, Fundamentals of Neural Networks, Pearson Education Pvt.Ltd, India, 2013.
2. Timothy J. Ross, Fuzzy Logic with Engineering Applications, Third Edition, John Wiley & Sons Ltd., India, 2014.

REFERENCES

1. Yegna Narayanan, Artificial Neural Networks, Eight Edition, PHI Learning Pvt. Ltd. New Delhi, 2003.

2. Simon Haykin Neural Networks, Fifth Edition, Pearson Education. Pvt. Ltd, 2005.
3. Sudarshan K. Valluru and T. NageswaraRao, Introduction to Neural Networks,Fuzzy Logic and Genetic algorithms, Jaico Publishing Home, 2010.
4. David.E.Goldberg, Genetic Algorithm in Search, Optimization and Machine learning, Fourth Edition, Pearson Education Pvt. Ltd., India, 2009.
5. ChanderMohan, An introduction to Fuzzy set theory and Fuzzy Logic, MV Learning, 2015.

COURSE OUTCOMES

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

1. Understand the basics of neural networks.(Unit I)
2. Derive the different algorithms. (Unit II)
3. Understand the concept of neuro controller. (Unit III)
4. Understand the basics of fuzzy logic controller (Unit–IV)
5. Understand the concept of fuzzy control. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2		✓		✓							✓	
CO3		✓		✓	✓			✓	✓			
CO4	✓	✓		✓				✓				
CO5		✓		✓	✓			✓	✓			

EIPESCN	**NON LINEAR CONTROL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To give exposure to nonlinear control and to discuss about the stability and applications of non linear systems.
- To acquire knowledge in the basics of nonlinear control.
- To understand the describing function analysis and stability analysis.
- To understand the need for sliding mode control.

Unit–I : Non Linear Systems

Non-linear Systems - Behavior of non-linear systems, jump resonance, subharmonic oscillation- Phase plane analysis: Singular points - construction of phase portraits using isoclines and delta method - limit cycles-existence of limit cycles.

Unit–II : Describing Function Analysis

Describing Function Analysis: Describing Function Fundamentals-Applications of Describing Functions-Basic Assumptions and definitions-Computing Describing Functions. Common nonlinearities in control systems-Describing Functions for common nonlinearities. Describing Function Analysis of Non-linear Systems-examples.

Unit–III : Stability Analysis

Stability analysis: Stability in the sense of Lyapunov's - second method of Lyapunov's - Lyapunov's stability analysis of linear time invariant systems and nonlinear system- Krasovskii's theorem- variable gradient method of generating Lyapunov's functions.

Unit–IV : Modelling and Control of Non-Linear Systems

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification –Real-time parameter estimation for nonlinear systems – Nonlinear PID controller - Gain scheduling control – case studies.

Feedback Linearization-Input-state and Input-output linearization using Lie derivative and lie brackets.

Unit–V : Sliding Control

Sliding Control: Sliding Surfaces- sliding condition-Filippov's construction of the equivalent dynamics –examples. Direct implementation of Switching control laws-Switching control in place of PWM and Dither signals. Continuous Approximations of switching control laws.

TEXT BOOKS

1. I.J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New AgeInternational (P) Ltd., Publishers, 2005.
2. Gibson, J.E, Nonlinear Automatic Control, McGraw Hill Book Co, 1963.

REFERENCES

1. Hassan K Khalil, Nonlinear Systems, Prentice Hall, 2002, Third Edition, 2002.
2. HenkNimeijer, Nonlinear Dynamical Control Systems, Springer Verlag,NewYork, 1990.
3. Alberto Isidori, Nonlinear Control Systems (3rd edition), Springer Verlag, 1995.
4. Jean-Jacques Slotine and Weiping Li, Applied Nonlinear Control, Prentice Hall, New jersey, 1991.
5. K.M.Hangos,J.Bokor and G.Szederkrnyi, Analysis and control of Nonlinear Process systems, Springer

COURSE OUTCOMES

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

1. Understand the basics of nonlinear systems.(Unit I)
2. Derive the describing function. (Unit II)
3. Understand the stability analysis of nonlinear systems. (Unit III)
4. Implement modelling of nonlinear systems and feedback linearization design. (Unit–IV)
5. Understand the recent trends in sliding mode control. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓							
CO2		✓									✓	
CO3		✓		✓				✓	✓			
CO4		✓		✓				✓	✓			✓
CO5	✓				✓			✓	✓	✓		

EIPESCN	OPTIMAL CONTROL	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To study about the statement of optimal control problem, formulation of optimal control problem and selection of performance measure.
- To introduce students to the fundamental concepts of calculus of variation.
- To understand the concepts of variational approach to optimal control problems.
- To derive the expression for continuous and discrete linear optimal regulator problem.
- To study about the concepts of dynamic programming and its application.

Unit–I : Optimal Control Problems and Performance Measures

Statement of optimal control problem - problem formulation and forms of optimal control - selection of performance measures.

Unit–II : Calculus of Variation

Fundamental concepts – extremum functionals involving single and several independent functions - piecewise smooth extremals - constrained extrema.

Unit–III : Variational Approach to Optimal Problems

Necessary conditions for optimal control - Pontriyagin's minimum principle - state inequality constraints - minimum time problem - minimum control effort problems.

Unit–IV : LQ Control Problem

Linear optimal regulator problem - Matrix Riccati equation and solution method - choice of weighting matrices - steady state properties of optimal regulators - linear tracking problem.

Unit–V : Dynamic Programming

Principle of optimality - recurrence relation of dynamic programming for optimal control problem - computational procedure for solving optimal control problems - characteristics of dynamic programming solution - dynamic programming application to discrete and continuous systems - Hamilton Jacobi Bellman equation.

TEXT BOOKS

1. D.E.Kirk, Optimal Control Theory-An Introduction, Dover Publications, New York, 2012.
2. Michael Athans and Peter L. Falb, Optimal Control: An Introduction to the Theory and Its Applications, Dover Publications, New York, 2007.

REFERENCES

1. Katruhiko Ogata, Modern Control Engineering, Prentice Hall of India Ltd, Fifth Edition, 2010.
2. M.Gopal, Modern Control Systems Theory, Third Edition, New Age International Publishers, 2015.

COURSE OUTCOMES

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

1. Ability to understand the optimal control problem formulation and its selection of performance measures.(Unit I)
2. Ability to recognize and recall the fundamentals of calculus of variation.(Unit II)
3. Ability to implement optimal control concept for minimum time and minimum control effort problems. (Unit III)
4. Ability to apply Matrix Ricatti Equation for real world problem. (Unit–IV)
5. Ability to understand the concepts of dynamic programming. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓									
CO2	✓	✓	✓									
CO3	✓	✓	✓									
CO4	✓	✓	✓		✓							✓
CO5	✓	✓	✓		✓						✓	✓

EIPESCN	**MODEL PREDICTIVE CONTROL**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To understand the fundamentals of model predictive control.
- To study the methods of predictive control.
- To analyse the implementation issues of MPC.
- To design and implement MPC algorithm for the given process.

Unit–I : Model Predictive Control

Introduction to Model Predictive Control strategy – Model predictive control elements – Prediction model, process model – Objective function – Control law – State space formulation.

Unit–II : Model Predictive Control Schemes

Dynamic matrix control – Model algorithmic control - Predictive functional control -Formulation of generalized model predictive control – Closed loops relationships.

Unit–III : Constrained model predictive control scheme

Constraints Handling: Amplitude Constraints and Rate Constraints – Constraints and Optimization – Constrained Model Predictive Control Scheme – Case Studies.

Unit–IV : Methods for implementing Model Predictive Control

Model predictive control and multi-parametric programming - Implementation of model predictive control for uncertain systems - Implementing Nonlinear Model Predictive Control Scheme-Closed loop min-max model predictive control implementation and dead time consideration.

Unit–V : Case studies

Self tuning GPC strategy and gain scheduling GPC for solar power plant – Design of MPC for a petrochemical industries.

TEXT BOOKS

1. E.F.Camacho and C.Bordons, Model Predictive Control, Springer, Second corrected Edition 2007.
2. B.W. Bequette, Process Control: Modeling, Design and Simulation, Prentice Hall, 2003.

REFERENCES

1. Seborg Edgar, Mellichamp.Doyle, Process Dynamics and Control John Wiley & Sons Pvt. Ltd., Third Edition 2013.
2. Carlos E.Garcia et.al, Model Predictive Control: Theory and Practice A Survey, Automatica, vol. 25, issue 3, pp. 335-348, May 1989.

COURSE OUTCOMES

After completion of this paper the student will understand

1. The basics of MPC including tuning parameters such as prediction horizon, control horizon and control weight. (Unit I)
2. The basics of Dynamic matrix control and model algorithmic control.(Unit II)
3. Effect of tuning parameters on control performance, stability and ability to handle constraints. (Unit III)
4. Development of various methods of MPC algorithm. (Unit–IV)
5. Implementation issues and applications of MPC in industry.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓		✓								
CO2	✓	✓		✓							✓	
CO3	✓	✓		✓								
CO4	✓		✓	✓							✓	✓
CO5			✓	✓	✓	✓		✓				✓

EIPESCN	**FAULT DETECTION AND DIAGNOSIS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To understand different faults that occurs in sensors and actuators.

- To identify kind, size and magnitude of the fault by model based and model free methods.
- To understand the structured residuals and directional structured residuals.
- To understand the methods to estimates the faults.

Unit–I : Introduction to Fault Detection and Diagnosis (FDD)

Scope of FDD: Types of faults and different tasks of Fault Diagnosis and Implementation - Different approaches to FDD: Model free and Model based approaches. Classification of Fault and Disturbances - Different issues involved in FDD Typical applications.

Unit–II : Analytical Redundancy Concepts

Introduction- Mathematical representation of Faults and Disturbances: Additive and Multiplicative types – Residual Generation: Detection, Isolation, Computational and stability properties – Design of Residual generator – Residual specification and Implementation.

Unit–III : Design of Structured Residuals

Introduction- Residual structure of single fault Isolation: Structural and Canonical structures- Residual structure of multiple fault Isolation: Diagonal and Full Row canonical concepts – Introduction to parity equation implementation and alternative representation.

Unit–IV : Design of Directional Structured Residuals

Introduction – Directional Specifications: Directional specification with and without disturbances – Parity Equation Implementation- Introduction of Residual generation of parametric fault – Robustness Issues- Statistical Testing of Residual generators

Unit–V : Data Driven Methods

Principal Component Analysis – Partial Least Squares - Canonical Variate Analysis – Knowledge Based Methods.

TEXT BOOKS

1. Janos J. Gertler, Fault Detection and Diagnosis in Engineering systems, Second Edition, Marcel Dekker, 1998.
2. R. Isermann, Fault-Diagnosis Systems An Introduction from Fault Detection to Fault Tolerance, Springer Verlag, 2006.

REFERENCES

1. L.H. Chiang, E.L. Russell and R.D. Braatz, Fault Detection and Diagnosis in Industrial Systems – Springer-Verlag-London, 2001.
2. Rami S. Mangoubi, Robust Estimation and Failure detection, Springer-Verlag, London 1998.

COURSE OUTCOMES

1. Ability to understand different approaches to Fault Detection and Diagnosis. (Unit I)
2. Ability to estimate the kind, size, type and time of occurrence of faults by analytical methods.(Unit II)

3. Ability to design and detect single and multiple faults using structured residual approach. (Unit III)
4. Ability to design and detect single and multiple faults using directional structured residual approach. (Unit–IV)
5. Ability to Understand the data driven methods like principle, partial least square methods etc., (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2		✓	✓	✓								✓
CO3			✓	✓							✓	
CO4			✓	✓							✓	
CO5				✓							✓	✓

OE - OPEN ELECTIVES

EIOESCN	**TRANSDUCER ENGINEERING**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers
- To introduce advances in sensor technology

Unit I

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

Unit II

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement.

Unit III

Self and mutual inductive transducers- capacitive transducers, eddy current transducers, proximity sensors, tacho generators and stroboscope.

Unit IV

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers, Basics of Gyroscope.

Unit V

Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

TEXT BOOKS

1. John P. Bentley, Principles of Measurement Systems, Pearson Education, 4th Edition, 2005.
2. Doebelin E.0, Measurement Systems - Application and Design, McGraw-Hill, 4th Edition, 2004.

REFERENCES

1. Murthy D. V. S, Transducers and Instrumentation, Prentice Hall, 2nd Edition, 2011.
2. James W.Dally, Instrumentation for Engineering Measurements, Wiley, 2nd Edition, 1993.
3. John G.Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition, 2008.
4. S.M. Sze, Semiconductor sensors, John Wiley & Sons Inc., 1994.

COURSE OUTCOMES

At the end of this course, students be able to

1. Familiar with the basics of measurement system and its input, output configuration of measurement system (Unit-I).
2. Familiar with both static and dynamic characteristics of measurement system (Unit-II)..
3. Familiar with the principle and working of various sensors and transducers. (Unit-III).
4. Able to design signal conditioning circuit for various transducers (Unit-IV).
5. Able to identify or choose a transducer for a specific measurement application (Unit-V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓		✓	✓				✓			
CO2	✓	✓		✓	✓							
CO3	✓	✓	✓						✓			
CO4		✓	✓		✓				✓		✓	
CO5	✓		✓						✓			✓

EIOESCN	**TEST AND MEASURING INSTRUMENTS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- The course is designed is make the students familiar with test and measuring instruments commonly used.

Unit–I

Electrical measurements: General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron instruments. Extension of instrument range: shunt and multipliers, CT and PT.

Unit–II

Measurement of Power: Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.

Unit–III

Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

Unit–IV

Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram Study of digital voltmeter, Digital multimeter, Digital LCR meter, Q-Meter, Digital wattmeter and energy meters.

Unit–V

CRO, DSO, Function generator, Audio frequency signal generation, Waveform analyzers, Spectrum analyzers.

TEXT BOOKS

1. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press, 3rd Edition, 2013.
2. Shawney A K, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons. 19th revised edition, 2013.

REFERENCES

1. Cooper, W.D. and Helfric , A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1st Edition, 2009.
2. Kalsi.H.S, Electronic Instrumentation, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2012.
3. Golding, E.W. and Widdis, F.C., Electrical Measurements and Measuring Instruments, A.H.Wheeler and Co, 5th Edition, 2011.

COURSE OUTCOMES

At the end of the course the student will be

1. Familiar with various measuring instruments (ammeters, voltmeters, wattmeters, energy meters extension of meters, current and voltage transformers) used to detect electrical quantities. (Unit I & II)
2. Able to design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement. (Unit-III)
3. Able to understand the analog and digital measurements (Unit-IV).
4. Familiar with the operation and usage of various analyzing instruments. (Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓				✓			
CO2	✓	✓	✓								✓	
CO3	✓	✓							✓			
CO4	✓		✓		✓				✓			✓

EIOESCN	MEASUREMENTS IN PROCESS INDUSTRIES	L	T	P	C
		3	-	-	3

COURSE OBJECTIVE

- To expose the students to various measurement techniques used for the measurement of temperature, flow, pressure and level in process industries.

Unit–I

Temperature measurement: Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and its measuring circuits, Radiation pyrometers and thermal imaging.

Unit–II

Pressure measurement: Introduction, definition and units, Mechanical, Electro-mechanical pressure measuring instruments. Low pressure measurement, Transmitter definition types, I/P and P/I Converters.

Unit–III

Level measurement: Introduction, Mechanical and electrical methods of level measurement.

Unit–IV

Flow measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters, Hot wire anemometer and ultrasonic flow meters.

Unit–V

Calibration and selection of Flow meters

TEXT BOOKS

1. Doebelin E.O., Measurement Systems - Application and Design, Tata McGraw Hill publishing company, 5th Edition, 2008.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.

REFERENCES

1. B.E.Noltingk, Instrumentation Reference Book, 2ndEdition, Butterworth Heinemann, 1995.
2. B.G.Liptak, Process Measurement and Analysis, 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
3. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, 5th Edition, McGraw Hill, Singapore, 1999.
4. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001.
5. Spitzer D. W., Industrial Flow measurement, ISA press, 3rd Edition, 2005

COURSE OUTCOMES

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

1. Familiar with the different temperature measurement techniques used in process industries. (Unit-I)

2. Able to understand the working principle of different pressure transmitters and level sensors used in industries. . (Unit-II)
3. Able to identify or choose temperature, flow, pressure and level measuring device for specific process measurement. (Unit-III & IV)
4. Familiar with various flow instrumentation used in industrial flow measurement.(Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓			✓					✓			
CO2	✓			✓	✓							
CO3	✓	✓	✓	✓	✓				✓			✓
CO4			✓	✓								✓

EIOESCN	**INDUSTRIAL AUTOMATION AND CONTROL**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.

Unit–I

Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

Unit–II

Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction- Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

Unit–III

Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

Unit–IV

Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements .

Unit–V

Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Fieldbus and Profi bus – Application and case studies of large scale process control using DCS.

TEXT BOOKS

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 5th Edition, Prentice Hall Inc., New Jersey, 2002.
2. Frank D. Petruzella, Programmable Logic Controllers, 4th Edition, McGraw Hill, New York, 2010.

REFERENCES

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Prentice Hall, New Delhi, 2005.
3. Krishna Kant, Computer-based Industrial Control, 2nd edition, Prentice Hall, New Delhi, 2011.
4. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

COURSE OUTCOMES

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

1. Design and development of PLC ladder programming for simple process applications. (Unit I & II)
2. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system. (Unit III)
3. Understand the popular process automation technologies(Unit IV)
4. Know the latest communication technologies like HART and Field bus protocol (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓				✓			
CO2	✓	✓		✓							✓	
CO3	✓	✓			✓							✓
CO4	✓	✓		✓	✓				✓			

EIOESCN	**NANO MATERIALS AND NANO ELECTRONICS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students about the basics of Nanotechnology and its applications.
- To provide adequate knowledge on Nanomaterial properties, Quantum Mechanics and Nano electronics.
- To expose the knowledge on Nano electronics devices and its applications.

Unit–I

Introduction to nanomaterials - Preparation/Synthesis: History of nanomaterials - Influence on properties by "nano - structure induced effects" - Some present and future applications of Nanomaterials, Approaches for synthesis of nanostructures - Processes for producing ultrafine powders - Chemical Synthesis - Physical Synthesis – Bio mimetic processes.

Unit–II

Characterization and Properties of Nanomaterials: Structural Characterization - X-ray diffraction, Scanning electron microscopy, Transmission electron microscopy, Scanning probe microscopy - Mechanical - Introduction - Property changes due to nanostructuring - Strengthening and Toughening Mechanisms – Chemical – Sensors – catalysis – Magnetic- Magnetic Properties of small atomic clusters – Why interest in nano-scale magnetic materials- Classifications of magnetic nanomaterial – Optical-Absorption of light in semiconductor materials - Optical properties of a translucid object.

Unit III

Quantum Mechanics: Schrodinger – Time Dependent / Independent Equation-Electron to Electron Interactions-Differential to Matrix Equation-Choosing Matrix Parameters-Non-Equilibrium Green's Functions (NEGF)-Conductance Functions for Coherent Transport-Elastic Dephasing-Quantum of Conductance-2D Conductor as ID Conductors in Parallel.

Unit–IV

Fundamentals of Nano Electronics: The New Ohm's Law-The Bottom-Up Approach-Electrons Flow-Ballistic and Diffusive Transport-Diffusion Equation for Ballistic Transport-Conductivity, Drift-electrostatics- smart contacts. Nano transistors-current equation, physics of Ballistic MOSFET – characteristics.

Unit–V

Carbon Nanotubes :Graphene band structure, properties. Synthesis of Carbon Nanotubes – The Structure of Carbon Nanotubes, Carrier Concentration – Electronic properties of Nanotubes – Electron Transport in ballistic conductor – Carbon Nanotube Electronics: Theory of CNT P-N junction - Carbon Nanotube Transistors – density of states - Schottky Barrier – Ohmic Contacts– Schottky Contacts –Subthreshold Short- Channel Effects.

TEXT BOOKS

1. Nanostructures &Nanomaterial: Synthesis, Properties and Applications, Guozhong Cao, Imperial College Press - World Scientific Publishing Co. Ltd, London - 2004.
2. Lessons from Nano electronics. A New Perspective on Transport-
3. SupriyoDatta, Purdue University, USA, 2012.

REFERENCES

1. Janos H. Fendler, Nanoparticles and Nanostructured films: Preparation, Characterization and Applications, ISBN: 3527294430, Wiley VCH, 1998.
2. Kenneth J. Klabunde, Nanoscale materials in chemistry, ISBN: 0471383953,

John Wiley &Sons, 2001.
3. Zhon Ling Wang, Characterization of Nano phase materials, ISBN: 3527298371, Wiley-VCH Verlag GmbH, 2000.
4. The physics of Carbon Nanotube Devices, ISBN: 978-0-8155-1573-9 François Léonard, 2009 by William Andrew.

COURSE OUTCOMES

1. Will get to know the future of electronics and its applications. (Unit I, II & IV)
2. Updates the students with the recent advancements in the nanotechnology. (Unit I, II & IV)
3. To introduce the students the concepts of quantum mechanics for analysis of nanoelectronic devices. (Unit III)
4. To understand Nano-material (Unit V)

Mapping of Cos with Pos												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											✓
CO2		✓										✓
CO3			✓									
CO4		✓								✓		

EIOESCN	**MICRO ELECTRO MECHANICAL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students to the fundamentals Micro electromechanical systems.
- To teach the fundamental concepts MEMS Fabrication process.
- To study the design concepts of MEMS devices.
- To compare types and Functionalities of various methods of micromachining.

Unit–I : Miniaturization of Systems

Need for miniaturization, Microsystems versus MEMS, Need for micro fabrication, smart materials, Structure and Systems, Application of smart material and Micro system. Scaling in mechanical domain, Scaling in Electrostatic domain, Scaling in thermal domain.

Unit–II : Micromachining Technology

Silicon as a material for micromachining-Crystal Structure , Silicon Wafer Preparation- Thin Film Deposition –Evaporation, Sputtering, CVD, Epitaxial Growth, Thermal Oxidation-Lithography – Photolithography , Lift-Off Techniques-Etching – Isotropic Etching, Anisotropic Etching, Etch Stops, Dry Etching - Silicon Micromachining – Bulk , Surface Micromachining – Specialized Materials for Microsystems-Polymers, Ceramic Materials- Advanced Process Of Micro fabrication-Wafer Bonding Techniques, Special Micro fabrication Techniques.

Unit–III : Silicon Capacitive Accelerometer

Overview, advantages of silicon capacitive accelerometer , typical applications, an example of a prototype, material used, fabrication process, principle of operation.

Piezoresistive pressure sensor**:** overview, advantages of piezoresistive pressure sensor, typical applications, material used, fabrication process, principle of operation, An example commercial Products.

Unit–IV : Modelling of Solids in Microsystems

The simplest Deformable Element: a bar- Transversely deformable Element: a beam- energy methods for elastic bodies- Bimorph effects.

Unit–V : MEMS Actuators and their Applications

Actuation mechanisms – Electrostatic actuation – Electrostatic cantilever actuators – Electrostatic comb drives – Feedback stabilization of electrostatic actuators - lectrostatic micro grippers – Electrostatic relays and switches - Thermal actuation – Thermal expansion of solids – Thermal array actuators –Piezoelectric actuation.

TEXT BOOKS

1. G.K.Ananthasuresh, K.J.Vinoy,S.Gopalakrishnan, K.N.Bhat,V.K.Aatre, Micro and smart systems.
2. Tai-Ran-Hsu, MEMS & Microsystems Design and Manufacture, Tata McGrawHill, New Delhi, 2002.

REFERENCES

1. Stephen D. Senturia, Microsystem Design, Springer International Edition, 2001.
2. Chang Liu, Foundations of MEMS, (ILLINOIS ECE Series), Pearson Education International,2006.
3. S.M. Sze, Semiconductor Sensors, John Wiley and Sons, 1994.
4. Gregory T.A. Kovacs, Micro machined Transducers, WCB McGraw Hill, 1998.

COURSE OUTCOMES

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

1. The fundamentals of Micro electromechanical systems and their applications will be studied. (Unit I)
2. The fundamental concepts of MEMS Fabrication process will be gained. (Unit II)
3. The design concepts of MEMS devices will be developed. (Unit II, III & IV)
4. The Functionalities of various methods of micromachining involved in different MEMS devices will be studied. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1			✓									
CO2					✓							
CO3					✓							
CO4			✓									

EIOESCN	INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES	L	T	P	C
		3	-	-	3

Course Objectives

- To understand the operations of petrochemical industries.
- To be familiar with the control loops in petrochemical industries .

Unit-I : Oil extraction and processing

Techniques used for oil discovery - seismic survey - methods of oil extraction - oil rig system - Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator - scrubber – coalescer

Unit-II : Petroleum refining

Petroleum refining process - unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum

Unit-III : Chemicals from petroleum

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC

Unit-IV : Control loops in petrochemical industry

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

Unit-V : Safety in instrumentation systems

Area and material classification as per National Electric Code (NEC) - Classification as per International Electrotechnical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Type X, Type Y and Type Z - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit

TEXT BOOKS

1. Balchen J.G and Mumme K.I., Process Control Structures and Applications, Von Nostrand Reinhold Company, New York, 1988.
2. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005

REFERENCES

1. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd., 1968.
2. Ram Prasad, Petroleum Refining Technology, Khanna Publishers, New Delhi, 2000.
3. www.scribd.com/doc/2336259/ABB-Oil-Gas-production-Hand-Book

Course OUtComeS

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

1. Understand the principle and working of Oil Industries.(Unit I)
2. Understand the refining process in Oil Industries (Unit II)
3. To know the petroleum by-products.(Unit III)
4. Analyse the control loops in petrochemical industries.(Unit IV)

5. To know the safety in instrumentation systems.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓					✓	✓			
CO2	✓				✓					✓		
CO3	✓	✓		✓	✓		✓				✓	
CO4	✓			✓	✓		✓	✓	✓			
CO5	✓		✓	✓				✓	✓			✓

HONOUR ELECTIVES

EIHESCN	**ADVANCED TOPICS IN PID CONTROL**	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**

COURSE OBJECTIVES

- To provide knowledge about the advances in PID controller and adaptive PID control.
- To acquire knowledge in the basics of PID controller and Anti-windup strategies.
- To study about PID controller design and robust performance.
- To understand the need for Adaptive PID control.

Unit–I : Basics of PID Control

Introduction-feedback control-On-Off control-Three actions of PID control-Proportional, Integral and Derivative actions-Structure of PID controllers-Modifications of the basic PID control law-Problems with derivative action-set point weighting-General ISA-PID control law-Digital implementation-Choice of the controller type. Derivative filter design: Introduction-The significance of the filter in PID design-Ideal Vs series form-Simulation using Matlab.

Unit–II : Anti-Windup Strategies and Setpoint Weighting

Introduction-Integrator windup-Anti-windup techniques-Avoiding saturation-conditional Integration-Back-calculation-combined approaches-Automatic reset implementation- Simulation using Matlab.

Set point Weighting: Introduction-Constant set point weight design-Variable set point weighting: Methodology- Simulation using Matlab.

Unit–III : PID Controller Design

ZN and related methods- rule based empirical tuning- pole placement- lambda tuning- algebraic design- optimization methods- robust loop shaping and frequency response methods- IMC based PID tuning- Design for disturbance rejection.

Unit–IV : Robust Performance and Performance Assessment

Modeling uncertainty-performance in the presence of uncertainty-robust pole placement design for robust performance- PID controller performance assessment.

Unit–V : Adaptive PID Control

Auto tuning- Adaptive Technique-model based methods-rule based methods-Multi model based PID Controller design- nonlinear PID Controller design.

TEXT BOOKS

1. Antonio Visioli, Practical PID Control, Springer, 2006.
2. Karl J. Astrom and Tore Hagguland, Advanced PID Control, ISA Publications,2005.

REFERENCE BOOKS

1. G.J. Silva, Aniruddhadatta, SP.Bhattacharyya, PID control for time delay systems, Springer, 2005.
2. Q.G. Wang, Z. Ye, W.J. Cai, C.C. Hang, PID control for Multivariable Process, Springer, 2008.
3. Karl J. Astrom and Tore Hagguland, PID Controllers: Theory, Design and Tuning, Second edition, ISA Publications, 1995.

COURSE OUTCOMES

At the end of the course the students will be able to:

1. Understand the basics of PID control.(Unit I)
2. Implement Anti-windup strategies.(Unit II)
3. Design a PID controller.(Unit III)
4. Understand the robust performance.(Unit–IV)
5. Understand the need for Adaptive PID control. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓		✓								✓
CO2		✓	✓	✓								
CO3		✓	✓	✓	✓						✓	
CO4		✓	✓	✓								
CO5		✓	✓	✓								✓

EIHESCN	**INDUSTRIAL SAFETY**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To provide the concept of Industrial Safety & provide knowledge for workplace safety
- To acquire knowledge in identification, evaluation and control of all the hazards
- To prevent harm or damage to people, property, or the environment.

Unit-I: Industrial safety

Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of

factories act 1948 for health and safety, wash rooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc, Safety color codes. Fire prevention and firefighting, equipment and methods.

Unit-II: Fundamentals of maintenance engineering

Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relation with replacement economy, Service life of equipment.

Unit-III: Wear and Corrosion and their prevention

Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

Unit-IV: Fault tracing

Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi.Electrical motors, Types of faults in machine tools and their general causes.

Unit-V: Periodic and preventive maintenance

Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance

TEXT BOOKS

1. Higgins & Morrow , Maintenance Engineering Handbook, Da Information Services, 1994.
2. H. P. Garg, Maintenance Engineering, S. Chand & Company Ltd, 2012

REFERENCES

1. Frank D Graham, Audels Pumps-Hydraulic Air Compressors, Mcgraw Hill Publication, 1949.
2. Fang, Hsai-Yang, Foundation Engineering Handbook, Chapman & Hall, London

COURSE OUTCOMES

At the end of the course the students will be able to:

1. Identify hazard and potential hazard areas Unit I)
2. Develop safety programs to prevent or mitigate damage or losses (Unit II)
3. Assess safety practices and programs.(Unit III)
4. Conduct safety audits.(Unit–IV)

5. Improve safety practices. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓		✓	✓				✓	✓		✓
CO2				✓								
CO3				✓	✓				✓	✓		✓
CO4					✓							✓
CO5				✓	✓				✓			✓

EIHESCN	**ROBOTICS AND AUTOMATION**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To understand the basic anatomy of robots and trajectory planning list of objectives about the course
- To enable students to understand about the work envelopes of robots and its role in automation
- To give an overview of the various methods of control of robots
- To select robots based on their applications and their related issues in industrial automation

Unit–I : Fundamentals of Robots

Definition –Historical background- Robot Anatomy : Polar, Cylindrical, Cartesian coordinate, Joint-arm configuration–Work volume– Robot Drive System : Hydraulic, Electric, Pneumatic – Control System: Limited sequence, Play back with point to point and Continuous path control Intelligent Robots- Dynamic performance: Speed of response and Stability - Precision of movement: Spatial Resolution, Accuracy, Repeatability and Compliance – Introduction to End effectors, Robotic Sensors, Robot Programming and work cell control.

Unit–II : Robot End Effectors, Sensors

End Effectors: Types-Mechanical grippers-Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops- Tools as end effectors - Robot/ End-effectors interface- Consideration in Gripper selection and Design.

Sensors: Transducers and Sensors – Sensors in Robotics: Tactile, Proximity and Range Sensors, Miscellaneous sensors and sensor based systems- Machine Vision System.

Unit–III : Programming and Control of Robots

Robot Programming: Methods of Programming-: Leadthrough Methods, Robot program as a path in space- Motion interpolation, WAIT, SIGNAL and DELAY Commands, Branching, Capabilities and limitations of Leadthrough Methods- Textual Robot Programming- structure, Motion, End effectors and Sensor commands, Program control communication, Monitor mode commands

Robot Control: Open and Closed loop control- control Problem- Linear control Schemes- Design of Partitioned PD, PID and Adaptive Controllers for Linear Second

order SISO Model of robot and their Block schematic representation- Control of Industrial Robots Using PLCs.

Unit–IV : Automation

Factory Automation: Fixed Automation, Flexible Automation and Programmable Automation. Intelligent Industrial Automation, Industrial Networking, Bus Standards

Automatic Feeders, Automatic Storage and Retrieval Systems (AS/RS), Transfer Lines, Automatic Inspection Systems

Unit–V : Applications of Robots

Factors influencing the selection of Robots – Robots for Welding, Painting, Assembly, Nuclear, Thermal and Chemical Plants.

Introduction to Mobile Robots, Legged Robots and Remote Controlled Robots, Automated Guided Robots, Micro Robots – Control and Safety Issues.

TEXT BOOKS

1. Groover, M.P., Weiss, M., Nagel, R.N., Odrey, N.G., Industrial Robots: Technology, Programming and Applications, McGraw-Hill Book Company, 2012.
2. Mittal R K, Nagrath I J, "Robotics and control", Tata McGraw Hill, 2010.

REFERENCES

1. Groover, M.P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice-Hall of India Private Limited, New Delhi, 2007
2. S.R.Deb, "Robotics Technology and Flexible Automation", Tata McGraw Hill, 1994
3. Yoran Koren, Robotics for Engineers, McGraw Hill, 1980.
4. Saeed B. Niku, An Introduction to Robotics- Analysis, Systems, Applications, Second Edition, John Wiley & Sons Inc., 2010.
5. Wesley, E. Sryda, "Industrial Robots: Computer interfacing and Control" PHI, 1985.

COURSE OUTCOMES

At the end of the course the student will be able to

1. Expertise in fundamentals of Robotics (Unit I)
2. Understand the issues related to end effectors and sensors (Unit II)
3. Acquire knowledge in Programming and control of Robots (Unit III)
4. Understand the issues related to implementation of Industrial Automation with Robot Application (Unit–IV :)
5. Gain an in depth understanding of the selection of robots for various application and their safety issues (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓										✓	
CO2	✓											
CO3				✓								
CO4		✓										
CO5					✓						✓	✓

EIHESCN	FIBER OPTICS AND LASER INSTRUMENTATION	L	T	P	C
		3	-	-	3

COURSE OBJECTIVES

- To provide basic knowledge of optical fibers and their properties.
- To expose adequate knowledge about the Industrial applications of optical fibers.
- To disseminate the students, the fundamental characteristics, types and industrial applications of optical laser.
- To provide adequate facts about holography and medical applications of optical laser.

Unit–I

Principles of light propagation through a fiber - Basic optical laws and definitions - Different types of fibers and their properties, fiber characteristics – Wave Propagation-Fiber Losses– Dispersion – Connectors and splicers – Optical sources and detectors.

Unit II

Fiber optic sensors – Measurement of pressure, temperature, current, voltage and liquid level – Polarimetric fiber sensor – Interferometric method of measurement of length – Moire fringes - Optical Multiplexer.

Unit–III

Laser Principles: Absorption process – Emission process - Fundamental characteristics of lasers – Properties of laser – Laser modes – Resonator configuration – Q-switching – Types of lasers: Gas lasers, solid lasers, liquid lasers, semiconductor lasers.

Unit–IV

Laser for measurement of distance, length, velocity, acceleration and current, voltage – Material processing: Laser heating, welding, melting and trimming of material – Laser spectroscopy.

Unit–V

Holography - basic principles - Holography for NDT - medical application of lasers: laser and tissue interaction, laser instruments for surgery, removal of tumors of vocal chords, brain surgery, plastic surgery, gynecology, and oncology.

TEXT BOOKS

1. Keiser, Optical Fiber Communication Systems, McGraw Hill Ltd., 2008.
2. S.Nagabhushana and N.Sathyanarayana, Lasers and Optical Instrumentation, I.K.International publishing, 2010.

REFERENCES

1. Govind P. Agrawal, Fiber-Optic Communication Systems, 4th Edition, Wiley publication, 2010.
2. Pallab Bhattacharya, Semiconductor Opto-Electronics, PHI, 2002.
3. John and Harry, Industrial lasers and their application, McGrawHill,2002.

4. Introduction to H pology raphy, CRC press, 2012.

COURSE OUTCOMES

1. Understand the Characteristics and properties of optical fibers. (Unit I)
2. Use of optical fibers in industries. (Unit II)
3. Identify the characteristics and principles of optical lasers. (Unit III)
4. Development of optical laser in industry applications. (Unit–IV :)
5. Applications of lasers in medical electronics. (Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓											
CO2	✓	✓										✓
CO3	✓	✓			✓						✓	
CO4	✓	✓	✓									
CO5	✓	✓	✓		✓						✓	✓

EIHESCN	**PROCESS DATA ANALYTICS**	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**

COURSE OBJECTIVES

- To impart knowledge on various Non-parametric approaches based system identification.
- To make the student understand the principles of State space modelling of linear and nonlinear systems.
- To know non-recursive and recursive parametric identification approaches and to develop robust parametric identification methods.
- To impart knowledge pertaining to practical aspects of system identification and control.

Unit-I Process Identification

(Non-Parametric methods): Transient response analysis - frequency response analysis - correlation analysis - State space modeling of systems - Nonlinear state space model and linearization of nonlinear models ; Modeling in state space - state space models – canonical state space forms- mechanical systems –Electrical systems – Liquid level systems- Thermal systems. State estimation using Kalman Filter-extended Kalman filter – unscented kalman filter-ensemble kalman filter for parameter Identification.

Unit – II Discrete time system models for control:

ARX models - bilinear parametric models – ARMAX,OE,BJ models - Hammerstein models – Wienner model –prediction error method and instrumental variable method . Selection of pseudo random binary sequence.

Unit – III Recursive Plant Model identification in open-loop:

Identification methods - least squares - recursive least squares - extended least squares – generalized least squares –weighted LSE-maximum likelihood method - model validation identified in open-loop – Model order selection.

Unit – IV Recursive plant model identification in closed-loop:

Identification methods - closed-loop output error algorithms - filtered closed-loop error algorithms - filtered open-loop identification algorithms - model validation identified in closed-loop - comparative evaluation of various algorithms. Subspaces identification method: classical and innovation forms, free and structures parameterizations- relay feedback identification of stable processes and unstable processes.

Unit – V Nonlinear system identification:

Modeling of nonlinear system using ANN- NARX, NNSS,NARMAX- generation of training data – training Feed-Forward and Recurrent Neural Networks- TSK model-Adaptive Neuro-Fuzzy Inference system(ANFIS), Practical aspects of System identification and control: Selection of input signals - offline and online identification; notion for persistent excitation,drifts and de-trending-outliers and missing data-pre-filtering-robustness – comparison of parameter estimation methods – model order testing and verification- case studies.

TEXT BOOKS

1. Ioan D. Landau and GianlucaZito, Digital Control Systems, Design, Identification and Implementation, Springer-Verlag London Limited 2006.
2. Arun K. Tangirala, " Principles of System Identification: Theory and Practice", CRC Press. 2014.

REFERENCES

1. F.Van der Heijden, R.P.W.DUIN, D.de Ridder and D.M.J. Tax, "Classification, Parameter Estimation and State Estimation , An Engineering Approach Using MATLAB, John Wiley & Sons Ltd. 2004.
2. W.T.Miller, R.S.Sutton and P.J.Webrose, " Neural Networks for Control",MIT Press,1995.
3. Dan Simon, "Optimal State Estimation Kalman,H-infinity and Non-linear Approaches", John Wiley and Sons, 2006.

COURSE OUTCOMES

Students will be able to:

1. Will be able to identify a suitable continuous time domain identification method for the taken up process. (Unit – I)
2. Ability to select particular state space model based on specific control engineering problem. (Unit – II)
3. Understand and implement the various complexity estimation methods, offline and online, open and closed loop estimation methods for modelling and estimating a process. (Unit – III)
4. Gain an idea for robust parameter estimation. (Unit – IV)
5. Select a specific identification method with an approximately equal complexity for the case studies. (Unit – V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓		✓				✓			
CO2		✓	✓		✓							✓
CO3	✓			✓							✓	
CO4		✓	✓		✓							
CO5		✓	✓	✓					✓			✓

EIHESCN	**SCADA SYSTEMS AND APPLICATION**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

Students will be able to:

- To understand what is meant by SCADA and its functions.
- To know SCADA communication.
- To get an insight into its application.

UNIT – I: Introduction to SCADA:

Data acquisition systems, Evolution of SCADA, Communication technologies - Monitoring and supervisory functions, SCADA applications in Utility Automation, Industries SCADA.

UNIT – II: SCADA System Components

Industries SCADA System Components: Schemes- Remote Terminal Unit (RTU), Intelligent Electronic Devices (IED), Programmable Logic Controller (PLC), Communication Network, SCADA Server, SCADA/HMI Systems.

UNIT – III: SCADA Architecture

SCADA Architecture: Various SCADA architectures, advantages and disadvantages of each system - single unified standard architecture -IEC 61850.

UNIT – IV: SCADA Communication

SCADA Communication: various industrial communication technologies - wired and wireless methods and fiber optics. Open standard communication protocols.

UNIT – V: SCADA Applications

SCADA Applications: Utility applications- Transmission and Distribution sector- operations, monitoring, analysis and improvement. Industries - oil, gas and water. Case studies, Implementation, Simulation Exercises.

TEXT BOOKS

1. Stuart A. Boyer: “SCADA-Supervisory Control and Data Acquisition”, Instrument Society of AmericaPublications,USA,2004.
2. Gordon Clarke, Deon Reynders: “Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems”, Newnes Publications, Oxford,UK,2004.

REFERENCES

1. William T. Shaw, "Cyber security for SCADA systems", Penn Well Books,2006.
2. David Bailey, Edwin Wright, "Practical SCADA for industry", Newnes,2003.
3. Wiebe, "A guide to utility automation: AMR, SCADA, and IT systems for electric power", Penn Well1999.

COURSE OUTCOMES

Students will be able to:

1. Describe the basic tasks of Supervisory Control Systems (SCADA) as well as their typical applications. (Unit-I)
2. Acquire knowledge about SCADA architecture, various advantages and disadvantages of each system. (Unit-II)
3. Knowledge about single unified standard architecture IEC61850. (Unit-III)
4. To learn about SCADA system components: remote terminal units, PLCs, intelligent electronic devices, HMI systems, SCADA server. (Unit-IV)
5. Learn and understand about SCADA applications in transmission and distribution sector, industries etc. (Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓	✓									
CO2	✓	✓	✓							✓		
CO3	✓			✓								✓
CO4		✓	✓								✓	
CO5		✓	✓	✓								✓

MINOR ENGINEERING

EIMISCN	**TRANSDUCER ENGINEERING**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVES

- To expose the students to various sensors and transducers for measuring mechanical quantities.
- To understand the specifications of sensors and transducers.
- To learn the basic conditioning circuits for various sensors and transducers
- To introduce advances in sensor technology

Unit I

General concepts and terminology of measurement systems, transducer classification, general input-output configuration, static and dynamic characteristics of a measurement system, Statistical analysis of measurement data.

Unit II

Resistive transducers: Potentiometers, metal and semiconductor strain gauges and signal conditioning circuits, strain gauge applications: Load and torque measurement.

Unit III

Self and mutual inductive transducers- capacitive transducers, eddy current transducers, proximity sensors, tacho generators and stroboscope.

Unit IV

Piezoelectric transducers and their signal conditioning, Seismic transducer and its dynamic response, photoelectric transducers, Hall effect sensors, Magnetostrictive transducers, Basics of Gyroscope.

Unit V

Digital displacement sensors, Fibre optic sensor, Semiconductor sensor and Smart sensors.

TEXT BOOKS

1. John P. Bentley, Principles of Measurement Systems, Pearson Education, 4th Edition, 2005.
2. Doebelin E.0, Measurement Systems - Application and Design, McGraw-Hill, 4th Edition, 2004.

REFERENCES

1. Murthy D. V. S, Transducers and Instrumentation, Prentice Hall, 2nd Edition, 2011.
2. James W.Dally, Instrumentation for Engineering Measurements, Wiley, 2nd Edition, 1993.
3. John G.Webster, Sensors and Signal Conditioning, Wiley Inter Science, 2nd Edition, 2008.
4. S.M. Sze, Semiconductor sensors, John Wiley & Sons Inc., 1994.

COURSE OUTCOMES

At the end of this course, students be able to

1. Familiar with the basics of measurement system and its input, output configuration of measurement system (Unit-I).
2. Familiar with both static and dynamic characteristics of measurement system (Unit-II)..
3. Familiar with the principle and working of various sensors and transducers. (Unit-III).
4. Able to design signal conditioning circuit for various transducers (Unit-IV)..
5. Able to identify or choose a transducer for a specific measurement application (Unit-V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓		✓	✓				✓			✓
CO2	✓	✓		✓	✓							
CO3	✓	✓	✓						✓		✓	
CO4		✓	✓		✓				✓			
CO5	✓		✓						✓			✓

EIMISCN	**TEST AND MEASURING INSTRUMENTS**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- The course is designed is make the students familiar with test and measuring instruments commonly used.

Unit–I

Electrical measurements: General features and Classification of electro mechanical instruments. Principles of Moving coil, moving iron instruments. Extension of instrument range: shunt and multipliers, CT and PT.

Unit–II

Measurement of Power: Electrodynamic wattmeter's, Low Power Factor (LPF) wattmeter, errors, calibration of wattmeter. Single and three phase power measurement, Hall effect wattmeter, thermal type wattmeter.

Unit–III

Different methods of measuring low, medium and high resistances, measurement of inductance & capacitance with the help of AC Bridges, Q Meter.

Unit–IV

Digital Measurement of Electrical Quantities: Concept of digital measurement, block diagram Study of digital voltmeter, Digital multimeter, Digital LCR meter, Q-Meter, Digital wattmeter and energy meters.

Unit–V

CRO, DSO, Function generator, Audio frequency signal generation, Waveform analyzers, Spectrum analyzers.

TEXT BOOKS

1. David A. Bell, Electronic Instrumentation and Measurements, Oxford University Press, 3rd Edition, 2013.
2. Shawney A K, A course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai and Sons. 19th revised edition,2013.

REFERENCES

1. Cooper, W.D. and Helfric , A.D., Electronic Instrumentation and Measurement Techniques, Prentice Hall, 1st Edition, 2009.
2. Kalsi.H.S, Electronic Instrumentation, Tata Mcgraw Hill Education Private Limited, 3rd Edition, 2012.
3. Golding, E.W. and Widdis, F.C., Electrical Measurements and Measuring Instruments, A.H.Wheeler and Co, 5th Edition, 2011.

COURSE OUTCOMES

At the end of the course the student will be

1. Familiar with various measuring instruments (ammeters, voltmeters, wattmeters, energy meters extension of meters, current and voltage transformers) used to detect electrical quantities. (Unit I & II)
2. Able to design suitable DC and AC bridges for the measurement of R, L, C and Frequency measurement. (Unit-III)
3. Able to understand the analog and digital measurements (Unit-IV).
4. Familiar with the operation and usage of various analyzing instruments. (Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓				✓			✓
CO2	✓	✓	✓								✓	
CO3	✓	✓							✓			
CO4	✓		✓		✓				✓			✓

EIMISCN	**MEASUREMENTS IN PROCESS INDUSTRIES**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

COURSE OBJECTIVE

- To expose the students to various measurement techniques used for the measurement of temperature, flow, pressure and level in process industries.

Unit–I

Temperature measurement: Introduction to temperature measurements, Thermocouple, Resistance Temperature Detector, Thermistor and its measuring circuits, Radiation pyrometers and thermal imaging.

Unit–II

Pressure measurement: Introduction, definition and units, Mechanical, Electro-mechanical pressure measuring instruments. Low pressure measurement, Transmitter definition types, I/P and P/I Converters.

Unit–III

Level measurement: Introduction, Mechanical and electrical methods of level measurement.

Unit–IV

Flow measurement: Introduction, definition and units, classification of flow meters, differential pressure and variable area flow meters, Positive displacement flow meters, Electro Magnetic flow meters, Hot wire anemometer and ultrasonic flow meters.

Unit–V

Calibration and selection of Flow meters

TEXT BOOKS

1. Doebelin E.O., Measurement Systems - Application and Design, Tata McGraw Hill publishing company, 5th Edition, 2008.
2. Patranabis D, Principles of Industrial Instrumentation, Tata McGraw Hill, 3rd Edition, 2010.

REFERENCES

1. B.E.Noltingk, Instrumentation Reference Book, 2ndEdition, Butterworth Heinemann, 1995.
2. B.G.Liptak, Process Measurement and Analysis, 4th Edition, Chilton Book Company, Radnor, Pennsylvania, 2003.
3. Douglas M. Considine, Process / Industrial Instruments & Controls Handbook, 5th Edition, McGraw Hill, Singapore, 1999.
4. Andrew W.G, Applied Instrumentation in Process Industries – A survey, Vol I &Vol II, Gulf Publishing Company, Houston, 2001.
5. Spitzer D. W., Industrial Flow measurement, ISA press, 3rd Edition, 2005

OURSE OUTCOMES

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

1. Familiar with the different temperature measurement techniques used in process industries. (Unit-I)
2. Able to understand the working principle of different pressure transmitters and level sensors used in industries. . (Unit-II)
3. Able to identify or choose temperature, flow, pressure and level measuring device for specific process measurement. (Unit-III & IV)
4. Familiar with various flow instrumentation used in industrial flow measurement.(Unit-V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓			✓					✓			✓
CO2	✓			✓	✓							
CO3	✓	✓	✓	✓	✓				✓		✓	
CO4			✓	✓								✓

EIMISCN	**ESSENTIALS OF CONTROL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**1**	**-**	**4**

COURSE OBJECTIVES

- To expose the students to the fundamentals of feedback control system.
- To analyse variety of classical control schemes using simulation software

Unit-I

Introduction to control system – Open loop and Closed loop system – Feedback system characteristics – Block diagram reduction techniques – Signal flow graph.

Unit-II

Order and type of system – time domain and frequency domain response of different system characteristics using simulation software – Introduction of stability – Routh Hurwitz stability criteria.

Unit-III

Introduction to root locus – plotting of root locus and stability analysis using simulation software. Introduction to bode and Nyquist plot – Plotting of bode and Nyquist plot using simulation software - Gain Margin and Phase margin calculation.

Unit-IV

Introduction to different compensator design – the design of different compensator design using simulation software. PID controller design using simulation software.

Unit-V

Application of control system for different domain with case studies.

TEXT BOOKS

1. J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New Age International (P) Ltd., Publishers, 2009.
2. M. Gopal, Control Systems Principles and Design, McGraw-Hill Education, Fourth edition, 2012.

REFERENCES

1. B. C. Kuo, Automatic Control Systems, Prentice Hall of Indian, Sixth Edition, 1991.
2. K. Ogata, Modern Control Engineering, Prentice Hall India Learning Private Limited,
3. Fifth Edition, 2010.
4. K. Ogata, Solving Control Engineering Problems with MATLAB, Prentice Hall, 1994.

COURSE OUTCOMES

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

1. The student learns the importance of feedback control system. (Unit-I)
2. The student understands time domain and frequency domain techniques using simulation software. (Unit-II & III)
3. The student is exposed to classical control design using simulation software (Unit IV & V).

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓				✓				✓			✓
CO2		✓	✓	✓	✓				✓		✓	
CO3		✓	✓	✓	✓				✓			✓

EIMISCN	INDUSTRIAL AUTOMATION AND CONTROL	L	T	P	C
		3	1	-	4

COURSE OBJECTIVES

- This course is designed to expose students to understand the process automation concepts like Programmable logic controller and Distributed control system.

Unit–I

Introduction and overview of Industrial automation – Block diagram of PLC – different types of PLC – Type of input and output – Introduction to relay logic- Application of PLC.

Unit–II

Introduction to Ladder logic programming – Basic instructions – Timer and Counter instruction- Arithmetic and logical instruction – MCR, PID controller and other essential instruction sets - Case studies and examples for each instruction set.

Unit–III

Introduction to high level PLC language – Programming of PLC using simulation software – Real time interface and control of process rig/switches using PLC.

Unit–IV

Introduction to DCS and SCADA - Block diagram – function of each component – Security objective – Operation and engineering station interface – Communication requirements .

Unit–V

Development of different control block using DCS simulation software – Real time control of test rigs using DCS. Introduction to HART, Fieldbus and Profi bus – Application and case studies of large scale process control using DCS.

TEXT BOOKS

1. John W. Webb and Ronald A Reis, Programmable Logic Controllers - Principles and Applications, 5th Edition, Prentice Hall Inc., New Jersey, 2002.
2. Frank D. Petruzella, Programmable Logic Controllers, 4th Edition, McGraw Hill, New York, 2010.

REFERENCES

1. Deshpande P.B and Ash R.H, Elements of Process Control Applications, ISA Press, New York, 1995.
2. Curtis D. Johnson, Process Control Instrumentation Technology, 8th Edition, Prentice Hall, New Delhi, 2005.
3. Krishna Kant, Computer-based Industrial Control, 2nd edition, Prentice Hall,New Delhi, 2011.
4. Lukcas M.P, Distributed Control Systems, Van Nostrand Reinhold Co., New York, 1986.

COURSE OUTCOMES

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

1. Design and development of PLC ladder programming for simple process applications.
2. Understand the different security design approaches, Engineering and operator interface issues for designing Distributed control system.
3. Understand the popular process automation technologies
4. Know the latest communication technologies like HART and Field bus protocol

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓	✓			✓				✓			
CO2	✓	✓		✓								
CO3	✓	✓			✓							
CO4	✓	✓		✓	✓				✓			

EIMISCN	**INSTRUMENTATION IN PETROCHEMICAL INDUSTRIES**	**L**	**T**	**P**	**C**
		3	**-**	**-**	**3**

Course Objectives

- To understand the operations of petrochemical industries.
- To be familiar with the control loops in petrochemical industries .

Unit-I : Oil Extraction and Processing

Techniques used for oil discovery - seismic survey - methods of oil extraction - oil rig system - Primary and Secondary recovery - Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator - scrubber – coalescer

Unit-II : Petroleum Refining

Petroleum refining process - unit operations in refinery - thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum

Unit-III : Chemicals from Petroleum

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC

Unit-IV : Control Loops in Petrochemical Industry

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production

Unit-V : Safety in Instrumentation Systems

Area and material classification as per National Electric Code (NEC) - Classification as per International Electrotechnical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Type X, Type Y and Type Z - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit

TEXT BOOKS:

1. Balchen J.G and Mumme K.I., Process Control Structures and Applications, Von Nostrand Reinhold Company, New York, 1988.
2. Liptak B.G., Instrumentation in Process Industries, Chilton Book Company, 2005.

REFERENCES:

1. Waddams A.L., Chemicals from Petroleum, Butter and Janner Ltd., 1968.
2. Ram Prasad, Petroleum Refining Technology, Khanna Publishers, New Delhi, 2000.
3. www.scribd.com/doc/2336259/ABB-Oil-Gas-production-Hand-Book

Course OUtComeS

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

1. Understand the principle and working of Oil Industries.(Unit I)
2. Understand the refining process in Oil Industries (Unit II)
3. To know the petroleum by-products.(Unit III)
4. Analyse the control loops in petrochemical industries.(Unit IV)
5. To know the safety in instrumentation systems.(Unit V)

Mapping of COs with POs												
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	✓		✓					✓	✓			
CO2	✓				✓							✓
CO3	✓			✓	✓		✓					
CO4	✓	✓		✓	✓		✓	✓	✓		✓	✓
CO5	✓		✓	✓				✓	✓			

ITEM NO.	APPENDIX

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

M.E., PROCESS CONTROL AND INSTRUMENTATION ENGINEERING

REVISED REGULATIONS & SYLLABI

(Students Admitted From the Academic Year 2019-2020)

VISION

To nurture higher echelons of technology through participative education, innovative and collaborative research with a view to bring out employable graduates of International standard.

MISSION

To establish state of the art facilities related to diverse dimension in the field of Instrumentation Engineering, Control Engineering, Process Control & Automation.

To foster higher quality of education with equivocal focus in theory and practical areas of Electronics, Control and Instrumentation Engineering.

To ensure that the dissemination of knowledge reaches the stakeholders and forge the opening of a fresh flair of human resources.

To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one's career.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

The major objectives of the M.E (Process Control & Instrumentation) programme are to equip the students with adequate knowledge and skills in the areas of Process Control and Instrumentation and prepare them for:

1. Imparting practical knowledge in process control, design of instrumentation systems and contribute to technological development.
2. Attaining professional competency to address the technological needs of society and industrial problems.
3. A successful career in Process Control and Automation industries, R&D organizations and Academic Institutions.
4. Showing the society for life-long self-governing and thoughtful learning skills in their career.
5. Exhibiting their potential in project management, collaborative and multidisciplinary task in their profession.

PROGRAMME OUTCOMES (POs)

A student who has undergone the M.E (Process Control & Instrumentation) program would have acquired abilities to

PO1:ENGINEERING KNOWLEDGE

Apply knowledge of mathematics, science and engineering in practice for instrumentation, control and automation with an ability to discriminate, evaluate, analyze and synthesize existing and new knowledge and integration of the same for enhancement of knowledge.

PO2:DECISIVE THINKING

Identify, analyse, formulate and solve complex engineering problems in instrumentation, control and automation engineering critically, to make intellectual and/or creative advances for conducting research in a wider theoretical, practical and policy context to handle emerging technologies relating to process industries.

PO3: PLAN AND PROGRESS

Solve instrumentation, control and automation problems, evaluate a wide range of potential solutions for those problems and arrive at feasible, optimal solutions after considering public health and safety, cultural, societal and environmental factors.

PO4: RESEARCH SKILLS

Extract the research skill to unfamiliar problems through literature survey and experiments, and apply appropriate research methodologies, techniques and tools, design, conduct experiments, analyze and interpret data, demonstrate higher order skill and view things in a broader perspective, contribute individually/in group(s) to the development of scientific/technological knowledge in instrumentation, control and automation domains.

PO5: USAGE OF MODERN TOOLS

Learn, Develop, Choose, apply appropriate techniques and resources, modern engineering and IT tools, including prediction and modelling, to complex instrumentation and control, automation engineering activities with an understanding of the limitations.

PO6: COLLABORATIVE AND MULTIDISCIPLINARY WORK

Collaborative and Multidisciplinary work and understanding of group dynamics, recognize opportunities and contribute positively to scientific research, demonstrate a capacity for decision-making based on open mindedness, objectivity and rational analysis in order to achieve common goals.

PO7: PROJECT MANAGEMENT

Demonstrate project management knowledge by applying the same to one's own work, as a member and leader in a team, manage projects by considering economical and financial factors efficiently in respective disciplines and multidisciplinary environments.

PO8: SOFT SKILLS

Communicate confidently and effectively with the peers and the society at large regarding complex engineering activities, be able to comprehend and write effective reports, design documentation by adhering to appropriate standards, make effective presentations.

PO9:LIFE-LONG LEARNING

Recognise the need for Life-long Learning with a high level of enthusiasm and commitment to improve knowledge and competence continuously and independently.

PO10: ETHICAL PRACTICES AND SOCIAL RESPONSIBILITY

Ethical practices and social responsibility, professional code of conduct, ethics of research and scholarship, consideration of the impact of research outcomes on professional practices and an understanding of responsibility to contribute to the community for sustainable development of society.

PO11: INDEPENDENT AND REFLECTIVE LEARNING

Independent and reflective learning, observe and examine critically the outcomes of one's actions and make corrective measures subsequently, and learn from mistakes without depending on external feedback.

MAPPING OF POs WITH PEOs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
PEO1	✓	✓	✓	✓	✓						
PEO2		✓	✓	✓		✓	✓	✓		✓	✓
PEO3	✓	✓	✓	✓		✓	✓	✓	✓		
PEO4						✓		✓	✓	✓	
PEO5		✓	✓		✓	✓	✓	✓		✓	✓

M.E (PROCESS CONTROL AND INSTRUMENTATION) FULL TIME

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIPCPC11	PC	Process Dynamics and Control	3	-	-	25	75	100	3
EIPCPC12	PC	Industrial Instrumentation	3	-	-	25	75	100	3
EIPCPE13	PE	Program Elective-I	3	-	-	25	75	100	3
EIPCPE14	PE	Program Elective-II	3	-	-	25	75	100	3
EIPCMC15	MC	Research Methodology and IPR	2	-	-	25	75	100	2
EIPCCP16	CP	Process Control & Instrumentation Lab	-	-	3	40	60	100	2
EIPCCP17	CP	Instrumentation System Design Lab	-	-	3	40	60	100	2
EIPCAC18	AC	Audit Course-I	2	-	-	-	-	-	0
Total						**205**	**495**	**700**	**18**

SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIPCPC21	PC	Industrial Data Communication and Control	3	-	-	25	75	100	3
EIPCPC22	PC	System Identification and Modeling	3	-	-	25	75	100	3
EIPCPE23	PE	Program Elective-III	3	-	-	25	75	100	3
EIPCPE24	PE	Program Elective-IV	3	-	-	25	75	100	3
EIPCOE25	OE	Open Elective - I (Inter faculty)	3	-	-	25	75	100	3
EIPCCP26	CP	Industrial Automation Lab	-	-	3	40	60	100	2
EIPCTS27	TS	Internship* and Seminar		Tr 2	S 2	40	60	100	2
EIPCAC28	AC	Audit Course-II	2	-	-	-	-	-	0
Total						**205**	**495**	**700**	**19**

SEMESTER III									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIPCPE31	PE	Program Elective-V	3	-	-	25	75	100	3
EIPCOE32	OE	Open Elective - II	3	-	-	25	75	100	3

		(Inter faculty)							
EIPCPV33	PV-I	Project work & Viva-voce Phase-I	-	Pr 16	S 4	40	60	100	10
Total						**90**	**210**	**300**	**16**

SEMESTER IV

Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIPCPV41	PV-II	Project work & Viva-voce Phase-II	-	Pr 24	S 6	40	60	100	15
Total						**40**	**60**	**100**	**15**

***Note:* * - Four weeks during the summer vacation at the end of II[nd] Semester.**

L: Lecture ,P: Practical, T: Tutorial,CA: Continuous Assessment, FE: Final Examination,Tr: Training, Pr: Project work, S: Seminar.

PC	Program Core	**CP**	Core Practical	**AC**	Audit Course
PE	Program Elective	**TS**	Industrial Training and Seminar	**PV**	Project work & Viva-voce
OE	Open Elective	**MC**	Mandatory Learning Course	**EI**	Branch code
				RI	M.E Specialization Code

M.E (PROCESS CONTROL AND INSTRUMENTATION) PART-TIME

S E M E S T E R – I

Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PEI PCPC11	PC	Process Dynamics and Control	3	-	-	25	75	100	3	EIPC PC11
2	PEIPC PC12	PC	Industrial Instrumentation	3	-	-	25	75	100	3	EIPC PC12
3	PEIPC MC13	MC	Research Methodology and IPR	2	-	-	25	75	100	2	EIPC MC15
4	PEIP CCP14	CP	Process Control & Instrumentation Lab	-	-	3	40	60	100	2	EIPC CP16
	Total						**115**	**285**	**400**	**10**	

S E M E S T E R – II											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PEIPC PC21	PC	Industrial Data Communication and Control	3	-	-	25	75	100	3	EIPC PC21
2	PEIPC PC22	PC	System Identification and Modeling	3	-	-	25	75	100	3	EIPC PC22
3	PEIPC OE23	OE	Open Elective - I (from the Dept.)	3	-	-	25	75	100	3	EIPC OEXX
4	PEIPC CP24	CP	Industrial Automation Lab	-	-	3	40	60	100	2	EIPC CP17
	Total						**115**	**285**	**400**	**11**	

S E M E S T E R – III											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PEIPC PE31	PE	Program Elective-I	3	-	-	25	75	100	3	EIPC PEXX
2	PEIPC PE32	PE	Program Elective-II	3	-	-	25	75	100	3	EIPC PEXX
3	PEIPC CP33	CP	Instrumentation System Design Lab	-	-	3	40	60	100	2	EIPC CP17
	Total						**90**	**210**	**300**	**8**	

S E M E S T E R – IV											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**

1	PEIPC PE41	PE	Program Elective-III	3	-	-	25	75	100	3	EIPC PEXX
2	PEIPC PE42	PE	Program Elective-IV	3	-	-	25	75	100	3	EIPC PEXX
3	PEIPC TS43	TS	Seminar / Mini project		S: 2	M: 2	40	60	100	2	EIPC TS27
	Total						**90**	**210**	**300**	**8**	

S E M E S T E R –V											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
1	PEIPC PE51	**PE**	Program Elective-V	3	-	-	25	75	100	3	EIPC PEXX
2	PEIPC OE52	**OE**	Open Elective - II (from the Dept.)	3	-	-	25	75	100	3	EIPC OEXX
	PEIPC PV53	**PV-I**	Project work & Viva-voce Phase-I	-	Pr: 16	S: 4	40	60	100	10	EIPC PV33
	Total						**90**	**210**	**300**	**16**	

S E M E S T E R –VI											
Sl. No.	**Course Code**	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent Course Code in M.E. Full Time**
	PEIPCPV41	**PV-II**	Project work & Viva-vocePhase-II	-	Pr: 24	S: 6	40	60	100	15	EIPCPV41
	Total						**40**	**60**	**100**	**15**	

L:Lecture ,**P**:Practical,**T**: Tutorial, **CA**:Continuous Assessment;**FE**:Final Examination, **S**: Seminar, **M**: Mini Project, **Pr**: Main project

S.No	COURSE CODE	LIST OF PROGRAM ELECTIVES	Credits
1.	EIPCPEXX	Instrumentation System Design	3
2.	EIPCPEXX	Advanced Instrumentation System	3
3.	EIPCPEXX	Instrumentation in Petrochemical Industry	3
4.	EIPCPEXX	Thermal Power Plant Instrumentation	3
5.	EIPCPEXX	Virtual Instrumentation	3
6.	EIPCPEXX	Automotive Instrumentation	3
7.	EIPCPEXX	Advanced Process Control	3
8.	EIPCPEXX	Adaptive Control	3
9.	EIPCPEXX	Optimal Control	3
10.	EIPCPEXX	Robust Control	3
11.	EIPCPEXX	Non Linear System Theory	3
12.	EIPCPEXX	Statistical Process Control	3
13.	EIPCPEXX	Advanced Digital Signal Processing	3
14.	EIPCPEXX	Machine Learning Techniques	3
15.	EIPCPEXX	Robotics & Automation	3
16.	EIPCPEXX	Artificial Intelligence for Process Control.	3
17.	EIPCPEXX	Real time Embedded System	3

S.No	COURSE CODE	LIST OF OPEN ELECTIVES	Credits
1.	EIPCOEXX	Industrial Drives and Control	3
2.	EIPCOEXX	Digital Control	3
3.	EIPCOEXX	Wireless Sensor Networks	3
4.	EIPCOEXX	Digital Image Processing	3
5.	EIPCOEXX	Multi Sensor Data Fusion	3

S.No	COURSE CODE	LIST OFAUDIT COURSES
1.	EIPCACXX	English for Research Paper Writing
2.	EIPCACXX	Disaster Management
3.	EIPCACXX	Sanskrit for Technical Knowledge
4.	EIPCACXX	Value Education
5.	EIPCACXX	Constitution of India
6.	EIPCACXX	Pedagogy Studies
7.	EIPCACXX	Stress Management by Yoga
8.	EIPCACXX	Personality Development through Life Enlightment Skills

EIPCPC11	PROCESS DYNAMICS AND CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the dynamics of various processes and modelling of physical processes using first principles.
- To get adequate knowledge about basic control actions and related issues.

- To educate the effect of various control actions and the methods of tuning the controller.
- To introduce the concept of MIMO process and its control schemes.
- To study the control schemes for typical processes and it's P & I Diagram.

Process Control: Design aspects – Hardware elements of process control system. Mathematical modeling of processes: Fundamental laws and equations – level, thermal, flow, gas and mixing process. Interacting and non – interacting process – self regulation – inverse response – degrees of freedom – linearization – transfer function representation of process – variable gain, variable time constant.

Feedback Control of Processes: Basic control actions – characteristics of ON/OFF, P, P+I, P+D, P+I+D control modes – non-linear PID control – position and velocity forms of PID controllers – anti-reset windup – bumpless transfer – practical forms of P+I+D control modes, selection of control modes for different processes – control schemes for flow, level, pressure and temperature. Methods of controller tuning, Ziegler – Nichols continuous cycling, damped oscillations, process reaction curve method – Cohen and Coon method, time – integral criteria.

Advanced Control Systems: Feedback control of systems with large dead time, dead time compensation – cascade control – feed forward and ratio control – adaptive and inferential control systems – internal model control – model predictive control – introduction to MPC schemes.

Design of Control Systems for Multivariable Process: Design equations – degrees of freedom – poles and zeros – number of controlled and manipulated variables – generation of alternative loop configurations – extension to systems with interacting units. Interaction of control loops – relative gain array – selection of loops – design of non-interacting control loops. Decoupling control.

Control of Typical Processes: Distillation column, control of top and bottom product composition, reflux ratio. CSTR, four – tank system and PH process.Piping and Instrumentation Drawing (P&I D) of control loops.

REFERENCES

1. Ramesh C Panda and T. Thyagarajan, An Introduction to Process modelling,Identification and control for Engineers, Narosa Publishing House, First edition, 2017.
2. B. WaynBequette, Process Control: Modeling, Design and Simulation, Prentice HallInternational series, Third edition, 2003.
3. George Stephanopoulos, Chemical Process Control, An Introduction to the Theory and Practice, Prentice Hall International Inc., First edition, 2008.
4. Donald R. Coughanowr, Process Systems Analysis and Control, Third Edition, McGraw Hill Inc., 2013.
5. Peter Harriott, Process Control, Tata McGraw Hill 26th Reprint, 2005.
6. D. Patranabis, Principles of Process Control, Tata McGraw Hill, Third Edition, 2013.

7. William L. Luyben, Michael L. Luyben, Essentials of Process Control, Tata McGraw Hill, 1997.

COURSE OUTCOMES

At the completion of this course, students will be able to:

1. Understand basic principles and importance of process control in industrial process plants.
2. Acquire knowledge of dynamic modelling and system behaviour.
3. Understand the need for mathematical basis for the design of control systems.
4. Design and implementation of advanced controllers.
5. Understand the concept of MIMO process.

MAPPING OF COs WITH Pos											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓										
CO2	✓	✓				✓		✓	✓		
CO3	✓	✓				✓			✓	✓	
CO4		✓	✓	✓		✓				✓	✓
CO5	✓										

EIPCPC12	**INDUSTRIAL INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on the various techniques used for the measurement of primary industrial parameters like flow, level, temperature and pressure.
- To make students understand the important parameters to be monitored and analyzed in Thermal power plant and Nuclear power plant.
- To get an exposure on the important parameters to be monitored and analyzed in Petrochemical Industry.
- To learn about the intrinsic safety techniquesadapted in industries.
- To familiarize the students about the safety instrumented system and method to evaluate risk and safety instrumentation levels.

Measurement of Important Process Variables:

Measurement principles of temperature, pressure, level and flow measuring instruments - general considerations for instrument mounting- calibration principles for temperature and pressure transmitters- semiconductor transducers for temperature, pressure, level, and flow.

Instrumentation for Thermal Power Plant:

Measurement of fuel flow, air flow, drum level, steam pressure, steam temperature - selection and installation of instruments for these variables -

dissolved oxygen analyzer -flue gas analyzer -ph analyzer - coal /oil analyzer - pollution instruments-dust monitor.

Instrumentation for Nuclear Power Plant:

Nuclear radiation sensors- out of core–neutron sensors-in core – process instrumentation: temperature sensing, pressure sensing and transmitting, flow sensing, level and position sensing, steam properties sensing, water properties sensing, gas properties sensing – special sensor for sodium cooled reactors and gas cooled reactors.

Instrumentation for Petro Chemical Industry/Refinery:

Selection and installation of instruments for the measurement of temperature, level, flow and pressure in refinery – measurements in pyrolysis, catalytic cracking and reforming processes-hydrocarbon analyser-sulphur in oil analyzer.

Instrumentation for Industrial Safety:

Intrinsic safety: Definition - conservation and emergency vents - flame, fire and smoke detectors - leak detectors - metal detectors.safety instrument system (sis): need, features, components, difference between basic processcontrol system and sis.

Safety Integrity Levels (SIL), Determination method : as -low as reasonablypractical (alarp), evaluating risk: risk matrix, risk graph, layers of protection analysis (lopa) – issuesrelated to system size and complexity –issues related to field device safety.

REFERENCES

1. D.Patranabis, “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.
2. B.G.Liptak, “Instrumentation Engineers Handbook (Measurement)”, Fourth Edition, Volume 1, CRC press, 2011.
3. Donald P.Eckman, Industrial Instrumentation, Wiley Eastern Limited, 1991.
4. ZamuelGlasstone and Alexander Sessonske, ”Nuclear Reactor Engineering”, CBS publishers and Distributors Pvt. Ltd., 2004.
5. Paul Gruhn and Harry L. Cheddie,” Safety Instrumented systems: Design, Analysis andJustification”, ISA, 2nd Edition, 2006.
6. Eric W. Scharpf, Heidi J. Hartmann, Harlod W. Thomas, “Practical SIL target selection : Riskanalysis as per the IEC 61511 safety Lifecycle”, Exida, 2012.
7. Gill, A.B., “Power Plant performance”, Butterworth and Co (Publishers) Ltd, 2003.

COURSE OUTCOMES

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

1. Apply knowledge on measurement and calibration principles of basic industrial process variablesto ensure proper functioning of industrial systems.
2. Appropriately select and mount the instruments for a particular process.
3. Execute instrumentation requirements in various process industries such as Thermal power plant and Nuclear power plant and Petro Chemical/ Refinery.

4. Identify hazardous area and ensure safety measures by evaluating risk levels and features.
5. Design and implement a safety instrumentation system.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓					✓			✓
CO2	✓	✓	✓								
CO3			✓	✓	✓	✓					
CO4				✓	✓			✓			
CO5				✓	✓	✓		✓			

EIPCMC15	**RESEARCH METHODOLOGY AND IPR**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**2**

COURSE OBJECTIVES

- To understand the research problem formulation and analyze research related information.

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Effective literature studies approaches, analysis Plagiarism, Research ethics. Effective technical writing, how to write report, Paper.Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology.Patent information and databases.Geographical Indications.

New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs

REFERENCES

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”, Ranjit Kumar, 2nd Edition , “Research Methodology: A Step by Step Guide for beginners”
3. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
4. Mayall , “Industrial Design”, McGraw Hill, 1992.
5. Niebel , “Product Design”, McGraw Hill, 1974.

6. Asimov , “Introduction to Design”, Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
8. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

COURSE OUTCOMES

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

1. Understand research problem formulation.
2. Follow research ethics
3. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.
5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓					✓			✓
CO2	✓	✓	✓								✓
CO3			✓	✓	✓	✓					✓
CO4				✓	✓			✓			✓
CO5				✓	✓	✓		✓			

EIPCCP16	**PROCESS CONTROL & INSTRUMENTATION LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

COURSE OBJECTIVES

- To impart knowledge on the real time process modelling principle.
- To design and implement tuning techniques of PID controller for a typical process and verify its performance in MATLAB/Simulink environment.
- To understand the calibration procedure for various transmitters.
- To implement closed loop control for processes like air temperature, air flow and level.
- To familiarize students with design and simulation of advanced control strategies for the given process.
- To develop programming skill for a typical PLC.

LIST OF EXPERIMENTS

1. a. Determination of control valve characteristics
   b. Determination of characteristics of capacitive level transmitter
2. a. Controller tuning using continuous cycling method

b. Controller tuning using Process Reaction Curve method

3. Modeling of an proto typeair temperature process
4. Study of Air flow control system and determination of transfer characteristics of I/P converter, Control Valve and Flow transmitter
5. Modeling and simulation of a Level process using TUTSIM software package
6. Determination of characteristics of a PID controller using MATLAB (Simulink) software
7. Determination of Transfer function (Experimental model) of Level process
8. Design and simulation of Averaging Control

COURSE OUTCOMES

At the end of the practical course the students will be able to:

1. Identify the types of control valve for a particular process number to determine the characteristics of level and flow transmitter and identify the error if any
2. Model and design controllers for different processes.
3. Design and implement advanced control techniques.
4. Develop and program with TUTSIM and MATLAB software for process control applications.
5. Do the modeling of a real time process.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓								
CO2	✓	✓	✓								
CO3				✓				✓			
CO4		✓			✓			✓			
CO5	✓		✓		✓	✓		✓			

EIPCCP17	**INSTRUMENTATION SYSTEM DESIGN LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

COURSE OBJECTIVES

- To impart knowledge about the implementation of Auto/Manual switch in PID controller.
- To study and implement anti-reset windup scheme and various practical forms of PID controller
- To design and implement an electronic PID controller
- To design and implement signal conditioning circuits for various processes.
- To learn the design and development procedure of cold junction compensation scheme for a thermocouple using RTD

LIST OF EXPERIMENTS

1. a. Implementation of Auto/Manual switch in PID controller
   b. Implementation of anti-reset windup scheme
2. Design of an Annunciator circuit using PLC
3. a. Implementation of practical forms of PID controller
   b. Design and simulation of two position controller for a Thermal process using
   Electronic Work Bench (EWB) software
4. Design and implementation of electronic PID controller
5. Realization of first order and second order systems with dead time using electronic circuits
6. a. Design and implementation of cold junction compensation scheme using RTD
   b. Design of Signal conditioning circuit for the given process
7. Design of Alarm circuit using Logic gates.
8. Design of control valve sizing and orifice.

COURSE OUTCOMES

At the end of the practical course the students will be able to

1. Design and implement the electronic PID controller with auto manual switch.
2. Design PLC based annunciator circuit and logic gates based alarm circuits.
3. Design PID controller with anti reset windup schemes and design of practical forms of process processes.
4. Design and implement cold junction compensation schemes.
5. Design orifice for flow process and size A control valve for a particular application.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓			✓						✓
CO2	✓	✓		✓	✓						✓
CO3	✓	✓		✓	✓						✓
CO4	✓	✓	✓		✓	✓					
CO5	✓		✓	✓	✓						✓

EIPCPC21	**INDUSTRIAL DATA COMMUNICATION AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To provide fundamental knowledge about industrial data acquisition system and different industrial networking standards.
- To provide comprehensive knowledge about the methods of internetworking.
- To give basic knowledge in the architecture and local control unit of distributed control system.
- To give adequate information about SCADA, PLC and OPC.
- To give basic knowledge about HART, field bus, and control network technology.

Data Acquisition Systems(DAS): Review of A/D and D/A Converters - Sampling and digitizing - Review of Analog Communication Systems and techniques - multiplexing –TDM & FDM- Data Communication - transmission lines and digital signals - practical line interface circuits - serial asynchronous communication protocol - Intel 8251A - current loop, RS 232 C- RS 485 - GPIB – USB, Bluetooth.

MODEM: Data coding methods - error detection, correction and encryption. Fiber Optic transmission - Optical fiber Cables - light sources and detectors.Architecture of a PLC – Analog and digital types of I/O modules – PLC system memories - Program and data organization inside a PLC - Networking of multiple PLC.

Methods of Computer Control of Processes, their Configuration and Comparison: Direct Digital Control, Supervisory Digital Control, Distributed Control System (DCS).

DCS :- Local Control Unit(LCU) and architecture - LCU languages - LCU - Process interfacing issues. Operator interface - requirements Engineering interface - requirements - displays - alarms and alarm management. Factors to be considered in selecting a DCS. Introduction to SCADA, OLE for Process control(OPC).

Network Models and Protocols: OSI model - Data link Control protocol. Media access protocol: Command/response - Token passing - CSMA/CD, TCP/IP. Bridges - Routers - Gateways.Standard ETHERNET and Industrial ETHERNET Configuration - Special requirement for networks used for Control, Wireless LAN.Introduction to MODBUS, CANBUS, LON WORKS, FIP.

Common Industrial Protocols:HART: Introduction - Evolution of Signal standard - HART Communication protocol - Communication modes - HART Commands – HART and the OSI model.Field Bus: Introduction - General Field bus architecture - basic requirements of field bus standard - field bus topology - Interoperability - Interchangeability.

REFERENCES

1. Behrouz A. Forouzan, Data communications and Networking, Tata Mcgraw Hill, 2004.
2. Frank Petruzella, Programmable Logic Controllers, 5th Edition, McGraw-Hill, 2017.
3. William L. Schweber, Data Communications, McGraw-Hill, 1988.
4. Yokogawa – CS 3000, Fundamental Training manual, 2009.
5. Romilly Bowden, HART Application Guide, HART Communication Foundation, 1999.
6. BG Liptak, Instrument Engineer Handbook- Process software and Digital Networks, 4th Edition, 2011.

COURSE OUTCOMES

At the end of the course the students will be able to:

1. Understand the basic principle and modes of digital data transmission and communication.
2. Understand the various types of buses and devices used for data communication in industry.

3. Implement the automation concepts in a process industry with DCS and PLC.
4. Understand different networking topologies for data communication in process industries.
5. Use HART and Filedbus protocols for process industries.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓		✓			✓			✓		✓
CO2		✓	✓		✓						
CO3				✓	✓	✓		✓			✓
CO4			✓	✓			✓				
CO5				✓	✓				✓		

EIPCPC22	**SYSTEM IDENTIFICATION AND MODELLING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on various non parametricapproach based system identification.
- To make the student understand the principles of state space modelling of linear and nonlinear systems.
- To know non recursive and recursive parametric identification approaches.
- To learn to develop robust parametric identification methods.
- To impart knowledge pertaining to practical aspects of system identification and control.

Process Identification (Non-Parametric methods): Transient response analysis - frequency response analysis - correlation analysis - State space modeling of systems - nonlinear state space model and linearization of nonlinear models ;modeling in state space - state space models – canonical state space forms- mechanical systems –electrical systems – liquid level systems- thermal systems. state estimation using kalman filter-extended kalman filter – unscented kalman filter-ensemble kalman filter for parameter identification.

Discrete Time System Models for Control: ARX models - bilinear parametric models – ARMAX,OE,BJ models - Hammerstein models – Wienner model – prediction error method and instrumental variable method .Selection of pseudo random binary sequence.

Recursive Plant Model Identification in Open-loop: Identification methods - least squares - recursive least squares - extended least squares – generalized least squares –weighted LSE-maximum likelihood method - model validation identified in open-loop – model order selection.

Recursive Plant Model Identification in Closed-loop: Identification methods - closed-loop output error algorithms - filtered closed-loop error algorithms - filtered

open-loop identification algorithms - model validation identified in closed-loop - comparative evaluation of various algorithms. Subspace identification method: classical and innovation forms, free and structures parameterizations- relay feedback identification of stable processes and unstable processes.

Nonlinear System Identification: Modeling of non linear system using ANN-NARX, NNSS,NARMAX- generation of training data – training feed-forward and recurrent neural networks- tsk model- adaptive neuro-fuzzy inference system(ANFIS), Practical aspects of System identification and control: Selection of input signals - offline and online identification; notion for persistent excitation, - drifts and de-trending-outliers and missing data-pre-filtering-robustness – comparison of parameter estimation methods – model order testing and verification-case studies.

REFERENCES

1. Ioan D. Landau and GianlucaZito, Digital Control Systems, Design, Identification and Implementation, Springer-Verlag London Limited 2006.
2. Dan Simon, "Optimal State Estimation Kalman,H-infinity and Non-linear Approaches", John Wiley and Sons, 2006.
3. Arun K. Tangirala, " Principles of System Identification: Theory and Practice", CRC Press. 2014.
4. F.Van der Heijden, R.P.W.DUIN, D.de Ridder and D.M.J. Tax, "Classification, Parameter Estimation and State Estimation , An Engineering Approach Using MATLAB, John Wiley & Sons Ltd. 2004.
5. Principles of System Identification: Theory and Practice, ArunK.Tangirala, CRC Press,Taylor and Francis group, 2015.
6. Karel J. Keesman , "System Identification: An Introduction",Springer publication,2011.

COURSE OUTCOMES

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

1. Identify a suitable continuous time domain identification method for the taken up process.
2. Select a particular state space model based on specific control engineering problem.
3. Understand and implement the various complexity estimation methods, offline and online, open and closed loop estimation methods for modelling and estimating a process.
4. Gain an idea for Robust parameter estimation.
5. Select a specific identification method with an approximately equal complexity for the case studies.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓		✓							
CO2	✓		✓					✓			
CO3		✓			✓						
CO4							✓				✓

CO5	✓			✓				✓			

EIPCCP26	**INDUSTRIAL AUTOMATION LAB**	**L**	**T**	**P**	**C**
		0	**0**	**3**	**2**

COURSE OBJECTIVES

- To impart knowledge on various digital Controller design.
- To design and implement tuning techniques of PID controller and verify in MATLAB/Simulink environment.
- To design and implement closed loop control for processes like Air temperature, Air flow and Level using LABVIEW software.
- To familiarize students with fundamental programming concepts in PLC and implementation of ladder logic for an automation application.
- To study the applications of SCADA and DCS for a typical process control application.

LIST OF EXPERIMENTS

1. Design and Simulation of Dead-beat controller using TUTSIM
2. a. Design of Dead time compensator using smith predictor algorithm using MATLAB/SIMULINK
   b)Design and Simulation of Inverse response compensator using MATLAB/SIMULINK
3. a. Study of LABVIEW software
   bStudy of Programmable Logic Controller (Keyence PLC)
4. b)Direction Control of DC motor using PLC
5. Study of SCADA software (Intouchwonderware)
6. PC based control of a simulated process
7. Design of Fuzzy &Neurocontroller for a Pressure Process
8. Study of DCS (Centum CS 3000)

COURSE OUTCOMES

At the end of the practical course the students will be able to

1. Model and design digital controllers for different processes.
2. Apply artificial intelligence algorithm for process control.
3. Get hands on experience on PLC interfacing and troubleshooting
4. Demonstrate his/her ability to develop code in LabView and SCADA software for process control applications.
5. Understand the features of DCS with real-time interface.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓				✓				✓	

CO2	✓	✓			✓	✓	✓			✓	✓
CO3		✓	✓	✓	✓					✓	
CO4	✓	✓	✓	✓	✓	✓		✓			
CO5	✓	✓			✓						

EIPCTS27	**INTERNSHIP AND SEMINAR**	**L**	**T**	**P**	**C**
		0	**2**	**2**	**2**

COURSE OBJECTIVES

- To expose the students to occupational environment related to controls and instrumentation.
- To create opportunity for acquiring practical skills in carrying out preventive maintenance of various field instruments.

The students should undergo training program in reputed industries in the field of process control and instrumentation during the summer vacation (at the end of second semester for full time) for a minimum stipulated period of four weeks. After completion of the training, the students have to submit a detailed report within ten days from the commencement of the third semester for full time on the training they had undertaken. The students will be evaluated bya team of staff members nominated by the head of the department through a viva voce examination.

COURSE OUTCOMES

At the end of the training the students will be able to

1. Face the challenges related to work environment
2. Manage the issues arising during the execution of projects related to process control and instrumentation.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓	✓	✓	✓		✓		✓	✓
CO2	✓	✓	✓	✓	✓			✓			✓

EIPCPV33	**PROJECT WORK & VIVA-VOCE PHASE-I**	**L**	**Pr**	**S**	**C**
		0	**16**	**4**	**10**

COURSE OBJECTIVES

- To develop the ability to solve a scientific problem related to controls and instrumentation all the way from its identification, literature review till the successful solution of the same.
- To train the students in preparing project reports, face reviews and viva voce examination.

COURSE OUTCOMES

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

1. Take up any challenging practical problems and find solution
2. Learn to adapt systematic and step-by-step problem solving methodology.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓			✓	✓			✓		✓
CO2		✓		✓				✓			✓

EIPCPV41	**PROJECT WORK & VIVA-VOCE PHASE-II**	**L**	**Pr**	**S**	**C**
		0	**24**	**6**	**15**

COURSE OBJECTIVES

- To develop the ability to solve a scientific problem related to controls and instrumentation all the way from its identification, literature review till the successful solution of the same.
- To train the students in preparing project reports, face reviews and viva-voce examination.

COURSE OUTCOMES

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

1. Take up any challenging practical problems and find solution
2. Learn to adapt systematic and step-by-step problem solving methodology.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓			✓	✓			✓		✓
CO2		✓		✓				✓			✓

PE - PROGRAM ELECTIVES

EIPCPEXX	**INSTRUMENTATION SYSTEM DESIGN**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make students familiarize orifice design and control valve sizing procedure.
- To impart knowledge on the design of signal conditioning circuits for the measurement of level and temperature.
- To develop skills needed to design and test Analog/ Digital PID controller, data acquisition system and alarm annunciator.

Orifice meter - design of orifice for given flow condition - design of rotameter. Control valves - design of actuators and positioners - valve characteristics - sizing of control valves - liquid, gas and steam services.

Design of V-I, I-V ,P-I and I-P converters. Analog and Digital filter design and Adaptive filter design – Design of signal conditioning circuits for level measurement - Design of signal conditioning circuits for temperaturemeasurement-RTD,thermocouple and thermistor.

Design of cold junction compensation circuit for thermocouple using RTD. Transmitters - zero and span adjustment in D/P transmitters - temperature transmitters- design of RTD based temperature transmitter, thermocouple based temperature transmitter, capacitance based level transmitter and smart flow transmitters, design of flapper-nozzle and design of pneumatic amplifiers.

Design of ON / OFF Controller using Linear Integrated Circuits- Electronic P+I+D controllers - design - adjustment of set point, bias and controller settings- Design of microprocessor based P+I+D controller - Design of microprocessor based system for data acquisition.

Design of alarm and annunciation circuits using analog and digital circuits – Design of Programmable Logic Controller - Design of configurable sequential controller using PLDs.

REFERENCES

1. C.D. Johnson, Process Control Instrumentation Technology, Prentice Hall of India, 8th Edition, 2014.
2. J.P.Bentley, Principles of Measurement Systems, Pearson Education,4th edition, 2004
3. N.A.Anderson, Instrumentation for Process Measurement and Control, Chilton Company, 3rd Edition,2005.
4. D.M.Considine, Process Instruments and Controls Handbook, McGraw-Hill., Fourth Ediion, 1994.
5. Bella G Liptak, Instrument Engineers' Handbook, Elsevier, 3rd Edition, 2010
6. Michael D. Whitt, Successful Instrumentation and Control Systems Design,ISA, 2nd Edition, 2012

COURSE OUTCOMES

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

1. Carryout orifice and control valve sizing for liquid/steam services.
2. Design signal conditioning circuits for temperature sensors, V/I , I/V P/I and I/P converters.
3. Design transmitters.
4. Design, fabricate and test PID controllers and alarm circuits.
5. Design microprocessor based data acquisition system

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓										✓
CO2	✓	✓		✓							✓
CO3	✓	✓		✓							✓

CO4			✓	✓	✓						✓
CO5	✓	✓			✓						✓

EIPCPEXX	**ADVANCED INSTRUMENTATION SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To familiarize the students with concepts of fiber optic sensors, modulating techniques and measurement methods.
- To impart knowledge about laser instrumentation and its application in industry.
- To equip the students about the principle and application of ultrasonic instrumentation systems.
- To learn virtual instrumentation system and software.
- To understand about the smart instruments used in transmitters, communication and measurement systems.

Fiber Optic Instrumentation

Principle of light propagation through a fiber- different types of fiber and their properties-fiber optic sensors- fiber optic instrumentation systems- different types of modulators- optical detectors- measurement of length by interferometer method-moiré fringes- Measurement of pressure, temperature, current, voltage, liquid level and strain.

Laser Instrumentation

Fundamental characteristics of laser-three level and four level laser-laser modes- resonator configuration-q switching and mode locking-cavity dumping-types of laser- measurement of length, distance, velocity, acceleration, current, voltage and atmospheric effects using laser- material processing- laser heating, welding, melting and trimming of materials- removal and vaporization.

Ultrasonic Instrumentation

Principle and propagation of ultrasonic waves- characterization of ultrasonic transmission-reflection and transmission coefficients-generation of ultrasonic waves-magnetostrictive and piezoelectric effects- ultrasonic test methods-pulse echo, transit time, resonance, direct contact and immersion type-measurement of thickness, depth, flow using ultrasonic sensors.

Virtual Instrumentation

Block diagram and architecture of virtual instrumentation- VI's and sub VI's-loops and charts-arrays, clusters and graphs-case and sequence structures-formula nodes, local and global variables- string and file i/o- instrument drivers-publishing data in the web.-simulation of system using VI- development of virtual instrument using GUI.

Smart Measuring Instruments

Smart/Intelligent transducer- Comparison with conventional transducers- Self diagnosis and remote calibration features- Smart transmitter with HART communicator protocol -Measurement of temperature, pressure and Flow using HART transmitter.

REFERENCES

1. Govind P. Agrawal, Fiber-Optic Communication Systems, 4th Edition, Wiley publication, 2010.
2. S.Nagabhushana and N.Sathyanarayana, Lasers and Optical Instrumentation, I.K.International publishing, 2010.
3. Jovitha Jerome, Virtual Instrumentation using LabVIEW, , Eastern Economy edition, PHI learning private Ltd., 2010
4. Lisa .K, Wells and Jeffrey Travis, "LABVIEW for Everyone", Prentice Hall, 2009.
5. Paul. W.Chapman, "Smart sensors" ISA Publications, 1996.
6. J.B.Dixit, AmitYadav, "Intelligent Instrumentation for Engineers", University Science Press 2012.

COURSE OUTCOMES

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

1. Select fiber optic sensors and Design a fiber optic based instrumentation system for the measurement of industrial process variables.
2. Apply the principle of Lasers and develop laser based measuring instrumentation system.
3. Develop ultrasonic instrumentation system for measurement and analysis.
4. Design systems applying virtual instrumentation principles.
5. Handle smart instruments and HART transmitters.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓								
CO2	✓		✓								
CO3			✓								
CO4	✓		✓	✓		✓		✓			
CO5			✓		✓						✓

EIPCPEXX	**INSTRUMENTATION IN PETROCHEMICAL INDUSTRY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

To enable students to acquire knowledge about

- The different methods of crude oil recovery, processing and refining
- Important Unit operations in petroleum refinery and petrochemical industry

- Production routes of important petrochemicals, and Control of selected petrochemicals roduction processes
- Hazards and therefore the necessary safety measure in planning and function of petrochemical Industry.

Oil Extraction and Processing

Techniques used for oil discovery:-seismic survey - methods of oil extraction - oil rig system – Primary, Secondary and Enhanced oil recovery - separation of gas and water from oil - control loops in oil gas separator - scrubber – coalescer.

Petroleum Refining

Petroleum refining process - unit operations in refinery :- thermal cracking - catalytic cracking - catalytic reforming - polymerization - isomerization - alkylation - Production of ethylene, acetylene and propylene from petroleum.

Chemicals from Petroleum

Chemicals from methane, acetylene, ethylene and propylene - production routes of important petrochemicals such as polyethylene, polypropylene, ethylene dioxide, methanol, xylene, benzene, toluene, styrene, VCM and PVC.

Control Loops in Petrochemical Industry

Control of binary and fractional distillation columns - Control of catalytic and thermal crackers - control of catalytic reformer - control of alkylation process - Control of polyethylene production – Control of VCM and PVC production.

Safety in Instrumentation System

Area and material classification as per National Electric Code (NEC) - Classification as per International Electro technical Commission (IEC) - Techniques used to reduce explosion hazards - Pressurization techniques - Type X, Type Y and Type Z - Intrinsic safety - Mechanical and Electrical isolation - Lower and Upper explosion limit.

REFERENCES

1. HavardDevold, “Oil and Gas Production Handbook-An Introduction to Oil and Gas Production” ABB ATPA Oil and Gas, 2006.
2. Bela G. Liptak, “Instrumentation in Process Industries”, Chilton Book Company, 2005.
3. Petroleum Refining: Technology and Economics, J.H. Gary and G.E.Handwerk, 4 th Edition, Marcel Dekkar, Inc., 2001.
4. Ram Prasad, Petroleum Refining Technology, Khanna Publishers, New Delhi, 2000.
5. Petroleum Production Engineering: A Computer Assisted Approach, BoyunGuo, William C. Lyons, Ali Ghalambor, Elesevier Science & Technology Books, 2007.
6. Petrochemical Process Technology, ID Mall, Macmillan India Ltd., 2007.

COURSE OUTCOMES

After completing this course the student will:

1. Gain basic knowledge about the methodologies applied for recovery and processing of petroleum.
2. Be familiar with different unit operations involved in Petroleum industry.
3. Have a general understanding of the production routes for important petrochemicals.
4. Be able to describe the control of Important processes like FCCU, Catalytic Reformerand Alkylation.
5. Be able to classify the hazardous zones and gain knowledge about the techniques used to reduce the explosion hazards.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓					✓			✓		✓
CO2		✓	✓				✓		✓		✓
CO3	✓	✓	✓	✓	✓			✓	✓		✓
CO4	✓		✓		✓				✓	✓	✓
CO5	✓		✓	✓	✓				✓		✓

EIPCPEXX	**THERMAL POWER PLANT INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

After completion of the course the students will acquire extensive knowledge about:

- Operation & importance of Instrumentation in Thermal power plant
- Development of Mathematical model of different systems in Thermal power plant
- Conventional and advanced control schemes applied to various processes in ThermalPower Plant
- Measurement of important parameters and control techniques applied to steam turbines
- Calculation and optimization of Boiler efficiency by including various losses in thermal power plant

Basics of Thermal Power Plant

Process of power generation in coal – fired and oil-fired thermal power plants- Types of Boilers Combustion process – Super heater – Turbine – Importance of Instrumentation in thermal power plants.

Boiler Modeling

Development of first principle and data driven models:- combustion chamber, boiler drum, superheater and attemperator

Boiler Control

Combustion control: Air-fuel ratio control-furnace draft control –Drum level control –Steam temperature Control– DCS in power plant – Interlocks in Boiler

Operation- Model predictive control of super heater – control of drum level using AI techniques.

Turbine & Alternator - Monitoring and Control

Measurement of speed, vibration, shell temperature of steam turbine – Steam pressure Control – Speed control of turbine – Alternator- Monitoring voltage and frequency –Operation of several units in parallel- Synchronization.

Optimization Of Thermal Power Plant Operation

Determination of Boiler efficiency – Heat losses in Boiler – Effect of excess air – Optimizing total air supply- Combustible material in ash- Reduction of turbine losses-Choice of optimal plant parameters- Economics of operation.

REFERENCES

1. A.B.Gill, "Power Plant Performance", Elsevier India, New Delhi , 2013.
2. S.M.Elonko and A.L.Kohal, "Standard Boiler Operations", McGraw Hill, New Delhi, 1994.
3. Sam G. Duke Low, "The Control of Boiler", ISA press, 1991 .
4. R.K.Jain, "Mechanical and Industrial Measurements", Khanna Publishers, New Delhi, 1995.
5. K. Krishnaswamy and M. PonniBala, "Power Plant Instrumentation", PHI Learning Pvt. Ltd, Delhi, 2015.

COURSE OUTCOMES

1. The student will be equipped with the basic knowledge of function of different systems in Thermal power plant
2. The student knows the procedural steps to obtain the mathematical model of various units inThermal power plant
3. Will be able to explain conventional and advanced control concepts and implementation in various processes.
4. Will get idea on the parameters to be monitored, measured and controlled in steam turbines calculation and optimization of Boiler efficiency by including various losses in thermal power plant.
5. Understand important control circuits in boiler and interlock in boiler operations.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓									
CO2	✓	✓				✓		✓			✓
CO3	✓	✓	✓		✓						
CO4	✓	✓		✓		✓	✓		✓	✓	✓
CO5	✓		✓	✓	✓					✓	✓

EIPCPEXX	VIRTUAL INSTRUMENTATION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide the background for developing a VI
- To make the student become competent in using state-of-the-art VI tools.
- To enable the student to gain experience in data acquisition and instrument control

Introduction

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

VI Programming Techniques

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O.

Data Acquisition

Introduction to latest ADCs, DACs. Introduction to PC based data acquisition - typical plug-in data acquisition board - multiplexing of analog inputs - single ended and differential inputs - different strategy for sampling of multi channel analog inputs. Concept of universal DAQ card - use of timers/counters

VI Toolsets

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Simulation of level, thermal, reactor processes. On-Off controller PID Controller.

Applications

Distributed I/O modules-Virtual Laboratory, Virtual Oscilloscope, Virtual function generator, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

REFERENCES

1. Robert H.Bishop, " LabVIEW 2009 Student Edition", Pearson College Division, 2009.
2. N.Mathivanan, "PC-based Instrumentation :Concepts and Practice", Eastern Economy Edition, PHI Learning private ltd ,2007.
3. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.
4. Jovitha Jerome, "Virtual Instrumentation Using LabVIEW", Eastern Economy Edition, PHI Learning private ltd ,2010.

5. Franco Davoli, Norbert Meyer, Remote Instrumentation and Virtual Laboratories: Service Architecture and Networking , Kindle Edition, 2010.
6. Kevin James, "PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control", Newnes, 2000.

COURSE OUTCOMES

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

1. Develop software program in VI
2. Experiment with plug-in DAQ interfaces for prototypemeasurement systems
3. Implement basis concepts incorporating various VI Toolsets based on the application in Virtual Instruments.
4. Get the knowledge of Smart Sensors.
5. Get knowledge about VI for real time systems, embedded controller, HMI/SCADA software and Active X programming.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓			✓		✓			✓
CO2	✓	✓	✓		✓						✓
CO3	✓	✓	✓	✓		✓					✓
CO4	✓	✓	✓	✓	✓				✓		
CO5	✓			✓	✓	✓	✓		✓		✓

EIPCPEXX	**AUTOMOTIVE INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the students to understand the role of electronics and software related to current trends in automobiles.
- To provide fundamental knowledge of sensors and other technologies used in modern automobiles.
- To provide a strong knowledge on control system to improve safety measures and also to increase comforts of users.
- To impart knowledge on Automotive standards and protocols.

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.

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.

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.

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.

Automotive Standards, Protocolsand Energy Management

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).

BMS (Battery Management System), FCM (Fuel Control Module),principles of system design, assembly process of automotives and instrumentation systems.

REFERENCES

1. Understanding Automotive Electronics, William B. Ribbens, Butterworth Heinemann Woburn, 6th ed., 2003.
2. Sensors Applications, Sensors for Automotive Technology by Jiri Marek, Hans Peter Trah, Wiley, 1st Edition, 2003.
3. U.Kiencke, and L. Nielson, *Automotive Control Systems*, Springer Verlag Berlin, 2000.
4. Automotive computers and control system by Tom Weather Jr. &Cland C. Hunter, Prentice Hall Inc., New Jersey, 1984.
5. Understanding Automotive Electronic by Bechhold, SAE, 1998.
6. Automotive Hand Book by Robert Boshe, Bentely Publishers, 5th ed. Germany, 2005.

COURSE OUTCOMES

After learning this course, the students should be able to:

1. Evaluate the sensor and measuring system of automobile.
2. Design the basic modeling and control scheme for automotive systems.
3. Acquire knowledge of various automotive standards and Protocols.
4. understand the current trend in the role of electronics and softwares in automobiles.
5. Apply electronics for body dashboard and Anti Lock Braking systems

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓		✓		✓	✓				✓	
CO2	✓			✓			✓	✓			✓
CO3			✓		✓		✓			✓	✓

CO4		✓		✓	✓						
CO5		✓	✓		✓			✓		✓	✓

EIPCPC22	**ADVANCED PROCESS CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To review the processes with special characteristics.
- To study the fundamental design and implementation of MPC.
- To study robust control system philosophy.
- To design and analyse optimal controllers.
- To understand and design controllers for MIMO process.

Introduction to Process Control: Review of first order and higher order systems, self and non-self regulatory processes, inverse response processes, non-minimum phase processes and open-loop unstable processes. Response to step, impulse and sinusoidal disturbances. Review of design and implementation of PID controller.

Model based Predictive Control: MPC strategy – MPC elements – prediction models – objective function – obtaining the control law – review of some MPC algorithms – Introduction to Non-linear predictive control.Implementation of Model Predictive Control for Heat exchanger and Distillation column.

Robust Control: Norms of vectors and matrices – norms of systems – calculation of operator norms – vector random spaces- specification for feedback systems – co-prime factorization and inner functions –structured and unstructured uncertainty- robustness synthesis of robust controllers – small gain theorem – d-k – iteration- robust control of second-order plant- robust control of distillation column.

Optimal Controllers:H_2 and H-infinity control – loop shaping design - Formulation – characterization of H-infinity sub-optimal controllers by means of Riccati equations – H-infinity control with full information – H-infinity estimation. LQG controller.

Design of Controllers for MIMO Processes: Introduction to Multivariable process control – selection of controlled outputs manipulation and measurements – RGA for square and non-square plants – control configuration elements – centralized and decentralized feedback control – Trade-offs in MIMO feedback design.

REFERENCES

1. Sigurdskogestad Ian postlethwaite, Multivariable Feedback Control, John wiley& sons, 2000.
2. E.F.Camacho and Bordom, Model Predictive Control, Second edition, Springer – Verlog London limited, 2000.

3. U. Mackenroth “Robust Control Systems: Theory and Case Studies”,Springer international Edition, 2010.
4. J. B. Burl, “Linear optimal control H2 and H-infinity methods”, Addison W Wesley, 2011.
5. D. Xue, Y.Q. Chen, D. P. Atherton, "Linear Feedback Control Analysis and Design with MATLAB, Advances In Design and Control”, Society for Industrial and Applied Mathematics, 2007.
6. I.R. Petersen, V.A. Ugrinovskii and A. V. Savkin, “Robust Control Design using H-infinity Methods”, Springer, 2000.

COURSE OUTCOMES

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

1. Able to analyse system behavior.
2. Able to understand and design MPC for a given process.
3. Ability to design robust control system.
4. Able to understand the concept of H2 and H∞ controller.
5. Able to understand and design a Multi-Input Multi-Output system.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1		✓									
CO2	✓	✓		✓					✓		
CO3		✓	✓		✓	✓					✓
CO4	✓	✓									
CO5				✓		✓			✓		

EIPCPEXX	**ADAPTIVE CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on how to recursively estimate the parameters of discrete input – output models (ARX/ARMAX etc) using recursive parameter estimation methods.
- To make the student understand the principles of STR, MRAC and Gain scheduling.
- To craft the student design simple adaptive controllers for linear systems using above methods.

Introduction

Introduction to System Identification: – Adaptive Control Vs Conventional feedback control - adaptive control schemes.

Gain schedulingand Model Reference Adaptive System

The principle - Design of gain scheduling controllers- Nonlinear transformations - application of gain scheduling - Auto-tuning techniques: Methods based on Relay feedback- Introduction to self oscillating adaptive system. Introduction- MIT rule – Determination of adaptation gain - Lyapunov theory –

Design of MRAS using Lyapunov theory – Bounded input bounded output stability – output feedback – Relations between MRAS and STR– Non-Linear systems.

Deterministic Self-tuning Regulators

Pole Placement design - Indirect Self-tuning regulators - direct self-tuning regulators – Disturbances with known characteristics. Direct adaptive control: Introduction – Adaptive tracking and regulation with independent objectives – Basic design – Extensions of the design – Adaptive tracking and regulation with weighted input – Adaptive minimum variance tracking and regulation – The Basic Algorithms – Asymptotic convergence analysis – Martingale convergence analysis – Adaptive generalized minimum variance control.

Stochastic Self-tuning Regulators

Design of minimum variance controller - Design of moving average controller - stochastic self-tuning regulators. Indirect adaptive control: Introduction – Adaptive pole placement – The basic algorithm – Analysis of the indirect adaptive pole placement – The "Singularity" problem – Adding external excitation –Adaptive generalized predictive control – Adaptive linear quadratic control – Iterative identification in closed loop and controller redesign.

Robust Self-Tuning Regulators,PracticalAspectsandCase studies

Robust direct adaptive control – The problem – Direct adaptive control with bounded disturbances – Direct adaptive control with unmodeled dynamics – an example.Robust indirect adaptive control - Standard robust adaptive pole placement – Modified robust adaptive pole placement-Practical aspects of Adaptive Control system.

Temperature control in a distillation column, chemical reactor control, pulp dryer control & control of a rolling mill.

REFERENCES

1. I.D.Landau, R.Lozano and M.M'Saad, Adaptive Control, second Edition, Springer – Verlog London limited, 2011.
2. Karl J.Astron Bjorn Wittenmark, Adaptive Control, second edition, Dover Edition, 2008.
3. Shankar Sastry, " Adaptive Control: Stability, Convergence and Robustness, Dover Books on Electrical Engineering, 2011.
4. PetrosIoannou , Jing Sun , "Robust Adaptive Control , First Edition, Dover Publication, 2012.
5. Kumpati S. Narendra (Author), Anuradha M. Annaswam, Stable Adaptive Systems, Dover Books on Electrical Engineering, 2005.
6. Gang Tao, "Adaptive Control Design and Analysis" 1st Edition. Wiley Interscience, 2003.

COURSE OUTCOMES

At the end of the course the student will able to

1. Design gain scheduling and the model reference adaptive systems.
2. Design different types of deterministic self tuning regulator.
3. Design different types of stochastic self tuning regulator.
4. Design robust self tuning regulator.

5. Understand practical aspects of adaptive control schemes for industrial processes.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1		✓	✓		✓	✓	✓		✓	✓	✓
CO2			✓		✓	✓				✓	✓
CO3			✓		✓	✓				✓	✓
CO4	✓			✓		✓			✓	✓	✓
CO5	✓			✓	✓	✓		✓		✓	✓

EIPCPEXX	**OPTIMAL CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To study the statement of optimal control problem, formulation of optimal control problem and selection of performance measure.
- To understand the fundamental concepts of calculus of variation and variational approach to optimal control problems.
- To derive the expression for continuous and discrete linear optimal regulator problem.
- To study the concepts of dynamic programming and its application.
- To understand the concept of numerical solution of two point boundary value problem.

Optimal Control Problems and Performance Measures

Statement of optimal control problem - problem formulation and forms of optimal control - selection of performance measures.

Calculus of Variation

Fundamental concepts – extremumfunctionals involving single and several independent functions - final time and final state are fixed - final time is fixed and final state is free - final time is free and final state is fixed - both final time and final state are free. Piecewise smooth extremals - constrained extrema.

Variational Approach to Optimal Problems

Necessary conditions for optimal control - Pontriyagin's minimum principle - state inequality constraints - minimum time problem - minimum control effort problems.

LQ Control Problem

Linear optimal regulator problem - Matrix Riccati equation and solution method - choice of weighting matrices - steady state properties of optimal regulators - linear tracking problem.

Dynamic Programming

Principle of optimality - recurrence relation of dynamic programming for optimal control problem - computational procedure for solving optimal control problems - dynamic programming application to discrete systems - Hamilton Jacobi Bellman equation. Numerical Techniques: Numerical solution of two-point boundary value problem - steepest decent and Fletcher Powell methods.

REFERENCES

1. D.E.Kirk, Optimal Control Theory-An Introduction, Dover Publications, New York, 2012.
2. M.Gopal, Modern Control Systems Theory, Third Edition, New Age International Publishers, 2015.
3. Katruhiko Ogata, Modern Control Engineering, Prentice Hall of India Ltd, Fifth Edition, 2010.
4. Michael Athans and Peter L. Falb, Optimal Control: An Introduction to the Theory and Its Applications, Dover Publications, New York, 2007.
5. D. Subaramnaidu, Optimal Control Systems, CRC Press, Newyork, 2003.
6. Frank L. Lewis, DragunaVrabie, Vassilis L. Symos, Optimal Control, 3rd Edition, Wiley Publication, 2012.

COURSE OUTCOMES

After completion of this paper the student will

1. Understand the optimal control problem formulation and its selection of performance measures.
2. Recognize and recall the fundamentals of calculus of variation.
3. Implement optimal control concept for minimum time and minimum control effort problems.
4. Apply Matrix Ricatti Equation for real world problem.
5. Understand the concepts of dynamic programming and to find numerical solution of two-point boundary value problem.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓			✓	✓		✓	✓	✓
CO2	✓		✓								
CO3			✓			✓		✓		✓	✓
CO4	✓		✓	✓			✓		✓		
CO5			✓		✓	✓	✓	✓			✓

EIPCPEXX	**ROBUST CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the need for robustness in process control

- To study the fundamentals required for robust control of a process
- To study the stability analysis of LTI system
- To design and analyse stabilizing controllers
- To study some of the methods robust optimal problems
- To give complete treatment of optimal and robust controller

Model Uncertainty and Robustness

Norms for signals and systems – I/P O/P relationship – Power analysis- model uncertainty – Small gain theorem - Robust stability – Stability under unstructured uncertainties – Robust performance – Deficiencies of classical control for MIMO systems.

Lyapunov Theory for LTI Systems

Descriptions of linear dynamical systems – Controllability and observability – Kalman canonical decomposition – pole placement and canonical forms – observers and observer based controllers – operations on systems – state space realization for transfer matrices – lyapunov equations – balanced realization – hidden models and pole-zero cancelation – multivariable system poles and zeros.

Stabilizing Controllers

Optimal robust stability – Conformal mapping – Gain margin optimization – Phase margin optimization – Robust performance more generally – Existence of stabilizing controllers- Duality and special problems – Parameterization of all stabilizing controllers – Structure of controller parameterization – Cart pendulum example for stabilizing controller.

LQR and LQG Problems

Algebraic Riccati equations– All solutions of a Riccati equations – Stabilizing solution and Riccati operator – Extreme solutios and matrix inequalities – Spectral factorization – Positive real functions – Inner outer factorization – Normalized co prime factorization - Standard LQR problem- Guaranteed stability margin of LQR – Solution through LMI

H-α Controland μ Synthesis

Problem formulation – Output feedback H-α control – General H-α solutions – Loop shifting – H_2 and H-α integral control – H-α filtering – LMI for robust control.

REFERENCES

1. L. Fortuna, M.Frasca(Eds) ,“Optimal and Robust Control”,CRC press, 2012.
2. K.Zhou, J.C. Doyle and Glover, “Robust and Optimal control”, Prentice Hall, 1996
3. J.C. Doyle, B.A. Francis and A.R. Tannenbaum, “ Feedback Control Theory” Macmillan,1992.
4. U. Mackenroth “Robust Control Systems: Theory and Case Studies”,Springer International edition, 2010.
5. J. B. Burl, “ Linear optimal control H2 and H-infinity methods”, Addison W Wesley, 1998.
6. D. Xue, Y.Q. Chen, D. P. Atherton, "Linear Feedback Control Analysis and

Design with MATLAB, Advances In Design and Control", Society for Industrial and AppliedMathematics, 2007.

COURSE OUTCOMES

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

1. Understand the fundamentals of robustness.
2. Understand the application of robust control in MIMO system.
3. Analyze the stability of robust system.
4. Design and analyze robust control system.
5. Understand the concepts of H-α control and μ synthesis.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓			✓	✓						
CO2	✓	✓		✓							
CO3	✓	✓	✓	✓							
CO4	✓	✓	✓	✓				✓			✓
CO5		✓	✓		✓						

EIPCPEXX	**NON LINEAR SYSTEM THEORY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

1. To introduce the nature of nonlinearities found in control systems both in the forward path and in the feedback path
2. To give exposure to analysis methods of nonlinear systems
3. To understand the describing function analysis.
4. To study about stability analysis.
5. To study about nonlinear control system design.

Non Linear Systems

Non-linear Systems - Behavior of non-linear systems, jump resonance, subharmonic oscillation - Nonlinearities in control system, Nonlinear models and nonlinear Phenomena-Examples, second order systems: qualitative behavior of linear systems, Multiple Equilibria, qualitative behavior near equilibrium points

Phase Plane Analysis

Concept of phase plane analysis, Singular points - construction of phase portraits using isoclines, delta method, Lienard's method and Pell's method - limit cycles-existence of limit cycles.

Describing Function Analysis

Describing Function Analysis: Describing Function Fundamentals-Applications of Describing Functions-Basic Assumptions and definitions-Describing Functions for common nonlinearities. Describing Function Analysis of Non-linear Systems.

Stability Analysis

Stability analysis: Stability in the sense of Lyapunov's - second method of Lyapunov's - Lyapunov's stability analysis of linear time invariant systems and nonlinear system- Krasovskii's theorem- variable gradient method of generating Lyapunov's functions.

Nonlinear Control System Design

Models for Nonlinear systems - Hammerstein and Wiener models - Input signal design for Identification –Real-time parameter estimation for nonlinear systems – Nonlinear PID controller - Gain scheduling control – case studies.

Feedback Linearization- feedback linearization and the canonical form, Input-state and Input-output linearization, Input-state linearization of SISO systems and Input-output linearization of SISO systems.

REFERENCES

1. Hassan K. Khalil, Nonlinear systems, third edition,Prentice Hall, 2002.
2. I.J. Nagarath and M.Gopal, Control Systems Engineering, Fourth Edition, New AgeInternational (P) Ltd., Publishers, 2005.
3. HenkNimeijer, Nonlinear Dynamical Control Systems, Springer Verlag,NewYork, 1990.
4. Alberto Isidori, Nonlinear Control Systems (3rd edition), Springer Verlag, 1995.
5. Jean-Jacques Slotine and Weiping Li, Applied Nonlinear Control, Prentice Hall, New jersey, 1991.
6. K.M.Hangos,J.Bokor and G.Szederkrnyi, Analysis and control of Nonlinear Process systems, Springer.

COURSE OUTCOMES

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

1. Understand the basics of nonlinear systems.
2. Construct the phase plane of systems
3. Derive the describing function.
4. Understand the stability analysis of nonlinear systems.
5. Implement modelling of nonlinear systems and feedback linearization design.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓				✓	✓			✓		✓
CO2	✓	✓					✓				
CO3			✓	✓		✓			✓		✓
CO4				✓	✓					✓	
CO5	✓		✓		✓			✓			✓

EIPCPEXX	STATISTICAL PROCESS CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To make the students understand the purpose and uses of SPC.
- To use the most common types of control charts and carry out process capability studies.
- To import knowledge about various SPC tools, data collection and construct basic control charts.
- To make the students understand concept of control charts for variables and attributes and how to interpret control chart results.
- To impart knowledge of other statistical process monitoring and control techniques.

Quality Improvement in the Modern Business Environment

The meaning of quality and quality improvement, dimensions of quality, quality engineering terminology, a brief history of quality control and improvement, statistical methods for quality control and improvement, univariate process monitoring and control.

Methods and Philosophy of Statistical Process Control

Introduction, chance and assignable causes of quality variation, statistical basis of the control chart basic principles, choice of control limits, sample size and sampling frequency, rational subgroups analysis of patterns on control charts, discussion of sensitizing rules for control charts, control charts application, the rest of the magnificent seven, implementing spc in a quality improvement program, an application of spc, applications of statistical process control and quality improvement tools in transactional and service businesses.

Control Charts for Variables

Control charts for x and r, statistical basis of the charts, development and use of x and r charts, charts based on standard values, interpretation of x and r charts. the effect of non normality on x and r charts, the operating characteristic function, the average run length for the x chart, control charts for –x and s, construction and operation of x and s charts, the x and s control charts with variable sample size, summary of procedures for x and r, and s charts, applications of variables control charts.

Control Charts for Attributes

The control chart for fraction nonconforming, development and operation of the control chart variable sample size, applications in transactional and service

business, the operating characteristic function and average run calculations, control charts for nonconformities (defects).

Other Statistical Process Monitoring and Control Technique

The cumulative sum control chart, basic principles: the cusum control chart for monitoring the process mean, the tabular or algorithmic cusum for monitoring the process mean, recommendations for cusum design, Exponential Weighted Moving Average [EWMA], EWMA for monitoring the process mean, design of EWMA, combining EPC(Engineering process control) and SPC, MINITAB software.

REFERENCES

1. Donald J. Wheeler, Understanding Variation: The Key to Managing Chaos 2, SPC Press, Revised Edition, 2000.
2. Paul Keller, Statistical Process Control Demystified, McGraw Hill Education, 1st Edition,2011.
3. Douglas Montgomery, Introduction to Statistical Process Control, Wiley publications, 7th Edition, 2013.
4. Eslie M. Licinski, Statistical process control , Artech House Publication,2000.
5. PeihuaQiu, Introduction to Statistical Process Control CRC Press, second Edition, 2013.
6. John S. Oakland, Statistical process control, Butterworth Heinmann, sixth edition, 2008.

COURSE OUTCOMES

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

1. Analyse quality control in industries.
2. Understand SPC and its design tools.
3. Construct control charts.
4. Understand the concept of variable and attribute charts.
5. Understand process monitoring and control techniques.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓				✓				
CO2	✓			✓							
CO3		✓									
CO4	✓										
CO5	✓		✓		✓			✓			

EIPCPEXX	**ADVANCED DIGITAL SIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- To review the mathematical basis of discrete time signal analysis.

- To discuss the estimation theory and predictors.
- To design and implement adaptive filters.
- To study the techniques of modern signal processing applications using multirate transforms.

Discrete Random Signal Processing: Discrete Random Processes, Expectations, variance, Co-variance, scalar product, energy of discrete signals-Parseval's theorem. Wiener Khintchine relation- power spectral density Periodogram sample autocorrelation-sum decomposition theorem, spectral factorization theorem- discrete random signal processing by linear systems- simulations of white noise-low pass filtering of white noise.

Spectrum Estimation: Non-parametric methods-correlation method- co-variance estimator - performance analysis of estimators-unbiased, consistent estimators Periodogram Estimator-Barlett spectrum estimation-Welch estimation Model based approach- ARMA and ARMA Signal Modeling -Parameter estimation using Yule - Walker method.

Linear Estimation and Prediction: Maximum likelihood criterion- efficiency of estimator - least mean square error criterion-Wiener filter discrete Wiener Hoff equations-Recursive estimators - Kalman filter- linear prediction, prediction error-whitening filter, inverse filter-Levin son recursion, Lattice recursion, Lattice realization.

Adaptive Filters: FIR adaptive filters - Newton's steepest decent method - adaptive filter based on steepest descent method Window-Hoff LMS adaptive algorithm - Adaptive channel equalization- Adaptive echo cancellor- adaptive noise cancellation- RLS adaptive filters-Exponentially weighted RLS- sliding window RLS-simplified IIR LMS adaptive filter.

Multirate and Wavelet Transform: Review of Decimation and Interpolation Process. Sub band filter theory – PR condition – Cosine modulated filters – Para-unitary filters. Application of wavelet transform with Sub band filter theory. Wavelet transform as a correlator. Multiresolution theory – Heisenberg uncertainty principle – Two dimensional wavelet transform.

REFERENCES

1. Manson H.Hayes, Statistical Digital Signal Processing and Modelling, John Wiley and sons, Inc., New York, 1996.
2. John G. Proakis, Dimitris G. Manolakis, Digital Signal processing, prentice Hall of India, 1995.
3. Sopocles J. Orfanidis, Optimum Signal Processing, McGraw Hill, 1990.
4. N. J Fliege ,Multirate Digital Signal Processing, John Wiley & Sons, 1999.
5. Soman K P, Ramachandran K I, Insight into Wavelets: From Theory To Practice, Prentice Hall of India, 2004.

Course OUtComes

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

1. Analysethe functions and characteristics of different op-amps.
2. Familiarize with various estimation techniques.
3. Able to realize systems using different realization algorithms.

4. Able to analyze and implement different types of adaptive filters.
5. Familiarize with multirate wavelet transform and its implementation.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓				✓			✓		✓
CO2	✓	✓					✓				
CO3	✓		✓			✓				✓	
CO4		✓		✓	✓		✓				✓
CO5			✓		✓					✓	✓

EIPCPEXX	**MACHINE LEARNING TECHNIQUES**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the machine learning theory.
- To train linear and non-linear learning models.
- To build tree and ensemble based models.
- To implement clustering & dimensionality reduction techniques.
- To apply reinforcement learning techniques.

Foundations of Learning

Components of learning – learning models – geometric models – probabilistic models – logicmodels – grouping and grading – learning versus design – types of learning – supervised –unsupervised – reinforcement – theory of learning – feasibility of learning – error and noise –training versus testing – theory of generalization – generalization bound – approximationgeneralizationtradeoff – bias and variance – learning curve - nearest neighbor models.

Linear Models

Univariate linear regression – multivariate linear regression – generalization and overfitting–validation–regularizedregression – going beyond linearity– locally weighted regression - logistic regression – perceptrons – multilayer neural networks – learning neuralnetworks structures – support vector machines – soft margin SVM.

Tree and Ensemble Models

Decision trees – learning decision trees – pruning – ranking and probability estimation trees–regressiontrees– k-d trees–ensemble learning– bagging and random forests – boosting – meta learning.

Unsupervised Learning

K-means – clustering around medoids – silhouttes – hierarchical -clustering– Mixture of Gaussians – EM algorithm - principal component analysis –locality sensitive hashing – partial least squares –chemometrics applications.

Reinforcement Learning

Passive reinforcement learning – direct utility estimation – adaptive dynamic programming –temporal-difference learning – active reinforcement learning – exploration – learning an actionutilityfunction – generalization in reinforcement learning – policy search – applications in gameplaying – applications in robot control.

REFERENCES

1. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007.
2. T. M. Mitchell, "Machine Learning", McGraw Hill, 1997.
3. Y. S. Abu-Mostafa, M. Magdon-Ismail, and H.-T. Lin, "Learning from Data", AMLBook Publishers, 2012.
4. Stanfod CS229 Course: http://cs229.stanford.edu
5. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012.
6. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.

COURSE OUTCOMES

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

1. Demonstrate the underpinning knowledge on machine learning.
2. Apply various linear models for different class of predictions.
3. Formulate machine learning problems using tree and ensemble models
4. Apply unsupervised learning algorithm for a typical problem
5. Develop reinforcement learning model for process control applications.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓			✓			✓	✓	✓
CO2	✓	✓	✓								✓
CO3			✓	✓	✓				✓		✓
CO4				✓	✓						
CO5	✓	✓	✓		✓		✓				✓

EIPCPEXX	**ROBOTICS AND AUTOMATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To study the various parts of robots and fields of robotics
- To study the various kinematics and inverse kinematics of robots
- To study the trajectory planning for robot

- To study the control of robots for some specific applications

Basic Concepts and Power Sources and Sensors

Definition and origin of robotics, different types of robotics, Various generations of robots, degrees of freedom, Asimov's laws of robotics, Static and dynamic performance, dynamic stabilization of robots.Hydraulic, pneumatic and electric drives. Determination of HP of motor and gearing: ratio, variable speed arrangements. Path determination, micro machines in robotics. Tactile, Proximity and Range Sensors, laser, acoustic, magnetic, fiber optic sensors and Machine vision system.

Manipulators, Actuators and Grippers

Construction of manipulators, manipulator dynamics and force control. Electronic and pneumatic manipulator control circuits .

End Effectors: Types-Mechanical grippers-Magnetic grippers, Vacuum cups, Adhesive gripper, Hooks and Scoops- Tools as end effectors - Robot/ End-effectors interface- Consideration in Gripper selection and Design.

Path Planning

Jacobian work envelop, hill climbing techniques. Methods of Programming: Leadthrough Methods, Capabilities and limitations of Leadthrough Methods, Robot program as a path in space- Motion interpolation, Robot Programming- structure, Motion, End effectors and Sensor commands, Program control communication, Monitor mode commands and Robot programming languages.

Application and Automation

Factory Automation: Fixed Automation, Flexible Automation and Programmable Automation. Intelligent Industrial Automation, Industrial Networking, Bus Standards. Automatic Feeders, Automatic Storage and Retrieval Systems (AS/RS), Transfer Lines, Automatic Inspection Systems

Applications of Robots

Manufacturing and non- manufacturing applications, robot cell design, selection of robot. Factors influencing the selection of Robots.Introduction to Mobile Robots, Legged Robots and Remote Controlled Robots, Automated Guided Robots, Micro Robots – Control and Safety Issues.

Robot Control: Linear methods, Non-linear methods- Control of Industrial Robots Using PLCs.

REFERENCES

1. Groover, M.P., Weiss, M., Nagel, R.N., Odrey, N.G., Industrial Robots: Technology, Programming and Applications, McGraw-Hill Book Company, 2012.
2. Mittal R K, Nagrath I J, "Robotics and control", Tata McGraw Hill, 2010.
3. Groover, M.P., Automation, Production Systems, and Computer-Integrated Manufacturing, Prentice-Hall of India Private Limited, New Delhi, 2007.
4. Saeed B. Niku, An Introduction to Robotics- Analysis, Systems, Applications, Second Edition, John Wiley & Sons Inc., 2010.
5. K. S. Fu , Ralph Gonzalez, C.S.G. Lee." Robotics", McGraw Hill, 2017.
6. MikellGroover, "Industrial Robotics - SIE: Technology - Programming and Applications", Special Indian Edition, 2017.

COURSE OUTCOMES

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

1. Expertise in fundamentals, Classification and issues related to end effectors and sensors of Robotics
2. Program, Propose and synthesize control law for a given application
3. acquire knowledge about different types of automation
4. Have knowledge about different types of robots safety issues and their applications of robots.
5. Have knowledge about various control methods of robots.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓	✓			✓		✓		✓	
CO2	✓	✓	✓	✓		✓	✓		✓		✓
CO3	✓	✓	✓	✓	✓		✓				
CO4		✓	✓		✓			✓		✓	
CO5		✓	✓		✓				✓		✓

EIPCPEXX	**ARTIFICIAL INTELLIGENCE FOR PROCESS CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To expose the students to the concepts of neural networks, fuzzy logic, genetic algorithm and particle swam optimization.
- To provide adequate knowledge of applications of neurocontroller, fuzzy logic controller and hybrid controllers for real time applications.
- To expose the ideas of GA in optimization and control.

Artificial Neural Networks: Biological neural networks – Artificial neural networks – Activation functions – ANN architectures – Learning methods – Back propagation network – KohonenselfOrgansing Maps – Adaptive Resonance Theory.

Neural Networks for Control: Neurocontroller – Functional block diagram – Inverse dynamics – System identification. Case studies: Neurocontroller for temperature, flow and level processes.

Fuzzy Logic System: Introduction to fuzzy logic – Fuzzy sets and Fuzzy relations: operations and properties -Fuzzification – Types of membership functions – Fuzzy rule base – Canonical rule formation – Decomposition methods.

Fuzzy Logic for control:Design of fuzzy logic controller for temperature and level processes.

Genetic Algorithm:Evolutionary programs – Genetic algorithms: genetic programming and evolutionary programming – Genetic algorithm versus

conventional optimization techniques – Genetic representations and selection mechanisms: Genetic operators – Different types of crossover and mutation operators – Optimization problems using GA – Discrete and continuous. Singleand multi Objective problems.

Hybrid Control Schemes: Fuzzification and rule base using ANN – Neurofuzzy--systems – Introduction to particle swarm optimization techniques – Optimization of membership function and rule base using Genetic algorithm and particle swarm optimization techniques - Hybrid control schemes for temperature and level control systems.

REFERENCES

1. LaureneFausett, Fundamentals of Neural Networks, Prentice- Hall, New Jersey, 3rd edition, 2008.
2. Timothy J. Ross, Fuzzy logic with Engineering applications, McGraw Hill, New York, 3rd edition, 2010.
3. Valluru.B.Rao, Hayagriva.Rao, Neural Networks & Fuzzy Logic, BPB Publications, New Delhi, 2003.
4. D.Driankov, H. Helleneloorn, M.Reinframe, An Introduction To Fuzzy Control, Narosa Publishing Co., New Delhi, 1996.
5. Jacek M. zurada, Introduction to Artificial Neural Systems,Jaico Publishing House, New Delhi, 1997.
6. Rajasekaran.S, VijayalakshmiPai.G.A, Neural Networks, Fuzzy logic and Genetic Algorithms, Prentice-Hall of India private limited, New Delhi,2003.

COURSE OUTCOMES

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

1. Understand the basics of ANN and derive different algorithms.
2. Understand the concept of neurocontroller and its application to process control.
3. Understand the concept of fuzzy logic control and its application to process control.
4. Understand the concept of GA to optimization problem.
5. Understand the concept of hybrid control schemes and its application to process control.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓	✓				✓		✓			✓
CO2	✓	✓	✓		✓					✓	✓
CO3	✓	✓	✓		✓						
CO4	✓	✓	✓		✓	✓			✓		
CO5	✓	✓	✓		✓	✓					✓

EIPCPEXX	REAL TIME EMBEDDED SYSTEM	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the Building blocks of Real Time Embedded System
- To familiarize the embedded hardware components & its interface
- To impart knowledge on embedded software development process
- To make the students understand the Real Time Operating Systems
- To give exposure to the Case studies in various fields

Introduction to Real Time Systems

Fundamentals of systems and RTS - Definitions, classification, Characteristics-Basic model of Real Time Systems – Timing constraints – Safety and Reliability- Typical applications of RTS.

Embedded System Components and its Interface

Embedded system definition- architecture and standards with examples - Embedded hardwareprocessors-memory devices-Interface and Peripherals- ARM processor based embedded boards - Power and its Management.

Embedded System Software Development

Software embedded in a system – IDE , Assembler, Compiler ,linker, simulator,debugger,In - circuit Emulator(ICE), Target hardware debugging , Program modeling – Program models, Data flow model, State machine programming models, UML models - High level language descriptions in embedded system, Java based embedded system design.

RTOS based Embedded System Design

Introduction to basic concepts of RTOS –Task, Process and Threads, Interrupt routines in RTOS, Multiprocessing & Multitasking, Preemptive and non-Preemptive scheduling, Task communication – shared memory –Inter Process communication – synchronization between processes – semaphores, mail box, pipes, priority Inversion, priority Inheritance, comparison of Real time operating systems: Vxworks, µC/OS II.

CASE STUDIES

Case studies of Embedded System Design and Coding in application areas of digital consumer electronics ,automotives and networking/communication.

REFERENCES

1. T.Noergaard , “Embedded Systems Architecture : A Comprehensive Guide for Engineers and Programmers”, Elsevier Publications, 2012.
2. A.S.Berger, “Embedded System Design : An Introduction to Process, Tools and Techniques”, CMP Books, 2008.
3. D.D.Gajski, F.Vahid, S.Narayan, “Specification and Design of Embedded Systems”, PTR Prentice Hall, 2007.
4. D.E.Simon, “An Embedded Software Primer”, Addison Wesley, 2000.
5. Kai Qian, David Den haring, Li Cao, “Embedded Software Development with C”, Springer, 2009.

COURSE OUTCOMES

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

1. Understand the fundamental of RTS and its application areas.
2. Understand the embedded system concepts for RTS.
3. Understand the software development environment for specific application.
4. Design RTOS with embedded system.
5. Understand the concept behind the applications as case studies.

MAPPING OF COs WITH POs											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	✓		✓				✓				✓
CO2											✓
CO3	✓	✓				✓					
CO4				✓				✓			✓
CO5											✓

OE - OPEN ELECTIVES

EIPCOEXX	**INDUSTRIAL DRIVES AND CONTROL**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

Course Objectives

- To learn about electric drives & its types.
- To acquire knowledge about the circuit model of electric motors.
- To implement the power converters for the drives by efficient control algorithms.
- To understand the need for the digital controllers.
- To study about the generation of control pulses for power electronic converters and their applications.

Introduction to Electric Drives: Classification, characteristics and advantages of electric drives – Speed- torque characteristics of various types of loads and drive motors – Joint speed- torque characteristics - Selection of power rating for drive motor based on thermal limits – Overload capacity – Starting, braking and reversing methods for various types of motors.

Modeling of DC and AC Machines: Circuit model of Electric Machines – Transfer function and State space models of series and separately excited DC motor - AC Machines – Dynamic modeling – linear transformations – equations in stator, rotor and synchronously rotating reference frames – flux linkage equations – Dynamic state space model- modeling of Synchronous motor.

Control of DC Drives: Analysis of series and separately excited DC motor with single phase converters operating in different modes and configurations – Analysis of series and separately excited DC motor fed from different choppers – two

quadrant and four quadrant operation – Closed loop control of dc drives – Design and analysis of controllers for load changes.

Control of AC Drives: Induction motor drives – stator voltage control of induction motor – torque – slip characteristics – operation with different types of loads – operation with unbalanced source voltages and single phasing – analysis of induction motor fed from non – sinusoidal voltage supply – stator frequency control – variable frequency operation – V/F control, controlled current and controlled slip operation.Synchronous motor drives – Principles of Synchronous motor control – adjustable frequency operation of synchronous motors – voltage source inverter drive with open loop control static rotor resistance control and slip power recovery scheme.

Digital Techniques in Speed Control: Advantages and limitations – Microprocessor, microcontroller and PLC based control of drives – Selection of drives and Control schemes for paper mills, cement mills, sugar mills.

REFERENCES

1. VedamSubrahmaniam, Electric drives – Concepts and applications, Tata McGraw Hill Publishing House, Chennai, 1994.
2. G.K. Dubey, Fundamental of electrical drives, Narosa Publishing House, Chennai, 1995.
3. G.K.Dubey, "Power Semiconductor Controlled Drives," Prentice Hall International, New Jersey, 1989.
4. Paul .C.Krause, Oleg wasynczuk and Scott D.Sudhoff, "Analysis of Electric Machinery and Drive Systems", 2ndedition , Wiley-IEEE Press, 2013.
5. Bimal K Bose, "Modern Power electronics and AC Drives", Pearson education Asia, 2002.
6. R .Krishnan, "Electrical Motor Drives- Modeling, Analysis and Control", Prentice Hall of India Pvt Ltd., 2nd Edition, 2003.

COURSE OUTCOMES

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

1. Get a thorough understanding of motor-load system dynamics and stability, modern drive system objectives and fundamentals of DC and AC motors.
2. Model both DC and AC motors in various conventional methods.
3. Design and analyze both converter and chopper driven DC drives.
4. Understand conventional control techniques of AC drives and will have the ability to design and analyze such system.
5. Get a detailed knowledge on advanced high performance control strategies for AC drives and emerging technologies in electric drives.

EIPCPEXX	DIGITAL CONTROL	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the components of digital control system

- To provide knowledge on pulse transfer functions and their analysis
- To Introduce Stability Concepts In Discrete Domain
- To Educate On Tuning Of PID Controllers In Discrete Domain
- To Introduce State Variable Analysis In Discrete Domain

Introduction

Advantages of Digital control systems - Practical aspects of the choice of sampling rate and multirate sampling - Basic discrete time signals - Quantization – Sampling theorem - Data conversion and Quantization - Sampling process - Mathematical modeling - Data reconstruction and filtering of sampled signals .

Z - Transform and Inverse ZTransform

Relationship between s - plane and z - plane - Difference equation - Solution by recursion and z - transform - pulse transfer functions of the zero - order hold and relationship between G(s) and G(z)– Bilinear transformation .

Digital Control Systems

Pulse transfer function - z transform analysis of open loop, closed loop systems - Modified z Transform . Root loci - Frequency domain analysis - Bode plots - Gain margin and phase margin - Design of Digital control systems based on Root Locus Technique. State equations of discrete data systems, solution of discrete state equations, State transition Matrix: z - transform method. Relation between state equations and transfer functions.

Controllability and Observability

Concepts on Controllability and Observability - Digital state observer: Design of the full order and reduced order state observer - Pole placement design by state feed back.

Stability Analysis

Stability analysis of linear digital control systems - Stability tests, Stability analysis of discrete time systems based on Lyapunov approach.

REFERENCES

1. M.Gopal, 'Digital Control And State Variable Methods', Tata McGraw Hill, 3rd Edition, 2009.
2. B.C.Kuo, Digital Control System, 2nd Edition, Oxford University Press, 2010.
3. V.I.GeorgeAndC.P.Kurien, Digital Control System, Cengage Learning, 2012.
4. M.SamiFadali, Antonio Visioli, Digital Control Engineering Analysis and Design, Academic Press, 2013.
5. C.M. Houpis, G.B.Lamount, ' Digital Control Systems- Theory, Hardware, Software', International Student Edition, McGraw Hill Book Co., 1985.
6. KannanM.Moddgalya, Digital Control, Wiley India, 2007.

COURSE OUTCOMES

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

1. Analyse digital systems in time domain
2. Analyse digital systems in frequency domain
3. Model and analyse digital systems in state space representation
4. Design controllers for digital systems in state space representation
5. Understand the concept of stability in discrete domain.

EIPCOEXX	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To introduce the technologies and applications for the emerging domain of wirelesssensor networks.
- To impart knowledge on the design and development of the various layers in the WSN protocol stack.
- To elaborate the various issues related to WSN implementations.
- To familiarize the students with the hardware and software platforms used in the design of WSN.

Introduction: Challenges for wireless sensor networks, Comparison of sensor network with ad hoc network, Single node architecture – Hardware components, energy consumption of sensor nodes, Network architecture – Sensor network scenarios, types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, design principles, Development of wireless sensor networks.

Physical Layer: Wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, wave propagation effects and noise, channels models, spread spectrum communication , packet transmission and synchronization, quality of wireless channels and measures for improvement, physical layer and transceiver design consideration in wireless sensor networks, energy usage profile, choice of modulation, power management.

Data Link Layer: MAC protocols –fundamentals of wireless MAC protocols, low duty cycle protocols and wakeup concepts, contention-based protocols, Schedule-based protocols, Link Layer protocols – fundamentals task and requirements ,error control ,framing, link management.

Network Layer: Gossiping and agent-based uni-cast forwarding , Energy-efficient unicast, Broadcast and multicast, geographic routing , mobile nodes, Data –centric and content-based networking – Data –centric routing, Data aggregation, Data-centric storage, Higher layer design issue.

Applications of WSN: WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications - Wildfire Instrumentation - Habitat Monitoring - Nanoscopic Sensor Applications – Case Study: IEEE 802.15.4 LR-WPANs Standard - ZigBee - Target detection and tracking.

REFERENCES

1. Feng Zhao and Leonidas J. Guibas, “Wireless Sensor Networks : An Information Processing Approach”, Elsevier, 2004.
2. Holger Karl and Andreas Willig, “Protocols And Architectures for Wireless Sensor Networks”, John Wiley, 2007.
3. Ivan Stojmenovic, “Handbook of Sensor Networks: Algorithms and Architectures”, Wiley,2005.

4. KazemSohraby, Daniel Minoli and TaiebZnati, “Wireless Sensor Networks: Technology, Protocols and Applications”, John Wiley, 2007.
5. BhaskarKrishnamachari, “Networking Wireless Sensors”, Cambridge University Press, 2011.

COURSE OUTCOMES

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

1. Understand the challenges in wireless sensor networks and various components involved in it.
2. Analyze WSN with respect to various performance parameters in the protocol stack.
3. Understand MAC algorithms and Network protocols used for specific WSN applications.
4. Understand the concept of network layer design issues related to higher layers
5. Design and develop a WSN for a gven application.

EIPCOEXX	DIGITAL IMAGE PROCESSING	L	T	P	C
		3	0	0	3

Course Objectives

- To study the basics of image processing and its applications.
- To familiarize with image enhancement and image compression techniques.
- To learn about image restoration techniques and implementation of projection algorithms.

Digital Image Processing: Origin– components - examples of fields that use DIP.

Digital Image Fundamentals: Elements of visual perception, light and the EM spectrum, a simple image formation model, image sampling and quantization, some basic relationships between pixels. Image transforms - Two dimensional orthogonal and unitary transforms - properties of unitary transform.

Image Enhancement: Point operations - contrast stretching - clipping and thresholding - digital negative intensity level slicing - bit extraction. Histogram: modelling - eqalization - modification. Spatial operations: smoothing techniques - magnification and interpolation. Transform operations.

Image Compression and Segmentation: Compression models - elements of information theory - error free compression - run length coding - loss less and lossy predictive coding - image compression standards.Image Segmentation - Detection of discontinuities, point, line and edge detections, gradient operators, Laplacian, edge linking and boundary detection, thresholding, region based segmentation.

Image Filtering and Restoration: Inverse and weiner filters – filtering using image transforms. Splines and interpolation.Maximum entropy restoration.Bayesian methods. Image analysis- spatial feature extraction - transform features. Edge detection – boundary extraction, shape features image segmentation**.**

Image Reconstruction from Projections: Radon transform-inverse radon transform back projection operator-convolution back projection- parallel beam geometry-Fan beam geometry. MRI Fourier reconstruction.

REFERENCES

1. Rafael C Gonzalez and Richard E Woods, Digital Image Processing, 2nd Edition, Pearson Education, 2003.
2. Jain Anil K., Fundamentals of Digital Image Processing, Prentice Hall of India, New Delhi, 1995.
3. RosenfieldAzriel and KakAvinash C, Digital Picture Processing, Academic PressInc., NY,1991.
4. Pratt William K, Digital Image Processing, John Wiley and Sons, 2001.

Course OUtComes

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

1. Analyzethe basics of image processing.
2. Familiarize with image enhancement techniques.
3. Compress an image using various compression techniques.
4. Restore an image from its degraded version.
5. Construct projections using transforms.

EIPCOEXX	MULTI SENSOR DATA FUSION	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To learn the concepts and techniques used in sensor data fusion.
- To understand the role of Mathematical tools used.
- To elaborate the concept of Kalman filter to data fusion problems.
- To impart knowledgeon advanced filtering techniques .

Multi Sensor Data Fusion: Introduction, sensors and sensor data, Limitations of single sensor, Use of multiple sensors, Fusion applications. The inference hierarchy: output data, Data fusion model, Architectural concepts and issues, Benefits of data fusion.

Mathematical Tools Used: Algorithms, Taxonomy of algorithms for multisensor data fusion co-ordinate transformations, rigid body motion, Dependability and Markov chains, Meta – heuristics, Data association, Identity declaration.

Estimation: Kalman filtering, practical aspects of Kalman filtering, Extended Kalman filters, Partical filter, Decision level identify fusion, Knowledge based approaches.

Advanced Filtering: Data information filter, extended information filter, Decentralized and scalable decentralized estimation, Sensor fusion and approximate agreement, Optimal sensor fusion using range trees recursively, Distributed dynamic sensor fusion.

High Performance Data Structures: Tessellated, trees, graphs and function. Representing ranges and uncertainty in data structures.Designing optimal sensor

systems with in dependability bounds.Implementing data fusion system.Application of multisensor data fusion for mobile robot mapping and Navigation.

REFERENCES

1. David L. Hall, Mathematical techniques in Multisensor data fusion, Artech House, Boston, 2004.
2. R.R. Brooks and S.S.Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey, 1998.
3. Mitchell.H.B, Multi-Sensor Data Fusion-An Introduction, Springer-Verlag, 2012.
4. Martin Liggins, II,JamesLlinas, David L.Hall, Handbook of Multisensor Data Fusion, CRC Press, 2008.
5. Arthur Gelb, Applied Optimal Estimation, M.I.T. Press, 1982.

COURSE OUTCOMES

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

1. Understand the importance of using data fusion in multi-sensor systems.
2. Understand simple approaches to data fusion for enhancing sensor reliability.
3. Derive and apply the kalman filter to data fusion problems.
4. Understand the importance of sensor management and data association.
5. Apply advanced filtering schemes for optimal sensor fusion

AUDIT COURSES

EIPCACXX	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSE OBJECTIVES

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission syllabus.

Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills are needed when writing a Title, Key skills are needed when writing an Abstract, Key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature,

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the conclusion.

Useful phrases, how to ensure paper is as good as it could possibly be the first-time submission.

REFERENCES

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Model Curriculum of Engineering & Technology PG Courses [Volume-I] [41]
3. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press 3.
4. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM.Highman'sbook. Adrian Wallwork, English.

EIPCACXX	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming.

Introduction Disaster Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Repercussions of Disasters and Hazards Economic Damage, Loss of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas in India Study of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness and Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation Meaning Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies" New Royal book Company.
2. Sahni, Pardeep et.al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi. 3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep&Deep Publication Pvt. Ltd., New Delhi.

EIPCACXX	SANSKRIT FOR TECHNICALKNOWLEDGE	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects
- Enhancing the memory power
- The engineering Scholars equipped with the Sanskrit will be able to explode the huge knowledge from ancient literature.

Alphabets in Sanskrit, past/ present/ future tense, simple sentences.

Order, introduction of roots technical information about Sanskrit literature.

Technical concepts of Engineering – electrical, mechanical, architecture, mathematics

REFERENCES

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" PrathamaDeeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

COURSE OUTCOMES

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood.
3. Being a global language, will help to develop logic in students.

EIPCACXX	VALUE EDUCATION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Understand value of education and self- development

- Imbibe good values in students
- Let the should know about the importance of character

Values and self-development –Social values and individual attitude and work ethics, Indian vision of humanism.Moral and non- moral valuation.Standards and principles.Value judgements.

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance. Confidence, Concentration.Truthfulness, Cleanliness.

Honesty, Humanity.Power of faith, National Unity.Patriotism.Love for nature,Discipline.

Personality and Behavior Development - Soul and Scientific attitude.Positive Thinking.Integrity and discipline.Punctuality, Love and Kindness. Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, HappinessVs suffering, love for truth. Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

REFERENCE

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

COURSE OUTCOMES

Students will be able to

1. Get the knowledge of self-development.
2. Learn the importance of Human values
3. Develop the overall personality

EIPCACXX	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
- To address the growth of Indian opinion regarding modern Indian intellectuals’ constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik
- Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

History of Making of the Indian Constitution:

History, Drafting Committee, (Composition& Working)

Philosophy of the Indian Constitution:

Preamble, Salient Features

Contours of Constitutional Rights & Duties:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Organs of Governance:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Local Administration:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative,CEO of Municipal Corporation.

Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Election Commission:

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

REFERENCES

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE OUTCOMES

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before thearrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party
4. [CSP]under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct.
5. Elections through adult suffrage in the Indian Constitution.
6. Discuss the passage of the Hindu Code Bill of 1956.

EIPCACXX	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Introduction and Methodology

Aims and rationale, Policy background, Conceptual framework andterminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions.Overview of methodology and Searching.

Thematic Overview

Pedagogical practices are being used by teachers, in formal and informal classrooms in developing countries.Curriculum, Teacher education.

Evidence on the Effectiveness of Pedagogical Practices

Methodology for the in depth stage: quality assessment of includedstudies. How can teacher education (curriculum and practicum) and the schoolcurriculum and guidance materials best support effective pedagogy? Theory of change.Strength and nature of the body of evidence for effective pedagogicalpractices.Pedagogic theory and pedagogical approaches.eachers' attitudes and beliefs and Pedagogic strategies.

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Research gaps and future directions

Research design, Contexts, Pedagogy Teacher education, Curriculum and assessment, Dissemination and research impact.

REFERENCES

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher Educationresearch project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basicmaths and reading in Africa: Does teacher preparation count? International Journal EducationalDevelopment, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary Education Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms indeveloping countries.
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

EIPCACXX	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

Definitions of Eight parts of yog.(Ashtanga)

Yam and Niyam

Do`s and Don't's in life.

i) Ahinsa, satya, astheya, bramhacharya and aparigraha

ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Asan and Pranayam

i) Various yog poses and their benefits for mind & body

ii)Regularization of breathing techniques and its effects-Types of pranayam

REFERENCES

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami YogabhyasiMandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

COURSE OUTCOMES

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also Improve efficiency

EIPCACXX	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Approach to day to day work and duties

ShrimadBhagwadGeeta :

- Chapter 2-Verses 41, 47,48,
- Chapter 3-Verses 13, 21, 27, 35,
- Chapter 6-Verses 5,13,17, 23, 35,
- Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

ShrimadBhagwadGeeta:

- Chapter2-Verses 56, 62, 68
- Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model.ShrimadBhagwadGeeta:

- Chapter2-Verses 17, Chapter 3-Verses 36,37,42
- Chapter 4-Verses 18, 38,39
- Chapter18 – Verses 37,38,63

REFERENCES

3. 1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication 2. Department), Kolkata
4. 3. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
5. 4. Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES

Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.

ITEM NO.	APPENDIX

FACULTY OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND INSTRUMENTATION ENGINEERING

M.E., REHABILITATIVE INSTRUMENTATION ENGINEERING

REVISED REGULATIONS & SYLLABI

(Students Admitted From the Academic Year 2019-2020)

VISION

To nurture higher echelons of technology through participative education, innovative and collaborative research with a view to bring out employable graduates of International standard.

MISSION

- To establish state of art facilities related to diverse dimension in the field of Instrumentation Engineering, Biomedical Engineering and Microelectronics and MEMS.
- To foster higher quality of education with equivocal focus in theory and practical areas of Electronics, Control and Instrumentation Engineering, Biomedical Engineering and Microelectronics and MEMS.
- To ensure that the dissemination of knowledge reaches the stakeholders and forge the opening of a fresh flair of human resources.
- To create opportunities for advancements in different facets of this discipline and offer avenues to reach the citadels of one's career.

PROGRAMME EDUCATIONAL OBJECTIVES (PEO)

The major objectives of the M.E (Rehabilitative Instrumentation) programme are to implement Science and Engineering principles in the broad area of medical instrumentation to improve healthcare delivery to human in association with physicians and surgeons and prepare them for:

1. Comprehend the fundamental concepts in Bio Medical Engineering.
2. Apply knowledge of Engineering, biology, and Biomechanical principles to the design, development, and evaluation of various medical devices for cost effective diagnosis and treatment of various ailments.
3. To help the society and specifically the physically challenged person for their comfortable life style.

PROGRAMME OUTCOMES (po)

A student who has undergone the M.E (Rehabilitative Instrumentation) program would have acquired abilities to

1. Possess a good knowledge of basic science (including medicine), mathematics & Engineering required for specific topics in Rehabilitation Engineering.
2. Have skill to use of different types of sensors and measurement of various physiological parameters.
3. Possess ability to provide effective solutions through data interpretation, design & implementation (as applicable to a given topic/scenario).

4. Able to identify the latest tools (hardware &/or software/program &/or materials) available, towards an effective biomedical solution to a given problem.
5. Understand the current healthcare necessities & the associated multidisciplinary environment and sustainability, and an ability to provide appropriate engineering-solutions especially for Physically Challenged persons.
6. Able to take leadership in investigating complex healthcare problems by putting together, a cohesive multidisciplinary team.
7. Able to understand about various imaging modalities used in the Hospitals.
8. Learn some of the latest techniques that can be applied to research.
9. Focuss the experience through Hospital training and projects in one or more areas of advanced research.

MAPPING OF PEO WITH PO									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
PEO1	✓	✓		✓		✓		✓	
PEO2	✓	✓			✓		✓		✓
PEO3	✓	✓	✓		✓	✓	✓	✓	

M.E(REHABILITATIVE INSTRTUMENTATION) FULL TIME

SEMESTER I									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIRIPC11	**PC**	Medical Physiology	3	-	-	25	75	100	3
EIRIPC12	**PC**	Impairment Engineering	3	-	-	25	75	100	3
EIRIPE13	**PE**	Program Elective-I	3	-	-	25	75	100	3
EIRIPE14	**PE**	Program Elective-II	3	-	-	25	75	100	3
EIRIMC15	**MC**	Research Methodology and IPR	2	-	-	25	75	100	2
EIRICP16	**CP**	Biosignal and Image Processing Lab	-	-	3	40	60	100	2
EIRICP17	**CP**	Biosensors and Transducers Lab	-	-	3	40	60	100	2
EIRIAC18	**AC**	Audit Course-I	2	-	-	-	-	-	0
					Total	**205**	**495**	**700**	**18**
'SEMESTER II									
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**
EIRIPC21	**PC**	Modelling and	3	-	-	25	75	100	3

		Control of Biological Systems							
EIRIPC22	**PC**	Artificial Organ Systems	3	-	-	25	75	100	3
EIRIPE23	**PE**	Program Elective-III	3	-	-	25	75	100	3
EIRIPE24	**PE**	Program Elective-IV	3	-	-	25	75	100	3
EIRIOE25	**OE**	Open Elective – I (Inter faculty)	3	-	-	25	75	100	3
EIRICP26	**CP**	Bio Instrumentation Lab	-	-	3	40	60	100	2
EIRITS27	**TS**	Internship* and Seminar		Tr 2	S 2	40	60	100	2
EIRIAC28	**AC**	Audit Course-II	2	-	-	-	-	-	0
					Total	**205**	**495**	**700**	**19**

SEMESTER III

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EIRIOE31	**PE**	Program Elective-V	3	-	-	25	75	100	3
EIRIOE32	**OE**	Open Elective - II (Inter faculty)	3	-	-	25	75	100	3
EIRIPV33	**PV-I**	Project work & Viva-voce Phase-I	-	Pr 16	S 4	40	60	100	10
					Total	**90**	**210**	**300**	**16**

SEMESTER IV

Course Code	Category	Course	L	T	P	CA	FE	Total	Credits
EIRIPV41	**PV-II**	Project work & Viva-voce Phase-II	-	Pr 24	S 6	40	60	100	15
					Total	**40**	**60**	**100**	**15**

Note: * - Four weeks during the summer vacation at the end of IInd Semester. **L:** Lecture , **P:** Practical, **T**: Tutorial**, CA:** Continuous Assessment, **FE:** Final Examination, **Tr**: Training, **S:** Seminar, **Pr**: Project work

PC	Program Core	**CP**	Core Practical	**AC**	Audit Course
PE	Program Elective	**TS**	Industrial Training and Seminar	**PV**	Project work & Viva-voce
OE	Open Elective	**MC**	Mandatory Learning Course	**EI**	Branch code
				RI	M.E Specialization Code

M.E(REHABILITATIVE INSTRTUMENTATION) PART-TIME

SEMESTER I										
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent course Code in M.E.Full Time**
PEIRIPC11	**PC**	Medical Physiology	3	-	-	25	75	100	3	EIRIPC11
PEIRIPC12	**PC**	Impairment Engineering	3	-	-	25	75	100	3	EIRIPC12
PEIRIMC13	**MC**	Research Methodology and IPR	2	-	-	25	75	100	2	EIRIMC15
PEIRICP14	**CP**	Biosignal and Image Processing Lab	-	-	3	40	60	100	2	EIRICP16
		Total				**115**	**285**	**400**	**10**	

SEMESTER II										
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent course Code in M.E.Full Time**
PEIRIPC21	**PC**	Modelling and Control of Biological Systems	3	-	-	25	75	100	3	EIRIPC21
PEIRIPC22	**PC**	Artificial Organ Systems	3	-	-	25	75	100	3	EIRIPC22
PEIRIOE23	**OE**	Open Elective – I (from the Dept.)	3	-	-	25	75	100	3	EIRIOE25
PEIRICP24	**CP**	Bio Instrumentation Lab	-	-	3	40	60	100	2	EIRICP26
		Total				**115**	**285**	**400**	**11**	

SEMESTER III										
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent course Code in M.E.Full Time**
PEIRIPE31	**PE**	Program Elective-I	3	-	-	25	75	100	3	EIRIPE13

PEIRIPE32	**PE**	Program Elective-II	3	-	-	25	75	100	3	EIRIPE14
PEIRICP33	**CP**	Biosensors and Transducers Lab	-	-	3	40	60	100	2	EIRICP17
					Total	**90**	**210**	**300**	8	

SEMESTER IV										
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent course Code in M.E.Full Time**
PEIRIPE41	**PE**	Program Elective-III	3	-	-	25	75	100	3	EIRIPE23
PEIRIPE42	**PE**	Program Elective-IV	3	-	-	25	75	100	3	EIRIPE24
PEIRITS43	**TS**	Industrial Training and Seminar / Mini Project	-	Tr 16	S 4	40	60	100	2	EIRITS27
					Total	**90**	**210**	**300**	**8**	

SEMESTER V										
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent course Code in M.E.Full Time**
PEIRIPE51	PE	Program Elective-V	3	-	-	25	75	100	3	EIRIPE31
PEIRIOE52	OE	Open Elective – II (from the Dept.)	3	-	-	25	75	100	3	EIRIOE32
PEIRIPV53	**PV-I**	Project work & Viva-voce Phase-I	-	Pr 16	S 4	40	60	100	10	EIRIPV33
					Total	**90**	**210**	**300**	**16**	

SEMESTER VI										
Course Code	**Category**	**Course**	**L**	**T**	**P**	**CA**	**FE**	**Total**	**Credits**	**Equivalent course Code in M.E.Full Time**
PEIRIPV61	**PV-II**	Project work & Viva-voce Phase-II	-	Pr 24	S 6	40	60	100	15	EIRIPV41
							Total		**15**	

LIST OF PROGRAM ELECTIVES

S.No	Subject
1	Medical Image Processing
2	Medical Diagnostic Instrumentation
3	Computational Neuroengineering
4	Computational Methods and Cancer Modelling
5	Biosignal Processing
6	Transportation in Living Systems
7	Cancer Biology
8	Computational Methods and Bone Modelling
9	Medical Imaging Systems and Radio Theraphy
10	Wavelet Transforms and its applications
11	Bioinformatics
12	Medical Ethics and Standards

LIST OF OPEN ELECTIVES

S.No	Open Electives
1	Computers in Medicine
2	Tissue and Stem Cell Engineering
3.	Radiological Equipments
4.	Sports medicine
5.	Computational Bioengineering
6.	Healthcare Systems
7.	Telemedicine
8.	Modeling of Physiological Systems
9.	Biomechanics
10.	Troubleshooting of Medical Equipments
11.	Design of Medical Equipments

LIST OF AUDIT COURSES FOR M.E. (FULL TIME)

S.No	Subject
1	English for Research paper writing
2	Disaster Management
3	Sanskrit for Technical Knowledge
4	Value Education
5	Constitution of India
6	Pedagogy Studies
7	Stress Management by Yoga
8	Personality Development through life Enlightenment Skills

EIRIPC11 / PEIRIPC11	MEDICAL PHYSIOLOGY	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

To understand basics of Human Anatomy and Physiology.

To understand different physiological processes taking place inside human body.

To impart knowledge on cell divisions, blood vascular system, ductless/endocrine glands, digestive system and nervous system and familiarize medical physiology to the students.

To apply this knowledge into biomedical engineering field.

Cell divisions and development of human body: Cell structure – functions. Tissues: Types of tissues, epithelial & connective, muscle and nervous. Classification of epithelial and connective tissues with their locations. Muscular architecture: Structure of skeletal, smooth and cardiac muscles – differences. Single unit and multi – unit smooth muscle – properties of muscle – muscle contraction sterling laws – mechanisms – E C coupling – muscle fatigue – rigor mortis – sliding filament theory – slow and fast muscle fibres – isotonic and isometric contraction.

Blood Vascular System: Composition and functions of blood, coagulation – actionof platelets, functions, mechanisms. Hemoglobin: functions – compounds and derivatives. Erythrocyte Sedimentation Rate (ESR) – significance. Blood coagulation – factors – process – anticoagulants – prothrombin time – clotting time – bleeding time – blood groups – ABO systems and Rh factors – Ultra structure and functions of blood vessels (artery and vein).

Ductless/endocrine glands: various ductless glands: pituitary glands – hypothalamus and adenohypohysis. Hormone secretion – actions of hormone and related applied physiology – thyroid gland – histology – blood and hormone secretion – action of hormone – Parathyroid gland and adrenal gland.

Digestive System: Anatomy – histology of gastro intestinal tract – oral cavity (mouth) – teeth – salivary glands – structure, composition and functions of saliva. Circulatory system: Anatomy – functions – heart valves – heart rhythm – conducting system of heart – blood supply – properties of cardiac muscles – action potential of single cardiac fiber – special junctionaltissue of heart – myogenic and neurogenic heart – conducting system of heart – E.C.G.

Nervous system: Anatomy – classification – structure of a typical neuron – synapse – synaptic transmission, neuro transmitter, Central Nervous System (CNS) – anatomy of brain and its sub divisions. Functions of brain – central canal of the spinal cord – thalamus and hypothalamus – spinal cord and transverse section effects. Peripheral nervous system – classifications of motor nerves – description – voluntary and involuntary action – Autonomic nervous system – classifications – functions. Neural **Transmission:** Introduction – sympathetic and parasympathetic response.CNS synaptic, electrical and chemical transmissions.Neuro muscular Junction: Structure – events in transmission – end – plate potential – post tetanic potential.

REFERENCES

1. Arthur C. Guyton and John E. Hall, Text book of Medical Physiology, Saunders (Elsevier), NJ, 11th Edition, 2005.
2. B.G. King, W.J. Showers, Human Anatomy & Physiology, W.B.Saunders Co., NY, 6th edition, 1969.
3. Ross and Wilson, Anatomy and Physiology in health and illness, Churchill Living Stone, 11th edition, 2010.

COURSE OUTCOMES

By successfully completing this course, students will be able to:

1. Describe and explain specific parts and key terms applied in anatomy and physiology.
2. Describe important physiological mechanisms involved in cell, tissue, and organ.
3. Understand organisation and functions of each organs and systems in human body.
4. Correlate the knowledge of medicine and engineering for the development of various instruments.
5. Understand the diseases associated with various parts of the body.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓					✓	✓	
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓		✓			✓
CO5					✓		✓		✓

EIRIPC12 / PEIRIPC12	**IMPAIRMENT ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on impairment, sensory and auditory rehabilitation, orthopaedic prosthetics and orthotics in rehabilitation.
- To study basics of Rehabilitation Engineering.
- To study various orthotic & prosthetic devices.
- To understand various assistive technology for vision & hearing.

Impairment: Introduction – impairment types – handicaps – measurements – assessment and characterization concepts in sensory and motor rehabilitation. Anthropometry: Static and dynamic Measurements – Area – movement, measurement of Muscular Strength and Capabilities.

Measurement tools and processes: Fundamental principles – structure – functioning – performance and behaviour – Subjective and objective. Ergonomic aspects in designating devices: Design of information devices – traditional Devices – V.D.Uâ€™ s, Using colour and Control designs.

Sensory and Auditory rehabilitation: Sensory augmentation and substitution.Visual system: Visual augmentation – tactual vision substitution, and Auditory vision substitution. Auditory system: Auditory augmentation – Audiometer – Hearing aids – cochlear implantation – visual auditory substitution – tactual auditory substitution. Tactual system: Tactual augmentation and substitution.

Orthopedic Prosthetics and Orthotics in rehabilitation: Motor rehabilitation: Introduction – concepts – applications. Intelligent prosthetic knee – hierarchically controlled prosthetic hand – self – aligning orthotic knee joint. Externally powered and controlled Orthotics and Prosthetics: FES systems – restoration of hand function, standing and walking – Hybrid Assistive Systems (HAS). Active Prostheses:Active above knee prostheses – myoelectric hand andarm prostheses – different types.The MARCUS intelligent Hand prostheses.

Computer applications in Rehabilitation and Robotic Manipulation Aids: Modes of operation and control – interfaces in compensation for visual perception – improvement of orientation and mobility. Computer assisted lipreading – Brain computer interface – concepts.

REFERENCES

1. Joseph D. Bronzino, Handbook of biomedical engineering, CRC Press, 3rd edition, 2006.
2. Robinson, C.J., Rehabilitation engineering. CRC press, 2003.
3. Horia – Nicolai L. Teodorescu, L.C. Jain, Intelligent systems and technologies in rehabilitation engineering; CRC Press; December 2000.
4. Etienne Grandjean, Harold Oldroyd, Fitting the task to the man, London: Taylor & Francis, 4th edition, 1988.

COURSE OUTCOMES

By the end of this course the student will be able

1. To design rehabilitation aid and apply them with confidence, to help the challenged people.
2. To build foundation for learners enabling the learners to pursue higher studies with specialization in Rehabilitation Engineering.
3. To design rehabilitation aids and its understanding.
4. To have a thorough understanding of aids which can be useful with the societal needs.
5. To apply and test the developed products and and automate it.

MAPPING OF COS WITH POS

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓							
CO2	✓	✓							✓
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					
CO5					✓	✓		✓	

EIRIMC15/ PEIRIMC 13	RESEARCH METHODOLOGY AND IPR	L	T	P	C
		2	0	0	2

Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations

Effective literature studies approaches, analysis Plagiarism, Research ethics. Effective technical writing, how to write report, Paper. Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee.

Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT.

Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications. New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs

References:

1. Stuart Melville and Wayne Goddard, “Research methodology: an introduction for science & engineering students’
2. Wayne Goddard and Stuart Melville, “Research Methodology: An Introduction”, Ranjit Kumar, 2 nd Edition , “Research Methodology: A Step by Step Guide for beginners”
3. Halbert, “Resisting Intellectual Property”, Taylor & Francis Ltd ,2007.
4. Mayall , “Industrial Design”, McGraw Hill, 1992.
5. Niebel , “Product Design”, McGraw Hill, 1974.
6. Asimov , “Introduction to Design”, Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, “ Intellectual Property in New Technological Age”, 2016.
8. T. Ramappa, “Intellectual Property Rights Under WTO”, S. Chand, 2008.

COURSE OUTCOMES

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

1. Understand research problem formulation.
2. Follow research ethics
3. Understand that today’s world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

MAPPING OF COS WITH POS											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	✓	✓	✓					✓			✓
CO2	✓	✓	✓								✓
CO3			✓	✓	✓	✓					✓
CO4				✓	✓			✓			✓
CO5				✓	✓	✓		✓			

EIRICP16 / PEIRICP14	BIOSIGNAL AND IMAGE PROCESSING LAB	L	T	P	C
		0	0	3	2

LIST OF EXPERIMENTS

1. Representation of basic signals.
2. Linear convolution.
3. Autocorrelation and cross correlation.
4. Development of FFT and IFFT Techniques.
5. Difference equation Representation of systems using Matlab.
6. Digital IIR Butterworth filter – LPF & HPF.
7. Digital IIR chebychev filter – LPF & HPF.
8. Design of FIR filter using windowing technique.
9. Upsampling and downsampling of Biosignals.
10. Analysis of ECG.
11. Analysis of EEG.
12. Analysis of PCG.

** The list of Experiments will be finalized by the course teacher in consultation with the HOD depending on the availability of equipments, the state of art and recent trends**.**

COURSE OUTCOMES

1) Students can learn different physiological signals and Images.
2) Students will be benefited by carrying out the experiments with real medical Images.
3) Students will be able know different abnormalities and analyse with the Images.
4) Students can face the society with challenging ideas by using various Image processing Techniques and work with the same knowledge in the Hospitals.

MAPPING WITH PROGRAMME OUTCOMES									
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				

CO2	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓			✓	✓
CO4		✓	✓	✓	✓		✓	✓	✓

EIRICP17 / PEIRICP33	BIOSENSORS AND TRANSDUCERS LAB	L	T	P	C
		0	0	3	2

LIST OF EXPERIMENTS

1) Temperature measurement using AD590 IC sensor
2) Displacement measurement by using a capacitive transducer
3) Study of the characteristics of a LDR
4) Pressure and displacement measurement by using LVDT
5) Study of a load cell with tensile and compressive load
6) Torque measurement Strain gauge transducer
7) Study & characterization of Biotransducers – Pressure, Temparature, Humidity
8) Study & characterization of Bioelectrodes – ECG, EMG, EEG
9) Study & characterization of Biotransducers – Tactile, Respiration, eyeball movement
10) Study of Giat Analysis

** The list of Experiments will be finalized by the course teacher in consultation with the HOD depending on the availability of equipments, the state of art and recent trends.

COURSE OUTCOMES

1) Students can learn different physiological signals and sensors.
2) Students will be benefited by carrying out the experiments with real subjects.
3) Students will be able know different abnormalities and simulate using the available equipments.
4) Students can face the society with challenging ideas by using various sensors and same can be troubleshooted in the hospitals.

MAPPING WITH PROGRAMME OUTCOMES									
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓			✓	✓
CO4		✓	✓	✓	✓		✓	✓	✓

EIRIPC21 / PEIRIPC21	MODELLING AND CONTROL OF BIOLOGICAL SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To gain basic knowledge about the concepts of control systems and study its application in physiological modeling.
- To understand the system concepts and different mathematical modelling techniques applied in analyzing any given system.
- To understand basic concepts of modeling for designing biological model.
- To train and motivate students for pursuing higher education and research for developing cutting edge technologies.

Feedback system: Basic feedback concepts – effect of feedback on noise – distortion analysis – open loop control system – control system with feed Back. Mathematical descriptions of systems: transfer function matriX–state space representation – state – variable description – mathematical description of composite systems. Solution of dynamical equation: state transition matriX– impulse response matriX–controllability and observability.

Biological control system: Introduction – dynamical systems – modelling – similarities between biological and engineering control system – biological receptors and receptor characteristics.The pupil control systems:General structure – dynamic response characteristics – open and closed loop instability – automatic aperture control.

Human thermal system: Basic concepts – modelling – thermo regulation – cold and warm bloodedness – lumped and partial differential equations. Case Study: Heat transfer example. Modeling the body as compartment: behavior in simple compartmental system – pharmaco kinetic model – urea distribution model. Multi compartmental system: Dissolution of drugs in solid form – distribution and accessibility of body water and tissue compartments – basis for zero and first order chemical kinetic behavior in the biological system.

Modeling of human thermal regulatory system: Parameters involved – control system model – biochemistry of digestion – types of heat loss from body – heat transfer models – subsystems of human body like skin, core.

Case Study Applications: Cardiac rate – blood pressure – respiratory rate – mass balancing of lungs – oxygen uptake by RBC and pulmonary capillaries – oxygen and carbon dioxide transport in blood and tissues.

REFERENCES

1. Benjamin C. Kuo, FaridGolnaraghi, Automatic Control Systems, John Wiley & Sons, Inc., NY, 9th edition, 2009.
2. M.Gopal, Digital Control and State Variable Analysis, Tata McGraw Hill, 2008.
3. David O. Cooney, Biomedical Engineering Principles – An introduction to Fluid, Heat, and Mass transport processes, CRC Press, 1976.

4. John H Milsum, Biological Control Systems, McGraw Hill, 1966.
5. Howard T Milhorn, The application of control theory to physiological systems, Saunders, Philadelphia, 1966.
6. E. Carson, E. Salzsieder, Modelling and Control in Biomedical Systems 2000 (including Biological Systems) (IFAC Proceedings Volumes) (Paperback), Pergamon Publishing, January 2001.

COURSE OUTCOMES

Students will be able to

1. Understand the concepts of modeling.
2. Design control strategies for various organ functioning.
3. Analyse the causes for malfunctioning of organs.
4. Analyse and do research in the micro level for diagnosing the diseases.
5. Theoritically diagnose the kind of diseases for their understanding from the case studies.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					
CO5					✓	✓		✓	✓

EIRIPC22 / PEIRIPC22	**ARTIFICIAL ORGAN SYSTEM**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the principles and biology underlying the design of implants and artificial organs.
- To understand the fundamentals of materials used for manufacturing implants, prosthesis and orthoses that has wide application in healthcare industry.

Bio materials: Definition of biomaterials – Requirements of biomaterials – classification of biomaterials – Comparison of properties of some common biomaterials – Effects of physiological fluid on the properties of biomaterials – Biological responses (extra and intra – vascular system). Surface properties of materials – physical properties of materials – mechanical properties – Biomaterial outlook for organ transplant, design considerations.

Introduction to artificial organs: Biomaterials used in artificial organs and prostheses – inflammation, rejection, correction. Rheological properties of blood – blood viscosity variation – effect of shear rate – hematocrit – temperature and protein contents – Casson equation – flow properties of blood through the blood vessels – problems associated with extracorporeal blood flow.

Artificial Heart and circulatory assist devices: Engineering design of artificial heart and circulatory assist devices.Artificial kidney: Structure – function – filtration – basic methods of artificial waste removal – hemo dialysis – equation for artificial kidney – middle molecule hypothesis. Hemo dialysers: flat plate type – coil type – hollow fiber – analysis of mass transfer in dialysers – regeneration of dialysate – membrane configuration – wearable artificial kidney machine – separation of antigens from blood in ESRD patients.

Artificial heart – lung machine: Introduction – gaseous exchange / transport – artificial heart – lung devices. Oxygenators: bubble, film oxygenators and membrane oxygenators – gas flow rate and area for membrane oxygenators. Liver support system – artificial pancreas – blood – skin.

Audiometry: air conduction – bone conduction – masking – diagram. Hearing aids: Types – receiver amplifiers – opthalmoscope – retinoscope – I.A.B.P principle and application. Rehabilitation Engineering: Rehabs for locomotion, visual, speech and hearing – artificial limb and hands – prosthetic heart valves – gait study – spinal rehabilitation.

REFERENCES

1. Joseph D. Bronzino, The Biomedical Engineering Handbook, CRC Press, 2000.
2. Khandpur. R. S., Hand Book of Biomedical Instrumentation, Tata McGraw Hill Pub Co. Ltd., New Delhi, 2nd ed., 2003.
3. Erie.D.Blom and Howard.B.Rothman, Artificial Organs, 1994.
4. David O. Cooney Biomedical Engineering Principles (Volume – II), Marcel Dekker Inc, New York, 1976.
5. Rory A. Cooper; HisaichiOnabe; Douglas A. Hobson, Introduction to Rehabiliation Engineering, CRC press, 2006.
6. E.Ballabio, Rehabilitation Engineering, IOS press, 1993.

COURSE OUTCOMES

Student will be able to

1. Understand the concept of biocompatibility and the methods of biomaterial testing.
2. Awareness about the testing of the biomaterials done biologically before implantation in the human body.
3. Gain knowledge in the existing designs of artificial organs.
4. Understanding the applications of the organs implants.
5. Develop additional features in the exsisting instruments.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			
CO2	✓	✓							
CO3	✓	✓	✓		✓		✓		✓
CO4	✓	✓		✓					
CO5		✓		✓			✓	✓	✓

EIRICP26 / PEIRICP24	BIO INSTRUMENTATION LAB	L	T	P	C
		0	0	3	2

LIST OF EXPERIMENTS

1. Respiratory system analysis using Spirometer.
2. ECG wave analysis using simulator.
3. Real time patient monitoring system.
4. 12 – lead ECG measurement System.
5. EMG Biofeedback with NCV.
6. EMG Measurement system.
7. Auditory system check up using Audiometer.
8. ECG heart rate system with HRV.
9. Heart sound measurement using PCG.
10. Measurement of BP, Pulse and SPO2.
11. Measurement of Giat Analysis.
12. Design of Medical Amplifier.

** The list of Experiments will be finalized by the course teacher in consultation with the HOD depending on the availability of equipments, the state of art and recent trends.

COURSE OUTCOMES

1) Students can learn different physiological signals.
2) Students will be benefited by carrying out the experiments with real subjects.
3) Students will be able know different abnormalities and simulate using the available equipments.
4) Students can face the society with challenging ideas.

MAPPING WITH PROGRAMME OUTCOMES									
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓				
CO2	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓			✓	✓
CO4		✓	✓	✓	✓		✓	✓	✓

EIRITS27 / PEIRITS43	INTERNSHIP AND SEMINAR	L	T	P	C
		0	2	2	2

COURSE OBJECTIVES

- To train the students in the field work related to process control and instrumentation and to have a practical knowledge in carrying out process control and instrumentation field related works.
- To train and develop skills in solving problems during execution of certain works related to process control and instrumentation.

The students individually undergo a training program in reputed concerns in the field of Process Control and Instrumentation during the summer vacation (at the end of second semester for full-time/fourth semester for part-time) for a minimum stipulated period of four weeks. At the end of the training, the student has to submit a detailed report on the training they had, within ten days from the commencement of the third semester for Full-time/fifth semester for part-time.

The students will be evaluated by a team of staff members nominated by head of the department through a viva-voce examination.

COURSE OUTCOMES

1) The students can face the challenges in the practice with confidence.
2) The student will be benefited by the training with managing the situation arises during the execution of works related to health care system.
3) The student will be able to design a project based on their training.
4) Students can face the society with challenging ideas.

MAPPING WITH PROGRAMME OUTCOMES									
COS	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1		✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓			✓	✓
CO4		✓	✓	✓	✓		✓	✓	✓

EIRIPV33 / PEIRIPV53	PROJECT WORK AND VIVA-VOCE PHASE – I	L	T	P	C
		0	16	4	10

COURSE OBJECTIVES

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

Upon completion of this project work, the students will be able to:

1. Take up any challenging practical problems and find solution.
2. Learn to adopt systematic and step-by-step problem solving methodology.
3. Design a given circuit with due interest.
4. Troubleshoot any given circuit and test the results.

MAPPING WITH PROGRAMME OUTCOMES									
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓			✓	✓
CO4		✓	✓	✓	✓			✓	✓

EIRIPV41 / PEIRIPV61	PROJECT WORK AND VIVA-VOCE PHASE – II	L	T	P	C
		0	24	6	15

COURSE OBJECTIVES

1. To develop the ability to solve a specific problem right from its identification and literature review till the successful solution of the same.
2. To train the students in preparing project reports and to face reviews and viva voce examination.

COURSE OUTCOMES

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

1) Take up any challenging practical problems and find solution.
2) Learn to adopt systematic and step-by-step problem solving methodology.
3) Design a given circuit with due interest.
4) Troubleshoot any given circuit and test the results.

MAPPING WITH PROGRAMME OUTCOMES									
COS	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9

CO1	✓	✓	✓	✓	✓	✓	✓	✓	✓
CO2	✓	✓	✓	✓	✓	✓	✓	✓	
CO3	✓	✓	✓	✓	✓			✓	✓
CO4		✓	✓	✓	✓			✓	✓

PE - PROGRAM ELECTIVES

EIRIPEXX / PEIRIPEXX	**MEDICAL IMAGE PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To study the production of X–rays and its application to different medical Imaging techniques.
- To study the different types of Radio diagnostic techniques.
- To study the special imaging techniques used for visualizing the cross sections of the body.
- To study the imaging of soft tissues using ultrasound technique

Introduction to Driving problems in biomedical imaging: Signal input – image matrix, digital image quality – digital image processing – picture archiving and communication system (PACS) – sources of imaging data acquisition and noise – elementary image processing – Grenander's Pattern Theory.

X–rays: Production X–rays – various components of radiographic systems – X–ray tube design – X–ray spectrum – rating charts of X–ray tubes. Electrical circuit for X–ray machine – filament circuits and mA control – HT circuits – KV control – control of exposure timers – collimators, scatter and grids – absorbed dose – basics of tables and arms – properties of X–ray films and screens – dark room accessories – types of X–ray tubes for various medical applications.

Fluoroscopy and angiography: Fluoroscopic imaging system – principle – specific system design. Digitalfluoroscopy – c – arm system – Digital Subtraction Angiography (DSA) – digital subtraction programming. Ultra Sound in Medicine: Introduction – generation – acoustic impedance – ultrasonic transducers and types – transmitter and detector principles – probe design – principles of image formation. Display system: Principles of A – mode, B – mode and M – mode display – scan conversion – image processing – Doppler Ultrasound and Colour flow mapping – application of diagnostic ultra sound.

Magnetic Resonance Imaging (MRI): Introduction – principles – instrumentation – magnets – gradient system – RF coils receiver system – pulse sequence – image acquisition and reconstruction techniques – functional MRI – application of MRI. Radio isotope imaging/Nuclear medicine: Radio nuclides for imaging – radionuclide production: cyclotron production, reactor production, generator production. Rectilinear scanners – Linear scanners – SPECT – PET – Gamma Camera – Comparison of other tomographic techniques.

Infra red Imaging: Physics of thermography – imaging systems – clinical themography – liquid crystal thermography. Special imaging techniques: Cineradiography – cinefluorography – stereoscopic radiography – magnification radiography – microradiography – tomography – neutron radiography.

REFERENCES

1. David J. Dowsett, Patrick A. Kenny, R. Eugene Johnston, The Physics of Diagnostic Imaging, Chapman & Hall Medical, Madras/London.2nd edition, 2006.
2. S. Webb, The Physics of Medical Imaging, Adam Hilger, Bristol. Taylor and Francis group, New York, 1988.
3. Rangaraj M. Rangayyan, Biomedical Image Analysis, CRC press, 2005.

COURSE OUTCOMES

Student will

1. Get the clear domain knowledge about the various Medical Imaging techniques.
2. To understand the various diagnostic applications of the medical imaging techniques.
3. To apply the imaging modalities in the medical hospitals.
4. To use the advanced techniques to diagnose the health problems.
5. Use their knowledge to use advanced Instruments for imaging.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			✓
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					
CO5			✓				✓		✓

EIRIPEXX / PEIRIPEXX	**MEDICAL DIAGNOSTIC INSTRUMENTATION**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the basic principle, working and design of various automated diagnostic equipments.
- To develop skills enabling Biomedical Engineers to serve Hospitals, National and International Industries and Government Agencies.
- To develop core competency in the field of Biomedical Engineering to gain technical expertise in biology and medicine for effective contribution in the development and improvement of health care solutions.
- To study various medical instrumentation systems, drug delivery systems and health management systems.

Electrocardiograph: Fibrillators and Defibrillators – Pacemakers – Arrhythmia Simulator. Ventilators: Basic principles – generators – inspiratory phase – cycling mechanisms – expiratory phase – ventilatory adjuncts – anaesthetic machines.

Electro EncephaloGraph: Multi channel EEG recording system – epilepsy – evokedpotential – Visual, Auditory and Somatosensory – MEG (Magneto Encephalon Graph) – EEG bio feedback instrumentation. Sliding theory of contraction: Recording and analysis of EMG waveforms – fatigue characteristics – Muscle stimulators – nerve stimulators – nerve conduction velocity measurement.

Measurement of mechanics of breathing: Spirometer – Lung volumeand vital capacity – measurements of residual volume – pneumotachometer – airway resistance measurement – whole body plethysmography – intra – alveolar and thoracic pressure measurements – apnea Monitor – types of ventilators – pressure – volume and time controlled – flow – patient cycle ventilators – humidifiers – nebulizers – inhalators.

Diagnosis: Basic principles of echo technique – display techniques A, B and M mode – ultrasound as diagnostic tool – echocardiogram – abdomen – obstetrics – gynaecology – ophthalmology.

Heart lung machine: Disc and membrane type oxygenerators – finger pump – roller pump, – Haemo Dialyser unit – Lithotripsy – principles of cryogenic technique – application – endoscopy – laproscopy. Patient monitoring system: ICU – post operative – ICCU – single and multichannel telemetry. Transmission of Biosignals over telephone lines – digital central monitoring systems for patient monitoring.

REFERENCES

1. Joseph J. Carr and John M. Brown, Introduction to Biomedical equipment technology, Pearson education, 4th edition, 2008.
2. John G.Webster, Medical Instrumentation Application and Design, Wiley India Edition, 3rd edition, 2007.
3. L.A. Geddes and L.E. Baker, Principles of Applied Biomedical Instrumentation, John Wiley Publications, 3rd Edition, 2008.

COURSE OUTCOMES

Student will be able to

1. Demonstrate the principles of electronics used in designing various diagnostic equipment.
2. Have in-depth knowledge about different streams in Biomedical Engineering with greater emphasis on health care equipments and the advanced technologies such as Telemedicine, Telemetry, Medical Imaging, etc.
3. Provide a better technical support with exposure to the hospitals and health care industry.
4. Understand the various techniques and applying for the betterment of the patients.
5. Understand critical care units and its importance

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓					✓		✓
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					
CO5	✓				✓				✓

EIRIPEXX / PEIRIPEXX	**COMPUTATIONAL NEURO ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Neural engineering and rehabilitation research applies neuroscience and engineering methods to analyze central and peripheral nervous system function and to design clinical solutions to neurological disorders or injury.
- To study the basics of Nervous system.
- To understand the development and arrangement of neural tissue.
- To study the neuronal disorders and injuries.
- To study the repairing and reconstruction mechanism of nervous system.

Introduction to computational neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience: Descriptive Vs. Functional models – Turing Vs. Neural computation. Introduction to anatomy and cellular basis of nervous system.Introduction to differential equations and theory of dynamical systems.

Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currnets – experimental techniques : voltage and space clamp experiments. The Hodgkin – Huxley formalism – activation and inactivation kinetics – complete model for action potential generation. Hodgkin – Huxley Vs. Markov models.

Qualitative Hodgkin – Huxley theory – voltage clamp techniques – Hodgkin – Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin – Huxley model: FitzHugh – Nagumo – Rinzel model. Abstract Models: phase model – rate model – McCulloch – Pitts neuron – integrate and fire neuron model.

Synapses and synaptic plasticity – simplified and phenomenological models of synaptic functions.synaptic transmission: electrical and chemical. Gated transmission at the nerve muscle synapse and central synapses – neurotransmitters. Cellular basis of learning: synaptic plasticity – The Hebbian rule of learning – variations for the Hebbian rule. Long term synaptic potentiation and depression. Synaptic plasticity on different time scales.

Basics of modeling neural networks: The two or three levels of neural dynamics. Supervised learning rules: Perceptron learning rule – Adaptation in linear neurons, Widrow – Hoff rule – objective functions and gradient descent – multilayer networks and back propagation. Unsupervised learning rules: Principle Component Analysis – decorrelation – Winner – take – all networks and clustering. Basic neural network architectures: feed – forward – feedback – lateral connections.

REFERENCES

1. Dayan, P. and L.F. Abbott, Theoretical Neuroscience: Computational and Mathematical modeling of neural systems, MIT Press, 2001.
2. W. Gerstner and W.M. Kistler, Spiking Neuron Models, Cambridge University Press, 2002.
3. Arabib, M.A., Erdi, P. and Szentagothai, J., Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Lauren Fausett, Fundamentals of Neural Networks, Prentice Hall, New Jersey, 1994.
5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer, 1989.

COURSE OUTCOMES

Through this course of study students will be able to

1. Understand the application of basic science and engineering techniques.
2. Develop methods to record from and exert control over the nervous system.
3. Understand and develop the models of associated organ systems.
4. Can carryout research in the analysis of memory of physiological systems.
5. Apply clinically for validation through research

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓	✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					✓
CO5		✓	✓	✓	✓			✓	✓

EIRIPEXX / PEIRIPEXX	**COMPUTATIONAL METHODS AND CANCER MODELLING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- Cancer Modelling is to analyze the origin of cancer and basics of Molecular Biology.
- To study the cause for Cancer.
- To understand the depth understanding of development of Cancer.
- To study the various types of cancer and its treatment methods.
- To study and design the mathematical models of various cancer.

Cancer: Definition, Benign Tumors Vs. Malignant Tumors, Types of Cancer, Common Symptoms, Molecular Hallmarks of Cancer – Growth Signal Autonomy, Evasion of Growth Inhibitory Signals, Evasion of Apoptosis (Programmed Cell Death), Unlimited Replicative Potential, Angiogenesis (Formation of New Blood Vessels), Invasion and Metastasis, Molecular Basis of Cancer – Cancer Genes (Oncogenes and Tumor Suppressor Genes), Carcinogenesis – A Multistep Process, Evidences for Multistage Models of Carcinogenesis

Global Cancer Incidence and Mortality: Data Source and Measurements, Overall Cancer Risk, Incidence and Mortality Patterns for Common Cancers, Issues in Interpreting Temporal Trends, Analytical Methods for Epidemiological Studies – Ecological Studies, Cross – Sectional Studies, Cohort Studies, Case – Control Studies, Interpretation of Epidemiology Findings, Molecular Epidemiology

Introduction to computational neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience: Descriptive vs. functional models – Turing vs. neural computation. Introduction to anatomy and cellular basis of nervous system. Introduction to differential equations and theory of dynamical systems.Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currnets – experimental techniques : voltage and space clamp experiments. The Hodgkin – Huxley formalism – activation and inactivation kinetics – complete model for action potential generation.Hodgkin – Huxley vs Markov models.Qualitative Hodgkin – Huxley theory – voltage clamp techniques – Hodgkin – Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin – Huxley model: FitzHugh – Nagumo – Rinzel model.

Abstract Models: phase model – rate model – McCulloch – Pitts neuron – integrate and fire neuron model.Synapses and synaptic plasticity – simplified and phenomenological models of synaptic functions.synaptic transmission: electrical and chemical. Gated transmission – at the nerve muscle synapse and central synapses – neurotransmitters.

REFERENCES

1. Dayan P. and L.F. Abbott, Theoretical Neuroscience: Computational and Mathematical modeling of neural systems, MIT Press, 2001.
2. W. Gerstner and W.M.Kistler, Spiking Neuron Models, Cambridge University Press, 2002.
3. Arabib M.A., Erdi P. and Szentagothai J., Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Teicher, Beverly A., Tumor Models in Cancer Research Series: Cancer Drug Discovery and Development, 2nd ed. Springer, 2011.
5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer, 1989.

COURSE OUTCOMES

Through this course of study students can able to

1. Understand the basics of molecular biology and cancer.
2. Analyse how Cancer develops and progresses.
3. Design the mathematical modelling and the causes of cancer can be analysed.
4. Understandvarious treatments methods and Imaging of cancer and the research problems can be solved to the extent.
5. Do research in the area of cancer modeling

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			
CO2	✓	✓							✓
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓					
CO5	✓						✓	✓	✓

EIRIPEXX / PEIRIPEXX	**BIOSIGNAL PROCESSING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To build a strong base for developing algorithms for signal processing systems and Imaging systems.
- To develop competency in terms of logical thinking, programming and application skills.
- To train and motivate students for pursuing higher education and research for developing cutting edge technologies.

Signals and Systems: Introduction to discrete time signals and systems – Properties – LTI system. Signal conversion: Conversion requirement for biomedical signals – signal conversion circuits. Discrete Fourier Transform (DFT) – properties – circular convolution – FFT computation using DIT and DIF algorithms.

FIR design: Windowing techniques – need and choice of windows – Linear phase characteristics. IIR design: Analog filter design – approximation methods – Warping – prewarping – Frequency transformation. Wavelet transformation: Introduction – basic principles.

Spectral analysis: Estimation of power density spectrum – periodogram – parametric model based spectral linear prediction theory – estimation using Auto Regressive (AR), Moving Average (MA) andAuto Regressive Moving Average (ARMA) models. Estimation of parameters – spectral error measure – EEG analysis.

Adaptive filters: Principle noise canceller model – 50 Hz adaptive cancelling using a sine wave model – maternal ECG cancellation in fetal electrocardiography – ECG QRS detection techniques – estimation of R-R interval – estimation of ST segment inclination – arrhythmia analysis monitoring – long term ECG recording – basics of ECG data reductiontechniques.

Electromuscular Signal Processing: Basic electromyography, EMG data acquisition, rectification and averaging. Neurological signal processing: The EEG Signals and its Characteristics – EEG Analysis – time frequency domain method – detection of spikes and spindles – detection of alpha, beta and gamma waves. Least squares and polynomial modelling: The Markov model and Markov chain – dynamics of sleep – wake Transition – hypnogram Model Parameters.

REFERENCES

1. Rangaraj M. Rangayyan: Biomedical Signal Analysis, John Wiley, 2002.
2. John G. Proakis, Dimitris G. Manolakis: Digital Signal Processing – Principles, Algorithms and Applications, Prentice Hall of India, 4th edition, 2005.
3. P. Ramesh Babu: Digital Signal Processing, Scitech Publications, India, 4th edition, 2007.
4. John L.Semmlow: Biosignal and Medical Image Processing – Matlab Based Applications, Marcel Dekker Inc., New York, 2nd edition, 2009.
5. D. C. Reddy, Biomedical Signal Processing – Principles and Techniques, Tata McGraw Hill Publishing company Ltd., 2nd reprint, 2006.

COURSE OUTCOMES

Student will be able to

1. Understand the fundamental techniques and applications of digital signal processing with emphasis on biomedical signals.
2. Implement algorithms based on discrete time signals.
3. Understand Circular and linear convolution and their implementation using DFT analyse signals using discrete Fourier transform.
4. Understand efficient computation techniques such as DIT and DIF FFT algorithms.
5. Analyse the biological signls for the scope of diagnosis

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓			
CO2	✓	✓					✓		✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓					
CO5				✓			✓	✓	✓

EIRIPEXX / PEIRIPEXX	TRANSPORTATION IN LIVING SYSTEMS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To familiarize the student with various transportation mechanism in living systems.
- To understand the concepts of organs.
- To study about the internal organs.
- Introduction
- Organization of the human body – cells – tissues – different organs.

Heat transport: Body temperature regulation based on thermostat principle and its operation – transportation in tissues – muscle, skin and other organs in different environmental temperatures.

Transportation of fluids: Blood transport through internal organs – urogenitary – cardio pulmonary and central nervous system.

Gastro intestine system: Diffusion – osmosis – electro osmosis – ultra filtration – reverse osmosis through natural membrane and artificial synthetic membranes.

Lymph: Transportation through internal organs, urogenitary, cardio pulmonary, central nervous and gastro intestine systems. Problems on lymph transfer in human body.

Mass transfer: Constituents of blood, urine, mass transfer in kidney, skeletal, nervous, gastro intestine and cardio pulmonary systems. Comparison with artificial organs.

REFERENCES

1. David O.Cooney, An introduction to fluid, heat & mass transport process – Principles, Vol.1, Marcel Dekker Inc., Newyork, 1976.
2. William F. Ganong, Review of Medical Physiology, McGraw Hill Medical, 22nd edition, 2005.
3. Charles Herbert Best, Norman Burke Taylor, John Burnard West, Best and Taylor's physiological basis of medical practice,Williams and Wilkins, Baltimore, 12th edition, 1991.

COURSE OUTCOMES

Student will be able to

1. Understand the internal organs.
2. Understand the organs functioning in detail.
3. Know the Physics involved in the body fluids.
4. Understand in depth knowledge of human systems.
5. Know about the minarels and liquids present in the body.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓	✓		✓				
CO2	✓	✓						✓	
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓	✓		✓		
CO5	✓				✓				

EIRIPEXX / PEIRIPEXX	**CANCER BIOLOGY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

To familiarize the student with cancer and Molecular biology.

Fundamentals of cancer biology : Regulation of cell cycle – Mutations that cause changes in signal molecules – Effect on receptor – Signal switches – Tumor suppressor genes – Modulation of cell cycle in cancer – Different forms of cancers, diet and cancer – Cancer screening and early detection – Detection using biochemical assays – Tumor markers – Molecular tools for early diagnosis of cancer.

Principles of carcinogenesis: Theory of carcinogenesis – Chemical carcinogenesis – Metabolism of carcinogenesis – X–ray radiation – Mechanism of radiation carcinogenesis.

Principles Of Molecular Cell Biology Of Cancer: Signal targets and cancer – Activation of kinases – Oncogenes – Identification of oncogenes – Retroviruses and oncogenes – Detection of oncogenes – Oncogenes/proto oncogene activity – Growth factors related to transformation – Telomerases.

Principles of cancer metastasis: Clinical significances of invasion – Heterogeneity of metastatic phenotype – Metastatic phenotype – Metastatic cascade – Basement membrane disruption – Three step theory of invasion – Proteinases and tumor cell invasion.

New molecules for cancer therapy: Different forms of therapy – Chemotherapy – Radiation therapy – Detection of cancers – Prediction of aggressiveness of cancer – Advances in cancer detection – Use of signal targets towards therapy of cancer.

REFERENCES

1. Weinberg, R.A., The Biology of Cancer, Garland Science, 2007.
2. Pelengaris, S. and Khan. M., The Molecular Biology of Cancer, Blackwell Publishing, 2006.
3. Macdonald, F. and Ford, C.H.J., Molecular Biology of Cancer, BIOS Scientific Publication, 2005.
4. Roger John Benjamin King, Mike W. Robins, Cancer Biology, Pearson prentice hall, 3rd edition, 2006.
5. Ruddon, R.W., Cancer Biology, Oxford University Press, 2nd Edition, 1995.

COURSE OUTCOMES

Student will be able to

1. Have clear understanding of basics of cancer and its types.
2. Understand the causes of Cancer.
3. Analyse the modalities for the detection of Cancer.
4. Develop cancer detecting modules.
5. Help the society by the developed products.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓		✓	✓
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					✓
CO5				✓	✓		✓	✓	✓

EIRIPEXX / PEIRIPEXX	**COMPUTATIONAL METHODS AND BONE MODELLING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To study about the Mathematical Modelling.
- To have knowledge on the Anatomy and physiology of Bones.
- To know how Cancer developes in Bones and affects its function.

Introduction to Bone Tissues – structure of bone tissues – primary and secondary bone – compact and cancellous bones – other types. Mechanical properties of materials and bones – elastic properties – strength – fracture mechanics properties – Modelling fracture in tension – as a composite – micro damage – Modelling and reconstruction: need for feedback control – Bone Modelling of cancellous bone – functions of internal remodeling – changing the grain.

Techniques associated with the study of bone – new material on computational methods, imaging of bone structure – strain gauging of live animals – Clinically related issues – elementary stress analysis of bone – bone prostheses and implants – non – invasive measurement of bone integrity.

Introduction to computational neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience: Descriptive vs. functional models – Turing vs. neural computation. Introduction to anatomy and cellular basis of nervous system.Introduction to differential equations and theory of dynamical systems.Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currents – experimental techniques: voltage and space clamp experiments. The Hodgkin – Huxley formalism – activation and inactivation kinetics – complete model for action potential generation.Hodgkin – Huxley vs Markov models.Qualitative Hodgkin – Huxley theory – voltage clamp techniques – Hodgkin – Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin – Huxley model: FitzHugh – Nagumo – Rinzel model.

Abstract Models: phase model – rate model – McCulloch – Pitts neuron – integrate and fire neuron model. Synapses and synaptic plasticity – simplified and phenomenological models of synaptic functions. Synaptic transmission: electrical and chemical. Gated transmission at the nerve muscle synapse and central synapses – neurotransmitters.

REFERENCES

1. Stephen C. Cowin, "Bone Mechanics Handbook, Second Edition", CRC Press, 2001.
2. John D. Currey**,** "Bones: structure and mechanics", Princeton University Press, 2002.
3. Arabib M.A., Erdi P. and Szentagothai J., Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Teicher, Beverly A., Tumor Models in Cancer Research Series: Cancer Drug Discovery and Development, 2nd ed. Springer, 2011.

COURSE OUTCOMES

Student will be able to

1. Understand the types of bone tissues and its structures.
2. Analyse the causes of Bone Cancer.
3. Model the different types of bones and Cancer affected Bones.
4. Do research on the theraptics on Bone Cancer.
5. Design new modalities for diagnosis with study analysis.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓		✓	
CO3	✓	✓	✓		✓		✓	✓	
CO4	✓	✓		✓				✓	✓
CO5	✓			✓		✓	✓		✓

EIRIPEXX / PEIRIPEXX	**MEDICAL IMAGING SYSTEMS AND RADIO THERAPY**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To acquire knowledge about the various medical imaging techniques.
- To understand the fundamental principle and working of the medical imaging systems involved in the diagnosis of health care.

X–Rays: Principle and production of soft X–Rays, Selection of anodes, heel pattern, Scattered Radiation, Porter – Bucky systems, Cooling System, Testing for various parameters of the unit, principles of Angiography and Fluoroscopic Techniques, Image Intensifiers, Single plane and bi plane recording units, digital subtraction angiography, mammography, dental X–ray units.

Tomography: Principle, Plane of Movement, Multisection Radiography, Computerised Axial Tomography, Type of Detection, image reconstruction, Spiral CT, Transverse Tomography, 3D Imaging.

Emission Imaging: Alpha, Beta, Gamma Emission, different types of Radiation Detectors, G.M. & Proportional Counters, Pulse Height Analysers, Isotopic, Scanners, Isotopic Diagnosis of RBC Destruction Rate, GI Bleedings Iron Concentration, Liver Functions, Functions of Gamma Camera, PET, SPECT, PET/CT.

Magnetic Resonance Imaging: Principle of MRI, MRI instrumentation, Imaging Different Sections of the Body, Tissue Characterization, MR Spectroscopy, Functional MRI.

Therapy Using X–Rays and Isotopes 9 Direct and Indirect effects of high energy radiation, Units for radiation Exposure, Depth Dose curves, Linear Accelerator Betatron, Cobalt and Cesium Therapy, Computation of Absorbed Dose Level, Automatic Treatment Planning, Hazardous Effects of Radiation, Radiation measuring units, Allowed Levels, ICRP regulation Protection Methods.

REFERENCES

1. Chesney D.N. and Chesney M.O., X-Ray Equipments for Students Radiographer, Blackwell Scientific Publications, Oxford, 1971.
2. Alexander, Kalender and Linke, Computer Tomography, John Wiley, Chichster, 1986.
3. Steve Webb, The Physics of Medical Imaging, Adam Hilger, Philadelpia, 1988.
4. Peggy. W, Roger.D.Ferimarch, MRI for Technologists, McGraw Hill Publications, New York, 1995.
5. Donald Graham, Paul Cloke, Martin Vosper, Principles of Radiological physics, Churchill Livingston, 5th Edition.
6. Donald W. McRobbice, Elizabeth A. Moore, Martin J. Grave and Martin R. Prince, MRI from picture to proton, Cambridge University press, New York, 2006.
7. Jerry L. Prince and JnathanM. Links, “Medical Imaging Signals and Systems”, Pearson Education Inc. 2006.

COURSE OUTCOMES

Student will be able to

1. Understand the different methods and modalities used for medical imaging.
2. Learn the preferred medical imaging methods for routine clinical applications.
3. Understand the engineering models used to describe and analyze medical images.
4. Apply these tools to different problems in medical imaging.
5. Develop drugs with the research Analysis

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓		✓	
CO2	✓	✓				✓	✓		✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓		✓			
CO5			✓	✓				✓	✓

EIRIPEXX / PEIRIPEXX	**WAVELET TRANSFORMS AND ITS APPLICATIONS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To learn the fundamental concepts of wavelet
- To apply the wavelet techniques for various biomedical signals.
- To do analysis with the signals and processing

Introduction to Wavelets: Introduction to Multirate signal processing – Decimation and Interpolation, Quadrature Mirror Filters, Subband coding, Limitations of Fourier transform, Short time Fourier transform and its drawbacks, Continuous Wavelet transform, Time frequency representation, Wavelet System and its characteristics, Orthogonal and Orthonormal functions and function spaces.

Multiresolution Concept and Discrete Wavelet Transform: Multiresolution formulation of wavelet systems – signal spaces, scaling function, wavelet function and its properties, Multiresolution analysis, Haar scaling and wavelet function, Filter banks – Analysis and Synthesis, 1D and 2D Discrete wavelet transform, Wavelet Packets, Tree structured filter bank, Multichannel filter bank, Undecimated wavelet transform.

Wavelet System Design: Refinement relation for orthogonal wavelet systems, Restrictions on filter coefficients, Design of Daubechies orthogonal wavelet system coefficients, Design of Coiflet and Symlet wavelets.

Wavelet Families: Continuous Wavelets – Properties of Mexican hat wavelet, Morlet, Gaussian and Meyer wavelets. Orthogonal wavelets – Properties of Haar wavelets, Daubechies wavelets, Symlets, Coiflets and Discrete Meyer wavelets. Properties of Biorthogonal wavelets, Applications of wavelet families.

Wavelet Applications: Denoising of Signals and Images, Image enhancement, Edge detection, Image Fusion, Image compression, Wavelet based feature extraction, Analysis of phonocardiogram signals, Analysis of EEG signals, Speech enhancement for hearing aids.

REFERENCES

1. M. Vetterli and J. Kovacevic, Wavelets and sub band coding', Prentice Hall, 1995.
2. C.SidneyBurrus, Ramesh Gopinath&HaitoGuo, 'Introduction to wavelets and wavelet transform', Prentice Hall, 1998.
3. MetinAkay, 'Time frequency and wavelets in biomedical signal processing', Wiley – IEEE Press, October 1997.
4. Raguveer m Rao&Ajith S. Bopardikar, 'Wavelet transforms – Introduction to theory and applications', Addison Wesley, 1998.
5. S.Mallet, 'A Wavelet tour of signal processing', Academic Press 1998.
6. G.Strang and T.Nguyen, 'Wavelet and filter banks', Wesley and Cambridge Press.
7. P.P.Vaidyanathan, 'Multi rate systems and filter banks', Prentice Hall 1993.

COURSE OUTCOMES

Student will be able to

1. Understand an in-depth knowledge about the basic concepts of wavelet and speech analysis
2. Apply wavelet for various physiological signals
3. Analyse the signal features and its functions
4. Do mathematical analysis on various types of Bio signals
5. Develop new algorithms for early diagnosis

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓						✓	
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓		✓			✓
CO5	✓		✓	✓				✓	✓

EIRIPEXX / PEIRIPEXX	**BIOINFORMATICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To impart knowledge on various aspects of bioinformatics.
- To study in detail about DNA and its formation.

Basic Concepts of Molecular Biology: Cells – Chromosomes, DNA, RNA, Proteins, Central dogma of molecular biology, Genomes and Genes – Genetic code, Transcription, Translation and Protein synthesis. Web based genomic and proteomic data bases: NCBI, Gen Bank.

Sequence alignments: Dot plot – Pair – wise sequence alignments – local and global – Sequence similarity and distance measures – Smith – Waterman algorithm, Needleman – Wunch algorithm, Multiple sequence alignment – Sum – of – Pairs measure – Star and tree alignments – PAM and BLOSUM, Phylogenetic analysis.

Informational view of Genomic data: Genomic Signal Processing – DNA Spectrograms – Identification of protein coding regions – Gene expression – Microarrays, Microarray image analysis.

Gene structure in Prokaryotes and Eukaryotes: Molecular Structure Prediction – Basic concepts and terminologies related to molecular structures – Basic molecular Visualization – RNA secondary structure prediction – Protein folding problem – Protein Threading – Protein Visualization – Introduction to Drug Discovery.

Software Tools: Use of Tools for basic and specialized sequence processing such as: BLAST, FASTA, RasMol, Phylip, Clustal W.

REFERENCES

1. Setubal, Meidanis, Introduction to Computational Molecular Biology, Thomson: Brooks/Cole, International Student Edition, 2003.
2. Jean – Michel Claverie, Cedric Notredame,Bioinformatics – A Beginners Guide, Wiley – Dreamtech India Pvt Ltd, 2nd edition, 2007.
3. Lesk, Introduction to Bioinformatics, Oxford University Press, Indian Edition, 3rd edition, 2008.
4. Higgins and Taylor, Des Higgins, Willie R. Taylor, Bioinformatics: Sequence, structure and databanks, Oxford University Press, Indian Edition, 2003.
5. Bryan P. Bergeron, Bioinformatics Computing, Prentice Hall of India, 2003.
6. Jiang, Xu and Zhang, Current topics in Computational Molecular Biology, Ane Books, New Delhi, 2004.

COURSE OUTCOMES

Student will be able to

1. Understand the concept of Gene structures.
2. Acquire awareness about the computational biology.
3. Work with various software tools.
4. Understands the various aspects of informatics applied in health industry so that quality of health care is improved.
5. Analyse the gene formations and diseases.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓					✓		
CO2	✓	✓				✓		✓	
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓					
CO5			✓	✓				✓	✓

EIRIPEXX / PEIRIPEXX	MEDICAL ETHICS AND STANDARDS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Achieve familiarity with some basic ethical framework& understand how these ethical frame works can help us to think through contemporary questions in medical ethics.
- Students will be able to know about the legal and ethical principles and application of these principles in health care settings & gain knowledge about the medical standards that to be followed in hospitals.

Introduction to Medical Ethics: Definition of Medical ethics, Scope of ethics in medicine, American medical Association code of ethics, CMA code of ethics – Fundamental Responsibilities, The Doctor and The Patient, The Doctor and The Profession, Professional Independence, The Doctor And Society.

Ethical Theories & Moral Principles: Theories – Deontology &Utilitarianism ,Casuist theory, Virtue theory, The Right Theory. Principles – Non Maleficence, Beneficence, Autonomy, Veracity, Justice. Autonomy & Confidentiality issues in medical practice, Ethical Issues in biomedical research ,Bioethical issues in Human Genetics & Reproductive Medicine

Hospital Accreditation Standrads: Accrediation – JCI Accreditation & its Policies. Patient centered standards, Healthcare Organization management standards.

Hospital Safety Standards: Life Safety Standards – Protecting Occupants, Protecting the Hospital From Fire, Smoke, and Heat, Protecting Individuals From Fire and Smoke, Providing and Maintaining Fire Alarm Systems, Systems for Extinguishing Fires Environment of Care Standards – Minimizing EC Risks, Smoking Prohibitions, Managing Hazardous Material and Waste, Maintaining Fire Safety Equipment, Features, Testing, Maintaining, and Inspecting Medical Equipment.

Medical Equipment Safety Standards: General requirements for basic safety & essential performance of medical equipments.IEC 60601 standards – Base Standard – general requirement of electrical medical devices, Collateral Standards EMC radiation protection &programmable medical device system, Particular Standards – type of medical device.

REFERENCES

1. Domiel A. Vallero, "Biomedical Ethics for Engineers", Elsevier Pub.1st edition, 2007.
2. Biomedical Ethics: A Canadian Focus. Johnna Fisher (ed.), Oxford University Press, Canada, 2009.
3. Robert M. Veatch, "Basics of Bio Ethics", Second Edition. Prentice Hall Inc., 2003.
4. Physical Environment Online: A Guide to The Joint Commission's Safety Standards is published by HC Pro, Inc. 2010.
5. Joint Commission Accreditation Standards for Hospitals, 2nd edition, 2003.
6. Ben Mepham, Bioethics – "An Introduction for the Biosciences", 2nd edition, 2008, Oxford.

COURSE OUTCOMES

Upon completion of this course the student should be able to demonstrate a measurable increase in their knowledge, skills and abilities related to:

1. Legal and professional guidelines for the health professions.
2. Public duties and consent.
3. Guidelines to obtain medical standards in hospitals.
4. Medical ethics, legal ethics and the differences associated with the medical society.
5. Standards for the devices

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓				✓		✓	✓
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓			✓		
CO5	✓	✓		✓				✓	

OE - OPEN ELECTIVES

EIRIOEXX/ PEIRIOEXX	**COMPUTERS IN MEDICINE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To familiarize the student with use of computers in medicine
- To use computers for bio signal analysis
- To automate the hospitals with the help of computers

Introduction: Computer hardware and software – programming languages – use in medical field – need of computing hospitals – cost effectiveness – help of computerization to physicians.

Patient data base management: Computerized medical records – security. Computer in clinical laboratory – database approach – automated clinical laboratory and analysis – computerized specimen analysis – analysis of ECG, EEG and EMG. Chromosome analysis by computer – computerized cytology and histogram – automated scanning for cervical cancer.

Basics of computer assisted medical imaging: Nuclear medicine – digital subtraction radiography – computerized ultra sonography – X–ray, CT, Nuclear magnetic resonance. Basics of computer assisted medical decision making – general model algorithms – fuzzy set theory – cognitive set theory – cognitive models – QMR, KES and TIA.

Computer in intensive care units: metabolic balance up keeping – pulmonary function evaluation – Cardio vascular evaluation – Computer assisted therapy – computer for case of renal disorders.

Computer aids for the handicapped: basic discussion with examples – introduction to computer assisted instruction in medicine – ISDN in medicine.

REFERENCE

1. R.D. Lele, Computers in medicine, Tata McGraw Hill Publishing Company Limited, 2nd reprint, 2008.

COURSE OUTCOMES

Student will be able to

1. Exposed to PC hardware as well as various microprocessor family.
2. Hardware behind data acquisition.
3. Scope of virtual reality in health care.
4. Develop insight knowledge about the biometrics and network security.
5. Automate the exsisting systems with computers.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓		✓		✓
CO4	✓	✓		✓					
CO5				✓	✓			✓	✓

EIRIOEXX/ PEIRIOEXX	**TISSUE AND STEM CELL ENGINEERING**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand basics of Tissue Engineering.
- To understand fundamentals of cell mechanisms.
- To teach the Physical & biological principles that serve as the scientific basis for understanding the interactions of biological molecules and cells with biomaterials employed for the fabrication of permanent implantable prostheses and as matrices for tissue engineering.
- To understand application of Tissue Engineering.

Tissue: Definition – structure – organization and types. Vascularity and angiogenesis – basic wound healing – cell migration – therapeutic and in – vitro testing.

Cell: Types – differentiations – different kind of matriX–cell – cell interaction. Cell culture: expansion – transfer – storage – characterization. Molecular biology: Cell signalling molecules – hormone – growth factor and delivery in tissue engineering. Cell attachment: differential cell adhesion – receptor – ligand binding – cell surface markers.

Scaffold and transplant: Biomaterials for tissue engineering – degradable materials (collagen, silk and polylactic acid) – porosity – mechanical strength – 3 – D architecture – cell incorporation. Tissues for replacing bone – cartilage – tendons – ligaments – skin and liver.Basic transplant immunology – stems cells – introduction – haematopoiesis.

Case study: cell transplantation for liver – musculoskeletal – cardiovascular and neural systems. Ethical – FDA and regulatory issues of tissue engineering.

Stem Cells: Origin, characterization, potential applications of human stem cells – Protocols for isolation and identification of stem cells – Differentiation of cells from human – neurospheres into neurons – astrocytes and oligodendrocytes – Immuno labelling. Gene therapy: immune rejection in stem cell therapy – new therapy for autoimmune disease – prenatal diagnosis of genetic abnormalities using fetal CD34+ stem cells.

REFERENCES

1. Sameul E. Lynch, De Robertis, J Geng, Tissue Engineering, Elsevier, 3rd Edition, 2007.
2. Clemens van Blitterswijk, Tissue Engineering, Academic Press, 2008
3. Robert. P.Lanza, Robert Langer & William L. Chick, Principles of Tissue Engineering, Academic Press, 2007.
4. B. Palsson, J.A. Hubbell, R. Plonsey and J.D. Bronzino, Tissue Engineering, CRC Press, 2003.
5. Kursad and Purksen, Embryonic Stemcell, Humana Press, 2002.

COURSE OUTCOMES

By successfully completing this course, students will be able to:

1. Understand the importance of tissue engineering in the field of biomedical engineering.
2. Understand the mechanisms involved in interaction of different materials with cells and tissues.
3. Explain different methods involved in characterization and preparation of biomaterials in tissue engineering.
4. Apply the knowledge in creating new models in drug delivery systems using synthetic and basic knowledge on stem cells and its various functional applications and therapy.
5. Design an implant for tissue replacement.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓				✓
CO4	✓	✓		✓					✓
CO5					✓	✓	✓	✓	✓

EIRIOEXX/ PEIRIOEXX	**RADIOLOGICAL EQUIPMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the generation of X-ray and its uses in imaging
- To know the techniques used for visualizing various sections of the body.
- To learn the principles of different radio diagnostic equipment in Imaging
- To discuss the radiation therapy techniques and radiation safety.

X – Rays : Production of X-rays – Various components of radiographic systems – Electrical circuit for X-ray unit – filament circuits and mA control- HT circuits- KV control –exposure switching and control of exposure timers- types of X-ray tubes for various medical applications. Rating charts of X-ray tubes.

Radiation Techniques: Scattered radiation and its control in radiography – collimators – pinky grids – absorbed dose - Basics of tables & arms. Fluoroscopy systems – TV chain for fluroscopy – Properties of X -ray films &screens - Characteristics of imaging system by modulation transfer function.

Exposure Controls : Automatic exposure controls - Photo timers - types - limitations - performance - serial film chargers – types - radiographic considerations - film exposure time - photo timer applications - automatic brightness control system.

Angiogrphy: Basic of digital angiography - Image processors for digital angiography - processor architecture – Temporal integration techniques for digital angiography- digital subtraction angiography.

Radiotherapy: Physical principles of radiotherapy. Dosage data for clinical applications. Measurement of output and use of ISODOSE charts. Collimators and beam direction devices. Telemetry sources and acceptance calibration. Safety protocols & protection. Principles of linear accelerators for radiation therapy. Radiation therapy planning.

REFERENCES

1. Chesneys , 'Equipment for Student Radiographers', 4th Edition, Wiley-Blackwell Publiishers, 1994.
2. Carr & Brown, 'Introduction to Biomedical Equipment Technology' Pearson Education, Asia, 1993.
3. R. S. Khandpur, 'Handbook of Bio-Medical Instrumentation', Tata McGraw Hill, 1989.
4. J.Webster, 'Bioinstrumentation', Wiley & Sons, 2004.

COURSE OUTCOMES

The student is exposed to the

1. Basics of radiation and its effects.
2. Various imaging modalities and current techniques.
3. Radiation safety and precautions to be followe in the Hospitals.
4. Advanced radiation theraphy for cancer treatment.
5. Knowledge of radiation and its effects.

	MAPPING OF COS WITH POS								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓		✓					
CO2	✓	✓					✓	✓	✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓		✓	✓		✓
CO5	✓			✓	✓			✓	✓

EIRIOEXX/ PEIRIOEXX	**SPORTS MEDICINE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To teach the key principles of sports medicine education.
- To enable the students with the knowledge of Biomechanics for the muscles an bones.
- To elaborate about the classification of sport injuries an physiological exercices.

Meaning and concept of sports medicine, scope of sports medicine in physical education and sports. History of Sports Medicine in India. Prevention of sports injuries. Role of Physical Educators and Coaches in the prevention of sports injuries. Pre-conditioning injury prevention exercises and drives Static Stretching exercises. Therapeutic exercise and their classification.

Sports Injuries: - Terminology and classification of common sports soft tissue injuries, Pathological changes in sprains, strain and contusion and their management. Regional injuries and their management- injuries of head, ears, eyes, nose, back, shoulders, elbows, hand, abdomen, thighs, knee, leg and ankle.

Rehabilitation procedures of sports injuries, Principles of rehabilitation of injuries, Therapeutic modelties i.e cryotherapy , hydrotherapy, electrotherapy and lesser therapy. Massage and its techniques.

Physiology of exercise, short and long term effects of exercise on muscular tissues, Physiological principles of development of strength, endurance, speed and flexibility.

Heart role and exercise. Threshold for training effects on heart, Cardiac reserve capacity, blood pressure and exercise. Lungs ventilation during rest and exercise, change in lungs diffusions during muscular activities.

REFERENCES :

1. Armstrong and Tuckler, “Injuries in Sports”, Staples Press, London 1964
2. Bolan, J.P and Rasch, P.J , ”Treatment and Prevention of Athletic Injuries”, The Inter-state Printers and Publishers, 1967.
3. Morehouse, L.E and Rasch, P.J, “Sports Medicine for Trainers”, Philadephia, W.B. Saunder CO.,1963.
4. Ryans Allan,”Medical Care of the Athlete”, McGraw Hill, 2003.
5. Pande, P.K. “ Know How Sports Medicine?” AP Publications, Jalandhar,2014.

COURSE OUTCOMES

The student is exposed to the

1. Awareness in sport Medicine.
2. Techniques to be applied for sports injuries.
3. Applications of Medical techniques for athelette.
4. Physiological exercices for various human systems and developmental strength.
5. New ideas for design projects.

	MAPPING OF COS WITH POS								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓						✓	✓
CO2	✓	✓					✓		✓
CO3	✓	✓	✓		✓			✓	
CO4	✓	✓		✓		✓	✓		✓
CO5			✓	✓	✓			✓	✓

EIRIOEXX/ PEIRIOEXX	COMPUTATIONAL BIOENGINEERING	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- Neural engineering and rehabilitation research applies neuroscience and engineering methods to analyze central and peripheral nervous system function and to design clinical solutions to neurological disorders or injury.
- To study the basics of Nervous system
- To understand the development and arrangement of neural tissue
- To study the neuronal disorders and injuries
- To study the repairing and reconstruction mechanism of nervous system.
- Introduction to Computational Neuroscience – motivation for biophysical modeling. Theory and modeling in neuroscience : Descriptive vs. functional models -Turing vs. neural computation. Introduction to anatomy and cellular basis of nervous system.Introduction to differential equations and theory of dynamical systems.

Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane, change in membrane potential with distance, voltage clamp experiment and Hodgkin and Huxley's model of action potential.

Ionic channels – ionic currnets- experimental techniques : voltage and space clamp experiments. The Hodgkin-Huxley formalism – activation and inactivation kinetics – complete model for action potential generation.Hodgkin-Huxley vs Markov models.

Qualitative Hodgkin-Huxley theory – voltage clamp techniques – Hodgkin-Huxley equations methods. Simplified neuron models: Simplifications of the Hodgkin-Huxley model: FitzHugh – Nagumo- Rinzel model. Abstract Models: phase model – rate model – McCulloch-Pitts neuron – integrate and fire neuron model.

Synapses and synaptic plasticity – simplified and phenomenological models of synaptic functions.synaptic transmission: electrical and chemical. Gated transmission at the nerve muscle synapse and central synapses – neurotransmitters.Cellular basis of learning: synaptic plasticity – The Hebbian rule of learning – variations for the Hebbian rule. Long term synaptic potentiation and depression. Synaptic plasticity on different time scales.

Basics of modeling neural networks: The two or three levels of neural dynamics. Supervised learning rules : Perceptron learning rule - Adaptation in linear neurons, Widrow-Hoff rule – objective functions and gradient descent – multilayer networks and back propagation. Unsupervised learning rules : Principle Component Analysis – decorrelation – Winner-take-all networks and clustering. Basic neural network architectures: feed-forward – feedback – lateral connections.

REFERENCES:

1. Dayan P and L.F.Abbott, Theoretical Neuroscience: Computational and Mathematical modeling of neural systems, MIT Press, 2001.
2. W. Gerstner and W.M.Kistler, Spiking Neuron Models, Cambridge University Press, 2002.
3. Arabib M.A, Erdi P and Szentagothai J, Neural Organization: Structure, functions and dynamics, MIT Press, 1997.
4. Lauren Fausett, Fundamentals of Neural Networks, Prentice- Hall, New Jersey, 1994.
5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer, 1989.

COURSE OUTCOMES

Through this course of study students will be able to

1. Understand the application of basic science and engineering techniques,
2. Develop methods to record from and exert control over the nervous system
3. Understand and develop the models of associated organ systems.
4. Can carryout research in the analysis of memory of physiological systems
5. Apply neural networks for detection and analysis of diseases.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					
CO5	✓		✓	✓				✓	✓

EIRIOEXX/ PEIRIOEXX	**HEALTH CARE SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To make the student to understand health care sector
- To give awareness about hospital set up in a larger perspective with an emphasis on the systems.

Environmental Issues: Introduction: Theoretical frame work - Environment - Internal and External – Environmental Scanning – Economic Environment – Competitive Environment – Natural Environment – Politico Legal Environment – Socio Cultural Environment - International and Technological Environment.

Introduction to Health Care: A Conceptual Approach to Understanding the Health Care Systems: Evolution – Institutional Settings - Out Patient services – Medical Services – Surgical Services – Operating department – Pediatric services – Dental services – Psychiatric services – Casualty & Emergency services – Hospital Laboratory services – Anesthesia services – Obstetrics and Gynecology services – Neuro – Surgery service – Neurology services.

Overview of Health Care Sector in India: Primary care – Secondary care – Tertiary care – Rural Medical care – urban medical care – curative care – Preventive care – General & special Hospitals-Understanding the Hospital Management – Role of Medical, Nursing Staff, Paramedical and Supporting Staff - Health Policy - Population Policy - Drug Policy – Medical Education Policy

Health Care Regulation:WHO, International Health regulations, IMA, MCI, State Medical Council Bodies, Health universities and Teaching Hospitals and other Health care Delivery Systems

Epidemiology Issues: Epidemiology -Aims – Principles – Descriptive, Analytical and Experimental Epidemiology - Methods - Uses

REFERENCES:

1. Zweifel.Peter, Breyer Friedrich, and MathiasKifmann, 'Health economics', Springer, 2009.
2. Y.Shanmugasundaram, 'Theory and practice of health economics in India', Institute for Advanced Studies & Research, 1994.

COURSE OUTCOMES

The student is exposed to the

1. Hospital administration.
2. Various environmental chanllenges in Health care domain
3. History and overview of healthcare system in the country.
4. Understands the regulation and standards.
5. Epidemiology Principles

	MAPPING OF COS WITH POS								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓		✓	✓	
CO4	✓	✓		✓		✓			✓
CO5			✓	✓	✓	✓	✓	✓	✓

EIRIOEXX/ PEIRIOEXX	**TELEMEDICINE**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To teach the key principles for telemedicine and health.
- To enable the students with the knowledge of telemedical standards, mobile telemedicine and its applications.

Telemedicine, telehealth and telecare: History of telemedicine – Main phases of telemedicine – Pre electronic telemedicine. Electronic telemedicine Technical Requirements – Type of information and standards, audio, data, Fax,

Video Types of communications and networking – networking architecture. POTS, ISDN, ATM Other Fixed networks – Air/airless communications, RF, Microwaves, Satellite, GSM, CDPD (Cellular Digital Packet Data) Acquisition/ displays – Acquisition systems Cameras, Scanners, Other medical specialized acquisition system.

Display systems: Analogue devices, LCD, Laser displays, Holographic representations, Virtual screen devices Computation / storage systems: Magnetic, Mixed, Optical (laser) devices (only brief description required).

Telemedicine applications: Teleradiology: Basic parts of a teleradiography system, Image acquisition and management, display, communication, interpretation Telepathology: Applications, requirements, security and confidentiality tools, telequantitation at distance. Telecytology: Applications, Telecardiology: requirements, portable solutions Telehome – Care Home based applications, Teleoncology: Applications, Telesurgery, telepsychiatry, Teledermatology Techniques.

Internet in telemedicine: Basic concepts – Security – secure socket layer – Firewalls – proxies. Personal Communication, Medical data sharing needs for telemedicine – Internet problems, Distant training, teleworking and telecasting. Ethical and legal aspects of telemedicine: confidentiality, patient rights and consent – ethical and legal aspects of internet – telemedical malpractice.

Constraints for the wide spread use of telemedicine: constraints linked to economy, social acceptance Strategic planning for telemedicine implementation. Analysis of the present situation and the demand Objectives and strategies – Plan of implementation, Forces affecting technology transfer scenarios for telemedicine.

REFERENCES

1. Olga Ferrer, Roca M. Sosa, Marcelo C, Hand Book of Telemedicine, IOS Press, 3rd edition, 2002.
2. Ling Guan, Multimedia image and video processing, CRC Press, 2000.
3. Thorsten M. Buzug, Heinz Handels, Dietrich Holz, Telemedicine: Medicine and Communication, Springer – Verlag, 2001.
4. Douglas V. Goldstein, e-Healthcare: Harness the power of Internet, e-commerce and e-care, Jones and Barlett Publishers.
5. C. Norris, Essentials of Telemedicine and Telecare, John Wiley& Sons 2002.

COURSE OUTCOMES

The student is exposed to the

1. Technologies applied in multimedia using telemedicine.
2. Protocols behind encryption techniques for secure transmission of data.
3. Applications of telehealth in healthcare.
4. Concept of the fundamental concepts necessary to for any telemedicine and telehealth activity.
5. Telemedicine and ways of connecting nodal hospitals

	MAPPING OF COS WITH POS								
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓					✓		
CO2	✓	✓					✓		
CO3	✓	✓	✓		✓		✓	✓	
CO4	✓	✓		✓		✓			✓
CO5					✓	✓	✓	✓	✓

EIRIOEXX/ PEIRIOEXX	**MODELLING OF PHYSIOLOGICAL SYSTEMS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To understand the fundamental engineering aspects of modelling Physiological systems.
- To utilize concepts derived from biomedical research to aid in the design of engineering systems.
- To apply system techniques and methods to biomedical problems.

Biological control system: similarities and differences – components of living control system – Model and Analog – system properties – resistance – storage – distributed and lumped systems. Mathematical approach – electrical analogues. Approaches to modelling: Mathematical modelling – classification of models – characteristics of models. Purpose of physiological modeling and signal analysis – linearization of nonlinear models – model formulation – identification – validation and Simulation Different approaches of modeling physiological systems – linear modeling – distributed modeling – nonlinear modeling – time – varying modeling.

Nonparametric modeling: Volterra models – Wienermodels – efficient volterra kernel estimation – analysis of estimation errors. Parametric modeling: Basic parametric model forms – estimation procedures – Volterra kernels of nonlinear differential equations – discrete – time volterra kernels of NARMAX models – from Volterra kernel measurements to Parametric models – equivalence between continuous and Discrete – parametric models.Introduction to various process controls like cardiac rate – blood pressure – respiratory rate – blood – glucose regulation – pharmacokinetic modeling – compartmental models – blood – tissue models.

Equivalent circuit model: Electromotive, resistive and capacitive properties of cell membrane – change in membrane potential with distance – voltage clamp experiment – voltage dependent membrane constant and simulation of the model – model for strength – duration curve – model of the whole neuron – Huxley model of isotonic muscle contraction – modeling of EMG – motor unit firing – amplitude measurement – motor unit and frequency analysis.

Physiological modelling: Electrical analog of blood vessels – model of systematic blood flow – model of coronary circulation – transfer of solutes between physiological compartments by fluid flow – counter current model of urine formation – model of Henle's loop – linearized model of the immune response – Germ, Plasma cell, Antibody, system equation and stability criteria.

Electrical circuit model of oxygenation: A model of immune response to disease (Block Diagram) – modelling of multi input/multi output systems: The two – input case – Applications of two – input modelling to physiological systems – Multi – input case spatiotemporal and spectro temporal modelling. Respiratory system: Modeling oxygen uptake by RBC and pulmonary capillaries mass balancing by lungs – gas transport mechanism of lungs and O_2 and CO_2 transport in blood and tissues.

Case studies on modeling of physiological system: Modeling of nerve action potential: Hodgkin – Huxley model.

Modeling of skeletal muscle contraction: Huxley Cross Bridge model. Modeling of myoelectrical activity.

Modeling of cardiovascular system: Block diagram representation of cardio vascular system.

REFERENCES

1. David T. Westwick, Robert E. Kearney, Identification of Nonlinear Physiological Systems, Wiley – IEEE Press, 2003.
2. Michael C. K. Khoo, Physiological Control Systems – Analysis, simulation and estimation, Prentice Hall of India, 2001.
3. J. Enderle, S. Blanchard, J. Bronzino, Introduction to Biomedical Engineering, Academic Press, 3rd edition, 2012.
4. Suresh.R.Devasahayam, Signals & Systems in Biomedical Engineering, Springer, 2000.
5. V.Z. Marmarelis, Advanced methods of physiological system modeling, Springer, 1999.
6. James V. Candy, Signal Processing: The Model Based approach, John Wiley sons, Newyork, 2006.
7. L.Stark, Neurological Control System, Plenum Press, New York, 1968.
8. R.B. Stein, Nerve and Muscle, Plenum Press, New York, 1980.

COURSE OUTCOMES

Student will be able to

1. Acquire an insight into and understanding of the utilization of models, system analysis and analog simulation in the field of bioengineering.
2. Understand basic concepts of modeling for designing biological model.
3. Model and simulate physiological processes for better understanding.
4. Use various simulation softwares for modeling biological systems.
5. Understand micro level analysis of cell signaling.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓			
CO3	✓	✓	✓		✓		✓	✓	
CO4	✓	✓		✓					✓
CO5	✓	✓	✓	✓					

EIRIOEXX/ PEIRIOEXX	**BIOMECHANICS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To provide the knowledge of mechanical concepts as applied to human movement.
- To study about the bone structure and cartilage.
- To study the structure, movements, and loads applied to spine, shoulder and hip.
- To study about the fluid mechanic system applied to human body

Basic Biological Principles: Diffusion – surface tension and viscosity – characteristics – influencingfactors – biological applications. Introduction to mechanics: Review of principles of mechanics – vector mechanics – Resultant forces of Coplanar and Non – coplanar – Concurrent and non – concurrent forces – parallel force in space – Equilibrium of coplanar forces – Newton's laws of motion – work and energy – moment of inertia. Fluid mechanics: Introduction – viscosity and capillary viscometer – rheological properties of blood – laminar flow – Couette flow and Hagen – poiseuille equation – turbulent flow.

Hard tissues: Bone structure – composition and mechanical properties of bone – , viscoelastic properties – Maxwell and Voight models – anisotropy – electrical properties of bone – fracture mechanism and crack propagation in bones – fracture fixators – repairing of bones – mechanical properties of collagen rich tissues, teeth and its properties.

Soft tissues: Structure and functions of cartilages, tendons – ligaments – stress – strain relationship – soft tissue mechanics – mechanical testing of soft tissues standard sample preparation – cross – section measurement – clamping of the specimen – strain measurement – environmental control, time dependent properties of testing.

Bones, joints and loco motor systems: Joints – classification based on structural, functional and regional – characters – mechanism of lubrication of synovial joints. Bone – composition – classification. Biomechanics of joints: Skeletal joints – basic considerations – basic assumption and limitations – forces and stresses – mechanics of the elbow, shoulder, spinal column, hip, knee and ankle.

Locomotion: Basis – gait analysis and goniometry – ergonomics – foot pressure measurements – force platform – mechanics of foot. Total Hip Prosthesis: requirements – types of components – Stress analysis and instrumentation, Knee Prosthesis. Cardiovascular mechanics: Heart valves – artificial valves – biological and mechanical valves development – testing.

REFERENCES

1. Donald R. Peterson and Joseph D. Bronzino, Biomechanics Principles and applications, CRC press, Taylor & Francis Group, LLC, 2008.
2. Duane Knudson, Fundamentals of Biomechanics, Springer publication, 2nd Edition, 2007.
3. R. McNeill Alexander, Biomechanics, Chapman and Hall, New York, 1975.
4. D. N.Ghista, Biomechanics of Medical Devices, Marcel Dekker, New York, 1982.
5. A.Z. Tohen and C.T. Thomas, Manual of Mechanical Orthopaedics.
6. D.N. Ghista and Roaf, Orthopaedic Mechanics: Procedures and Devices, Academic Press, London, 1978.
7. V.C. Mow and W.C. Hayes, Basic Orthopedic Biomechanics, Lippincott – Raven Publishers, Philadelphia, 1997.

COURSE OUTCOMES

Student will be able to

1. Understand the definition of biomechanics, prostheses orthoses and its classification and design principles.
2. Develop a better understanding of how mechanical principles influence human motion during everyday life.
3. Analyze the forces at joints for various static and dynamic human activities; analyze the stresses and strains in biological tissues.
4. Understand the principles of mechanics that is used to analyze human movement.
5. Analyse the mechanism of joints and bones

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓				✓		✓	
CO3	✓	✓	✓		✓		✓		
CO4	✓	✓		✓					✓
CO5	✓	✓		✓	✓				

EIRIOEXX/ PEIRIOEXX	TROUBLESHOOTING OF MEDICAL EQUIPMENTS	L	T	P	C
		3	0	0	3

COURSE OBJECTIVES

- To provide knowledge to students to enable them to troubleshoot the various equipments used in hospitals.

Troubleshooting Procedures : Fundamental troubleshooting procedures: Making of an Electronic Equipment, causes of Equipment Failure, Troubleshooting Process & Fault finding Aids, Troubleshooting Techniques, and Grounding Systems in Electronic Equipment, Temperature Sensitive Intermittent Problems, and correction Action to repair the Equipment.

Testing of passive components and semiconductor devices :

Testing of passive components & semiconductor devices: resistors, capacitors & inductors, causes of failure for electronic components, testing procedure for semiconductor devices: special diodes, bipolar transistors, field effect transistor (FET), and thyristor.

Fault Diagnosis In Integrated Circuits: Fault Diagnosis In Analog& Digital Integrated circuits: Fault Diagnosis in Op-Amp Circuits, Digital Troubleshooting Methods, Digital IC Troubleshooters, Circuit board Troubleshooting.

Troubleshooting Of Biomedical Instruments : Trouble shooting of ECG Machine, EEG Machine, Defibrillator Electrosurgical unit, Anaesthesia machine, Autoclaves & sterilizers, Endoscope.

Troubleshooting Of Biomedical Equipments : Troubleshooting of Incubators, Nebulizer, Oxygen Concentrators, Oxygen cylinders & flow meters, Pulse Oximeter, Sphygmomanometers, Suction Machine,X-Ray Machine Troubleshooting.

REFERENCES:

1. R.S.Khandpur, 'Troubleshooting Electronic Equipment- Includes Repair &Maintenance', Tata McGraw-Hill, Second Edition 2009.
2. Dan Tomal and Neal Widmer, 'Electronic Troubleshooting', McGraw Hill, 3rdEdition 2004.
3. Nicholas Cram & Selby Holder, 'Basic Electronic Troubleshooting forBiomedical Technicians', TSTC Publishing, 2nd Edition 2010.
4. World Health Organisation, 'Maintenance & Repair of Laboratory, Diagnosticimaging & Hospital Equipment', Geneva,1994.

COURSE OUTCOMES

Students will be able to

1. Understand the concepts of Medical Equipments.
2. Understand the functioning of equipments and usage in Hospitals.
3. Techniques about various electronic circuits in medical equipments.
4. Troubleshoot the medical devices
5. Applying the service concepts in developing new features

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓				
CO4	✓	✓		✓					
CO5		✓	✓	✓					✓

EIRIOEXX/ PEIRIOEXX	**DESIGN OF MEDICAL EQUIPMENTS**	**L**	**T**	**P**	**C**
		3	**0**	**0**	**3**

COURSE OBJECTIVES

- To equip students with basics of design, construction and development process of devices which are used in medical, clinical or laboratory practice

Introduction to Medical Equipments : Define medical device, Classification of medical device, Medical devices medical instrumentation, Origin of bio-potential, Physiological signal, Human machine interface ,Input output and control signal, Data acquisition, Sensor, Amplification, Medical electrical stimulator.

Minimally Invasive Device and Technique : Laparosopic instrumentation, surgical instrumentation in ophthalmology -Phacoemulsification: Instrument and system - Vitrorectomy: Instrument and system- Human machine interface.

Diagnostic Equipment Design : System description of diagnostic equipment: Patient monitoring system, ECG, EEG, Blood pressure monitor, Digital stethoscope, Thermometer, System description and diagram of pulse oximeter, optical fiber optics for circulatory and respiratory system measurement.

Therapeutic Equipment Design : System description of therapeutic equipment: Pacemaker, External cardio vector defibrillator, Implantable cardio vector defibrillator, Deep brain stimulation, Functional electrical stimulator (FES),Hemodialysis delivery system, Mechanical ventilator.

Implant and Prosthesis : System description of various implant and prosthesis: Total hip prosthesis, Joint replacement, Design of artificial pancreas, Drug elutingstent and its engineering design - Intraocular lens implant, Cochlear implants, Heart valves.

REFERENCES

1. Gail Baura, 'Medical Device Technologies: A Systems Based Overview UsingEngineering'**,** Elsevier science, 2002.
2. Martin Culjat, Rahul Singh, Hua Lee,'Medical Devices: Surgical and Image-Guided Technologies', John Wiley & Sons, Reinaldo perez, *Design ofmedical electronic device*, Elsevier science, 2002.
3. C.Richard, Fries, 'Handbook of Medical Device Design', Marcel DekkerAG, 2nd edition 2005.

4. Anthony Y. K, Chan, 'Biomedical device technology: principles and design',Charles Thomas, 2008.
5. Theodore R, Kucklick, 'The Medical Device Ramp-D Handbook',Taylor&Francis Group LLC, 3rd edition 2013.
6. David Prutchi, Michael Norris, 'Design and Development of Medical Electronic Instrumentation: A Practical perspective of the design, construction and test of medical devices', John Wiley & Sons, 2005

COURSE OUTCOMES

Students will be able to

1. Understand the basic design of medical devices.
2. Learn various acquisition modules in Medical devices.
3. Learn various theraptic equipments.
4. Understand the design of implants.
5. Understand more about joint replacements.

MAPPING OF COS WITH POS									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**
CO1	✓	✓							
CO2	✓	✓							
CO3	✓	✓	✓		✓			✓	✓
CO4	✓	✓		✓			✓		
CO5					✓	✓	✓		✓

AUDIT COURSES

EIRIACXX	**ENGLISH FOR RESEARCH PAPER WRITING**	**L**	**T**	**P**	**C**
		2	**0**	**0**	**0**

COURSE OBJECTIVES:

Students will be able to:

- Understand that how to improve your writing skills and level of readability
- Learn about what to write in each section
- Understand the skills needed when writing a Title Ensure the good quality of paper at very first-time submission syllabus.

Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness

Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction.

Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.

Key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature.

Skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the conclusion.

Useful phrases, how to ensure paper is as good as it could possibly be the first- time submission.

REFERENCES

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books) Model Curriculum of Engineering & Technology PG Courses [Volume-I] [41]
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press 3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman'sbook. 4. Adrian Wallwork, English.

EIRIACXX	DISASTER MANAGEMENT	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Students will be able to:

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming.

Introduction Disaster

Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.

Repercussions Of Disasters And Hazards:

Economic Damage, Loss Of Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.

Disaster Prone Areas In India

Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics

Disaster Preparedness And Management

Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.

Risk Assessment

Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.

Disaster Mitigation Meaning

Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.

REFERENCES

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies "'New Royal book Company.
2. Sahni, PardeepEt.Al. (Eds.)," Disaster Mitigation Experiences And Reflections", Prentice Hall Of India, New Delhi. 3. Goel S. L., Disaster Administration And Management Text And Case Studies",Deep &Deep Publication Pvt. Ltd., New Delhi.

EIRIACXX	SANSKRIT FOR TECHNICAL KNOWLEDGE	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world Learning of Sanskrit to improve brain functioning
- Learning of Sanskrit to develop the logic in mathematics, science & other subjects Enhancing the memory power
- The engineering Scholars equipped with the Sanskrit will be able to explode the huge knowledge from ancient literature.

Alphabets in Sanskrit, past/ present/ future tense, simple sentences. Order, introduction of roots technical information about Sanskrit literature. Technical concepts of Engineering – electrical, mechanical, architecture, mathematics

REFERENCES

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-VempatiKutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi.

COURSE OUTCOMES

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood.
3. Being a global language, will help to develop logic in students.

EIRIACXX	VALUE EDUCATION	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- Understand value of education and self- development
- Imbibe good values in students
- Let the should know about the importance of character

Values and self-development –Social values and individual attitude and work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.

Importance of cultivation of values, Sense of duty, Devotion, Self-reliance. Confidence, Concentration. Truthfulness, Cleanliness.
Honesty, Humanity. Power of faith, National Unity. Patriotism. Love for nature, Discipline.

Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking, Free from anger, Dignity of labour, Universal brotherhood and religious tolerance, True friendship, Happiness Vs suffering, love for truth. Aware of self-destructive habits, Association and Cooperation, Doing best for saving nature.

Character and Competence –Holy books vs Blind faith, Self-management and Good health, Science of reincarnation, Equality, Nonviolence,Humility, Role of Women, All religions and same message, Mind your Mind, Self-control, Honesty, Studying effectively

REFERENCES

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi.

COURSE OUTCOMES

Students will be able to

1. Knowledge of self-development.
2. Learn the importance of Human values
3. Developing the overall personality

EIRIACXX	CONSTITUTION OF INDIA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Students will be able to:

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.

- To address the growth of Indian opinion regarding modern Indian intellectuals'constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
- To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

History of Making of the Indian Constitution:

History, Drafting Committee, (Composition & Working)

Philosophy of the Indian Constitution:

Preamble, Salient Features

Contours of Constitutional Rights & Duties:

Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

Organs of Governance:

Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

Local Administration:

District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.

Pachayati raj: Introduction, PRI: ZilaPachayat, Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments),

Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

Election Commission:

Election Commission: Role and Functioning, Chief Election Commissioner and Election Commissioners, State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

REFERENCES

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

COURSE OUTCOMES:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.

2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956.

EIRIACXX	PEDAGOGY STUDIES	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES:

Students will be able to:

- Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
- Identify critical evidence gaps to guide the development.

Introduction and Methodology

Aims and rationale, Policy background, Conceptual framework and terminology, Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching.

Thematic overview

Pedagogical practices are being used by teachers, in formal and informal classrooms in developing countries. Curriculum, Teacher education.

Evidence on the effectiveness of pedagogical practices

Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. eachers' attitudes and beliefs and Pedagogic strategies.

Professional development: alignment with classroom practices and follow-up support, Peer support, Support from the head teacher and the community. Curriculum and assessment, Barriers to learning: limited resources and large class sizes.

Research gaps and future directions

Research design, Contexts, Pedagogy Teacher education, Curriculum and assessment, Dissemination and research impact.

REFERENCES

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, Compare, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher Education research project (MUSTER) country report 1. London: DFID.

4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? International Journal Educational Development, 33 (3): 272–282.
5. Alexander RJ (2001) Culture and pedagogy: International comparisons in primary Education Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

COURSE OUTCOMES

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal classrooms in developing countries.
1. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners.
2. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy.

EIRIACXX	STRESS MANAGEMENT BY YOGA	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To achieve overall health of body and mind
- To overcome stress

Definitions of Eight parts of yog. (Ashtanga)

Yam and Niyam

Do`s and Don't's in life.

6. i) Ahinsa, satya, astheya, bramhacharya and aparigraha
7. ii) Shaucha, santosh, tapa, swadhyay, ishwarpranidhan

Asan and Pranayam

8. i) Various yog poses and their benefits for mind & body
9. ii) Regularization of breathing techniques and its effects-Types of pranayam

REFERENCES

1. 'Yogic Asanas for Group Tarining-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata.

COURSE OUTCOMES:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also Improve efficiency

EIRIACXX	PERSONALITY DEVELOPMENT THROUGH LIFE ENLIGHTENMENT SKILLS	L	T	P	C
		2	0	0	0

COURSE OBJECTIVES

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

Neetisatakam-Holistic development of personality

- Verses- 19,20,21,22 (wisdom)
- Verses- 29,31,32 (pride & heroism)
- Verses- 26,28,63,65 (virtue)
- Verses- 52,53,59 (dont's)
- Verses- 71,73,75,78 (do's)

Approach to day to day work and duties

Shrimad Bhagwad Geeta : Chapter 2-Verses 41, 47,48,

Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35,

Chapter 18-Verses 45, 46, 48.

Statements of basic knowledge.

Shrimad Bhagwad Geeta:

Chapter2-Verses 56, 62, 68

Chapter 12 -Verses 13, 14, 15, 16,17, 18

Personality of Role model. Shrimad Bhagwad Geeta:

Chapter2-Verses 17, Chapter 3-Verses 36,37,42,

Chapter 4-Verses 18, 38,39

Chapter18 – Verses 37,38,63

REFERENCES

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication
2. Department), Kolkata
3. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
4. Rashtriya Sanskrit Sansthanam, New Delhi.

COURSE OUTCOMES:

Students will be able to:

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students.