DR.BABASAHEBAMBEDKARTECHNOLOGICALUNIVERSITY,LONERE

Dr.BabasahebAmbedkarTechnologicalUniversity(EstablishedasaUniversityofTechnologyintheStateofMaharashtra)
(UnderMaharashtraActNoXXIXof2014)
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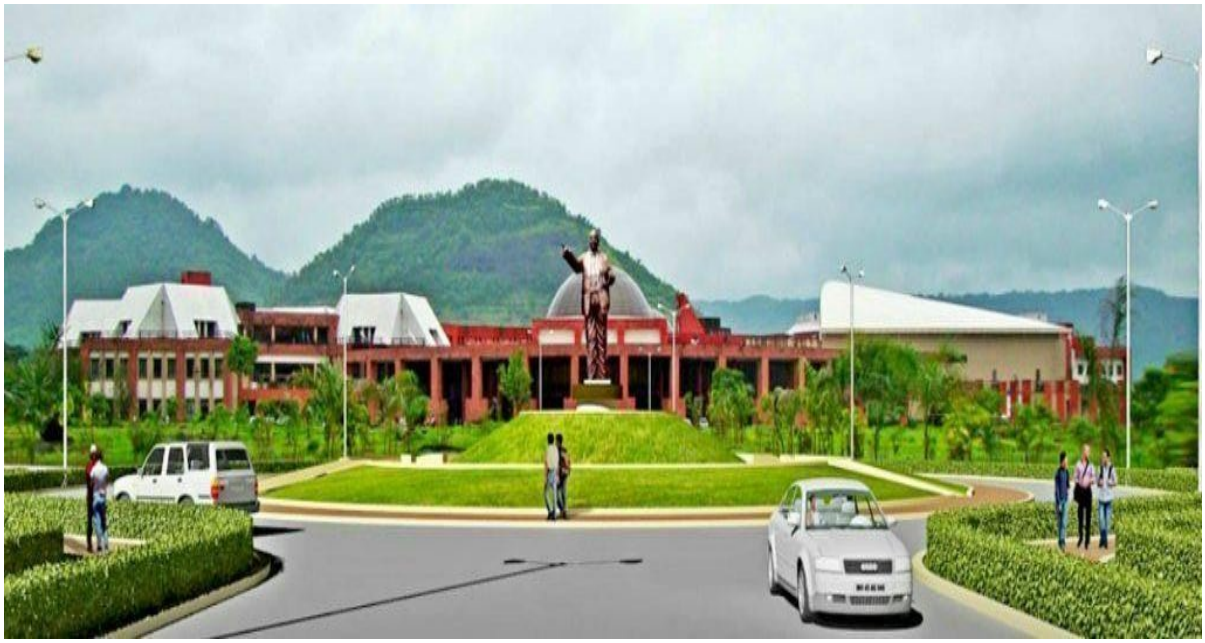
CURRICULUM

UNDERGRADUATEPROGRAMME

FINAL YEAR B. TECH.

ELECTRICAL AND INSTRUMENTATION ENGINEERING

WitheffectfromtheAcademicYear2023-2024



DR.BABASAHEBAMBEDKARTECHNOLOGICALUNIVERSITY,LONERE

B. Tech in Electrical & Instrumentation EngineeringCurriculumforFinal Year

SemesterVII									
CourseCategory	CourseCode	CourseTitle	TeachingScheme			EvaluationScheme				Credit
			L	T	P	CA	MSE	ESE	Total	
PCC1	BTEIC701	ProcessInstrumentation	3	1	-	20	20	60	100	4
PEC4	BTEIPE702	GroupF	3	-	-	20	20	60	100	3
OEC3	BTEIOE703	GroupG	3	-	-	20	20	60	100	3
OEC4	BTEIOE704	GroupH	3	-	-	20	20	60	100	3
HSSMC	BTHM705	ProjectManagement	4	-	-	20	20	60	100	4
HSSMC	BTHM706	AdvancedEngineering Economics	-	-	-	-	-	-	-	Audit
LC	BTEIL707	ProcessInstrumentationLab	-	-	2	60	-	40	100	1
Project	BTEIM708	MiniProject–III	-	-	4	60	-	40	100	2
Internship	BTEIP609	Internship–3Evaluation	-	-	-	-	-	50	50	1
		Total	**16**	**1**	**6**	**220**	**100**	**430**	**750**	**21**
SemesterVIII										
CourseCategory	CourseCode	CourseTitle	TeachingScheme			EvaluationScheme				Credit
			L	T	P	CA	MSE	ESE	Total	
	BTEIP801	NPTEL online courses	3	-	-	20	20	60	100	03
Project/Internship	BTEIP802	Projectwork/Internship	-	-	24	60	-	40	100	12
		Total	**-**	**-**	**24**	**60**	**-**	**40**	**100**	**15**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core CoursePEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory CourseHSSMC= Humanities andSocial ScienceincludingManagementCourses

- **ImportantNote:MinimumEightExperimenttoperformbasedonthesyllabusforthelaboratorysubject.**

GroupF[Sem-VII](ProfessionalElective)

Sr. No.	Course Code	CourseTitle
01	BTEIPE702A	AutomobileInstrumentation
02	BTEIPE702B	ElectromagneticFieldTheory
03	BTEIPE702C	FlexibleACTransmissionSystem

GroupG[Sem-VII](OpenElective)

Sr. No.	Course Code	CourseTitle
01	BTEIOE703A	Mechatronics
02	BTEIOE703B	InternetofThings
03	BTEIOE703C	OpticalInstrumentation

GroupH[Sem-VII](OpenElective)

Sr. No.	Course Code	CourseTitle
01	BTEIOE704A	BatchProcessControl
02	BTEIOE704B	InstrumentationforAgriculture
03	BTEIOE704C	RoboticsControl

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NPTEL Online courses

Sr. No.	Course Name	Duration (Weeks)	Institute	Name of Professor
1.	Control Engineering	12 Week	IIT Madras	Prof. RamkrishnaPasumarthy
2.	Fundamentals Of Power ElectronicsSystems	12 Week	IISc Bangalore	Prof. Vivek Agarwal, Prof. L. Umanand
3.	Biomedical Signal Processing	12 Week	IIT Kharagpur	Prof. Sudipta Mukhopadhyay
4.	Industrial Automation and Control	12 Week	IIT Kharagpur	Prof. Siddhartha Mukhopadhyay

SEMESTERVII

BTEIC701PROCESSINSTRUMENTATION 4Credits

Unit1:DigitalControlMethodandInstrumentationschemes 10 Hours

Overview of process Control System loop components, Block diagram, Concept and need ofAdvancedProcessInstrumentation.ProcessVariables& degree offreedom.Digitalcontrolmethods - Direct Digital Control, Supervisory computer control, Interactive multivariable controlsystem, Alarm & alarm management system. Instrumentation schemes - Operation, controlledandmanipulatedvariables,feedback,andfeedforward,cascadecontrolstrategiesforheatexchanger,dryers andcrystallizers.

Unit2:Distillation ColumnControl 7 Hours

Operation of distillation column, Feed forward Systems, Flow Control of Distillate and Bottoms,Refluxcontrol,CompositionControl,PressureandTemperatureControls.Constantandmaximum recovery methods, distillate optimization.Multiproduct control, distillation controlusingneural control.

Unit3:BoilerInstrumentation 7Hours

Operation of boiler manipulated and controlled variables in boiler control. Safety interlocks andburner management system, instrumentation for boiler pressure control, air to fuel ratio control,boilerdrumlevelcontrol,steamtemperaturecontrol, optimizationofboiler efficiency.

Unit4:Instrumentation forPumpsandCompressors 7 Hours Types and operation of pumps, manipulated and controlled variables in pump control, pumpcontrol methods and instrumentation for pump control, types and operation of compressors,capacity control method of compressors, instrumentation for control of different variables incentrifugal,rotaryandreciprocatingcompressor includingsurgeand anti-surgecontrol.

Unit5:ProcessSafety&Safetymanagement Systems: 7 Hours Introduction to process safety, risk, risk terminologies, consequence and risk, risk measurement,Process Hazard Analysis (PHA), Hazard and operability study (HaZOp), Safety Integrity Level(SIL),IntroductiontoIEC61511standardforFunctionalsafety,protectionlayers,SafetyInstrumentedSystem:function, architecture,safetylife cycle,Applicationofsafetysystem.

Text/ReferenceBooks

1. ProcessControl SystemsbyF. G. Shinskey(TMH).
2. ProcessControlbyB.G.LIptak(Chilton).
3. ComputerBasedIndustrialControlbyKrishnaKant(PHI).
4. DistributedComputerControlforIndustrialAutomationbyPopovicandBhatkar(Dekker).
5. ChemicalProcessControlbyG.Stephanopoulos(PHI).
6. DistillationColumn Control byF. G. Shinskey(TMH).
7. ProcesscontrolInstrumentation–C.D.Johnson
8. Process controldesigningprocesses andcontrol systemfordynamic processes Thomes E.marlin
9. AnalogandDigitalcontrol –RamakantGaikwad.
10. Distributedcomputercontrolforindustrialautomation,PpovikBhatkar,DekkarPub.

BTEIPE702AAUTOMOBILEINSTRUMENTATION 3Credits

Unit1:Fundamentalsof AutomotiveElectronics 7 Hours

Open loop and closed loop systems components for electronic engine management, vehiclemotioncontrol, Current trends in modern Automobiles

Unit2:ElectronicFuel Injectionandignitionsystems 7 Hours Introduction,throttlebodyignitionandmulti-portorpointfuelinjection,Advantagesofelectronic ignition system, Types of solid state ignition systems and their principle of operation,Electronicspark timingcontrol system.

Unit3:Enginecontrol system 7 Hours

Engine cranking and warm up control, Acceleration enrichment –Deceleration leaning and idlespeedcontrol,integratedenginecontrolsystem,exhaustemissioncontrolsystem,Engineperformancetesting

Unit4:Automobilechassiselectroniccontrolsystem 7 Hours

Principle of electronic braking, automatic transmission electronic control circuit, cruise controlcircuit, the electronic steering control theory, ABS, ASR, ESP, and other electronic controlmethod.

Unit5:AutoBodyElectronicControlTechnologyandErgonomics 10 Hours Automotive centrallocking and anti-theftsystem controltechnology,electronically controlledwindowsand doorsandairbagtechnology,principleofcontrolcircuitcomponentsandcharacteristics. Ergonomics: Driver information system,lightingsystem components,batterymonitoring and control,Air conditioning, steering control techniques, Automatic gear controlsystems,Emission standards.

Text/ReferenceBooks

1. WilliamB.Riddens,-UnderstandingAutomotiveElectronics‖,5thEdition,(Butterworth HeinemannWoburn), (1998).
2. Tom Weather Jrand ClandC. Hunter, -Automotive Computers and Control System‖,PrenticeHallInc. ,NewJeresy.
3. JiriMarek,HansPetertrah,-SensersApplications,SensersforAutomotiveTechnology‖ 1st Edition ,Wiley
4. T.Mellard,AutomotiveElectronicSystems‖1987byHeinenmannProfessional.

BTEIPE702BELECTROMAGNETICFIELDTHEORY 3Credits

Unit1:VectorAnalysis 7 Hours

Introduction,co-ordinate–systemtransformation,vectorcalculus,DivergenceofvectorandDivergence theorem, curl of a vector and Stokes theorem, Laplacian of a scalar, classification ofvectorfields.

Unit2:Electrostatics 7 Hours

Coulomb's law, Electric field strength, field due to a line charge, sheet charge and volumecharge.Electricflux-density,Gauss'slaw(Maxwell'sfirstequationinelectrostatics),applications of Gauss'slaw. Electric Potentialand potential difference, Potential ofa pointcharge and system of charges, Conservative property, potential gradient, dipole.Energy densityinelectrostatic field.

Unit3:Magnetostatics **7 Hours**

Biot-Savart's law- magnetic field due to filamentary current, distributed current surface andvolumecurrents.Ampere'scircuitallaw,Scalarandvectormagneticpotentials.Maxwell'sequations for steady magnetic fields, force on a current element in a magnetic field. Forcebetweentwocurrent elements and torquein a current loop.

Unit4:Electromagnetic field **7 Hours**

Faraday's law,Lorentz-forceequation, displacement currentand modified Ampere's circuitallaw in integral form. Continuity equation. Power flow in electromagnetic field - the Poyntingtheorem, sinusoidally time-varying fields and its Maxwell's equation. The retarded potentials,polarizationofvector fields.

Unit5:Materials,fieldsandElectromagneticwaves: **7 Hours**Currentandcurrentdensity.Conductorsinfields-driftvelocity,mobility,conductivity.Dielectricsinfields-polarization,flux-density,electricsusceptibility,relativepermittivity.Magneticmaterials,magnetization,permeabilityandmagneticboundaryconditions.Electromagneticwaves-Helmontzequation,radiationofelectromagneticwaves.Wavemotionin free space, perfect dielectric, lossy dielectric, propagation in good conductors-skin effect.Reflectionand refraction, Guided EM waves.

Text/ReferenceBooks

1. D.J.Griffiths,_IntroductiontoElectrodynamics',AddisonWesley,1999.
2. D.K.Cheng,_FieldandWaveElectromagnetics',AddisonWesley,1999.
3. W.H.Hayt,_EngineeringElectromagnetic',FifthEdition.TMH,1999.
4. N.N.Rao,_ElementsofEngineeringElectromagnetics',PearsonEducation,Inc,2004.
5. MathewN.O.Sadiku,ElementsofElectromagnetics,OxfordUnivPress
6. N.N.Rao,Basicelectromagneticandapplications,McGraw Hill.

BTEIPE702CFLEXIBLEACTRANSMISSIONSYSTEM 3Credits

Unit1:Transmission Interconnection **7 Hours**

FlowofpowerintheACsystem,factorsaffectingloadingcapability,powerflowanddynamicstabilityconsiderationofaTransmissioninterconnection,DescriptionandapplicationofHVDC

transmission, DC System components and their functions, Converter configuration, Principles ofDC Link control and Converter control characteristics, Firing angle, Current and extinction anglecontrol,DC link power control

Unit2:FlexibleAC Transmission 7 Hours

Benefits of FACTS, Basic Realities & Roles, Types of FACTS Controller, Principles of Seriesand Shunt Compensation.Introduction to Voltage source and Current source converter. Shuntcompensation (SVC): Objectives of shunt compensation, Midpoint voltage regulation for longtransmission line, voltageinstabilityprevention, improvement oftransientstability

Unit3:Reactivepowercontrol andVARsources 7 Hours Reactive power control and VAR sources Methods of controllable VAR generation, DescriptionofStaticVARCompensators(SVC),VariableimpedancetypeVARgenerators.Thyristorcontrolled reactor (TCR), Thyristor Switched Capacitor (TSC), TSC-TCR, Fixed capacitor TCR(FC-TCR).Shunt compensation

Unit4: 7 Hours

Variableimpedancetypeseriescompensator,ThyristorSwitchesSeriesCapacitor(TSSC),ThyristorControlledSeriesCompensators(TCSC).SwitchingConvertertypeSeriesCompensatorIntroductiontointerlinepowerflowcontroller,SpecialpurposeFACTScontrollers,Thyristorcontrolledvoltagelimiterandvoltageregulator,Thyristorcontrolledbrakingresistor andcurrent limiter.

Unit5:STATCOMandSynchronousSeriesCompensator 7 Hours SwitchingtypeVARgenerator,StaticSynchronousCompensator(STATCOM),Basicoperatingprinciple,Configuration.Basiccontrolapproach,ComparisonbetweenSVCandSTATCOM. Series Compensator: Objectives of series compensation, improvement of transientstability.SynchronousSeriesCompensator:(SSSC)andControllerforSSSC,Basicconfiguration and working of Unified Power Flow Controller (UPFC). Unified Power FlowController, Circuit Arrangement, Basic Principle of P and Q Control, independent real andreactivepowerflowcontrol, Applications GCSC,TSSC, TCSC&SSSC.

TextBooks/ReferenceBooks

1. N.G Hingorani, L. Gyugyi, –Understanding FACTS: Concepts and Technology of FlexibleACTransmissionSystems‖,IEEEPressBook,StandardPublishersandDistributors,Delhi, 2001.
2. PadiyarK.R.,–HVDCPower Transmission System‖,WielyEastern PVTLimited.
3. ThyristorBasedFACTSControllersforElectricalTransmissionSystem,R.M.Mathur,andR. K.Verma
4. FACTS:ControllerinPowerTransmission&Distribution,K.R.Padiyar,NewAgeInternational .
5. HVDCandFACTScontrollers,ApplicationofStaticconverterinPowerSystem,V.K.SoodNew AgeInternational
6. E.W. Kimbark–Direct Current transmission‖, Vol.1, JohnWielly, New York.
7. ‚J.E Miller, –ReactivePower Control in Electric Systems‖, John Wiley&Sons

BTEIOE703AMECHATRONICS 3Credits

Unit1:Introduction toMechatronics **7 Hours**

Definition of mechatronics.Mechatronics in manufacturing, products and design. Review offundamentalsofelectronics.StructureofMechatronicssystem.Sensors-Characteristics-Temperature, flow, pressure sensors. Displacement, position and proximity sensing by magnetic,optical, ultrasonic, inductive, capacitive and eddy current methods. Encoders: incremental andabsolute, gray coded encoder. Resolvers and synchros.Piezoelectric sensors.Acoustic Emissionsensors.Principleandtypes of vibration sensors.

Unit2:ActuatorsandMEMS **7 Hours**

Hydraulic and Pneumatic actuators - Directional control valves, pressure control valves, processcontrol valves. Rotary actuators.Development of simple hydraulic and pneumatic circuits usingstandardSymbols.

Micro Electro Mechanical Systems - Fabrication: Deposition, lithography, MicromachiningmethodsforMEMS,DeepReactiveIonEtching(DRIE)andLIGAprocesses.Principle ,fabricationand workingofMEMSbased pressuresensor,accelerometer andgyroscope.

Unit3:MechatronicsinComputerNumerical Control(CNC) machines **7 Hours**

DesignofmodernCNCmachines-Mechatronicselements-Machinestructure:guideways,

drives.Bearings:anti-frictionbearings,hydrostaticbearingandhydrodynamicbearing.Re-circulating ball screws, pre-loading methods.Re-circulating roller screws. Typical elements ofopen and closed loop control systems. Adaptive controllers for machine tools. ProgrammableLogicControllers(PLC)– Basicstructure,input/outputprocessing.Programming:Timers,InternalRelays,CountersandShiftregisters.Developmentofsimpleladderprogramsforspecificpurposes.

Unit4:Systemmodelling **7 Hours**

Mathematicalmodelsandbasicbuilding blocksof generalmechanical,electrical,fluidandthermalsystems.MechatronicsinRobotics-Electricaldrives:DC,AC,brushless,servoandstepper motors. Harmonic drive.Force and tactile sensors. Range finders: ultrasonic and light-basedrangefinders

Unit5:Roboticvision system-Imageacquisition **7 Hours**Vidicon,chargecoupleddevice(CCD)andchargeinjectiondevice(CID)cameras.Imageprocessing techniques: histogram processing: sliding, stretching, equalization and thresholding.Case studies of Mechatronics systems: Automatic camera, bar code reader, pick and place robot,automaticcar parkbarrier system,automobileengine management system.

Text/ReferenceBooks

1. BoltonW.,Mechatronics:ElectronicControlSystemsinMechanicalandElectricalEngineering,Person EducationLimited, New Delhi,2007
2. RamachandranK.P.,G.K.Vijayaraghavan,M.S.Balasundaram,Mechatronics:IntegratedMechanicalElectronicSystems,WileyIndiaPvt.Ltd.,NewDelhi, 2008.
3. SaeedB.Niku,IntroductiontoRobotics:Analysis,Systems,Applications,Personducation,Inc., New Delhi, 2006.
4. DavidG.Aldatore,MichaelB.Histand,IntroductiontoMechatronicsandMeasurementSystems,McGraw-HillInc., USA, 2003.
5. GordonM.Mair, IndustrialRobotics,PrenticeHall International,UK,1998.
6. HMT, Mechatronics, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2004.VijayK.Varadan,K.J.Vinoy,S.Gopalakrishnan,SmartMaterialSystemsandMEMS:DesignandDevelopment Methodologies,John Wiley&SonsLtd.,England, 2006.

BTEIOE703BINTERNETOFTHINGS 3Credits

Unit1:IntroductiontoInternet ofThings 7 Hours

Definition & Characteristics, Physical Design of IOT,Logical Design of IOT, IOT Enablingtechnologies, IOT Levels & Deployment Templates Domain specific IOTs – Home automation,Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health & Lifestyle IoT andM2M,IoT System Management with NETCONF-YANG

Unit2:IOT PlatformDesign Methodology 7 Hours Purpose & Requirements Specification, Process Specification, Domain Model Specification,InformationmodelSpecification,Servicespecification,IOTlevelSpecifications,FunctionalViewSpecifications,OperationalViewSpecification,deviceandcomponentintegration,applicationdevelopment,casestudyonIOTsystem forweather monitoring

Unit3:Embeddedsuite forIoT 7 Hours

Physical device – Arduino / Raspberry Pi Interfaces, Hardware requirement of Arduino / Pi,Connecting remotely to the Arduino /Raspberry Pi, GPIO Basics, Controlling GPIO OutputsUsing a Web Interface, – Programming , APIs / Packages, Arduino Interfaces, Integration ofSensors and Actuators with Arduino, Introduction to Python programming – Python data types &data structure,Control flow (if, for, while, range, break/continue, pass), Functions, Modules,packages,filehandling,date/timeoperations,classes,Pythonpackages ofinterestfor IOT

Unit4:ConnectivityTechnologiesandCommunication ProtocolsinIOT 7 HoursRFID:Introduction,PrincipleofRFID,ComponentsofanRFIDsystem,WirelessSensorNetworks:WSNArchitecture,thenode,connectingnodes,NetworkingNodes,SecuringCommunicationWSN specificIoTapplications,

Protocols in IOT: CoAP, XMPP, AMQP, MQTT, Communication Protocols: IEEE 802.15.4,Zigbee,6LoWPAN, Bluetooth, WirelessHART

Unit5:IOT PhysicalServerandCloudOfferings 7 Hourscloud architecture standards and interoperability- Cloud types; IaaS, PaaS, SaaS. Benefits andchallenges of cloud computing, public, private clouds community cloud, Fog Computing, SDNCloudStorageModels&CommunicationAPIs,WebApplicationMessagingProtocol(WAMP),

Python web application framework – Django, Developing Application with Django, DevelopingREST web services, SkyNetIoT Messaging Platform. Case Studies Illustrating IOT Design –Smart lighting, Home Intrusion Detection, Smart Parking, Weather Monitoring System, WeatherReportBot,AirPollutionMonitoring,Forestfire Detection,SmartIrrigation,IoTPrinter.

Text/ReferenceBooks

1. PethuruRaj,AnupamaC.Raman,TheInternetofThingsEnablingTechnologies,Platforms, and Use Cases, CRC Press Taylor & Francis Group, International StandardBookNumber-13: 978-14987-6128-4
2. RajkumarBuyya, Amir VahidDastjerdi Internet of Things –Principals and Paradigms,MorganKaufmannisanimprintofElsevier,ISBN:978-0-12-805395-9HakimaChaouchi, ―The Internet of Things Connecting Objects to the Web‖ ISBN : 978-1-84821140-7,WillyPublications
3. OlivierHersent,DavidBoswarthick,OmarElloumi,TheInternetofThings:KeyApplicationsandProtocols,ISBN: 978-1-119-99435-0,2nd Edition,WillyPublications
4. DanielKellmereit,DanielObodovski,–TheSilentIntelligence:TheInternetofThings‖,. Publisher:LightningSourceInc;1edition(15April2014).ISBN-10:0989973700,ISBN-13:978-0989973700.
5. Fang Zhaho, Leonidas Guibas, –Wireless Sensor Network: An information processing approach‖, Elsevier,ISBN: 978-81-8147-642-5.
6. Daniel Minoli, –Building the Internet of Things with IPv6 and MIPv6: The Evolving WorldofM2M Communications‖,ISBN:978-1-118-47347-4,WillyPublications
7. Bernd Scholz-Reiter, Florian Michahelles, –Architectingthe Internet of Things‖, ISBN 978-3-642-19156-5e-ISBN 978-3-642-19157-2,Springer

BTEIOE703COPTICALINSTRUMENTATION 3Credits

Unit1:OptoelectronicFundamentals **6 Hours**

Light and Elements of solid-state physics nature of light, wave nature of light, light sources blackbody radiation, units of light Energy bands in solids, semiconductor types, works function,functions.

Unit2:Display Devices **8 Hours**

Luminescence and the light emitting diode, Radiative recombination processes, LED materials,Commercial LED materials, LED construction, response time of LEDs, LED drive circuitryplasmadisplayliquidcrystaldisplays.LASERS:Emissionpopulationinversion,opticalfeedback classes of laser, doped insulator lasers. Semiconductor lasers, gas lasers, liquid dyelasers,laserapplications,measurement ofdistanceholography.

Optical Fibers: Classification of optical fiber, principle of light transmission through a fiber,fabrication of optical fibers, material consideration loss and band width limiting mechanism,performfabrication techniques, fiberdrawing,fiber optic communication system.

Unit3:Optical FiberSensors **7 Hours**

Fiber optic sensors, intensity modulated sensors, microbend strain intensity modulated sensor,liquidleveltypeshybridsensor,internaleffectintensitymodulatedsensor,phasesensor,diffraction grating sensors, sensors using single mode fiber, interferometric temperature sensor,distributed fiber optic sensors, polarization problem in interferometric sensors using single modefiber. Medical applications of fiber sensors, Fabry-Perot fiber optic sensors, Electric field

andvoltagesensors,Chemicalfiberopticgyroscopes,magneticfieldandcurrentfibersensor,military and aerospace applications, important applications of integrated optic fiber technology,Localareanetworks.

Unit4:OpticalFiberSensorApplications **7**

HoursSpecial applications, ADM, video link, satellite link, computer link,nuclear reactor link, digitaltransmissioninopticalfiber

networks,videocompression,N.A.measurement,workingofOTDR, microprocessor based OTDR, applications of OTDR, dispersion measurements, BitErrorRate(BER) measurement,attenuationmeasurementusingOTDR,cutoffwavelengthmeasurement,microbendingloss.

Unit5:LaserGyroscopes and Holography **7**

HoursThe Signac effect, Basic gyro configurations. Ring Laser Gyros (RLG): Dithered RLG, RingZeemanlasergyro,performanceofRLG.FiberOpticsGyros(FOG):OpenloopFOG,RequirementsonFOGcomponents,technologytoimplementFOG,ClosedloopFOG,theresonantFOGMEMSgyro, Piezoelectricgyro.ThebasicprinciplesofHolography,viewinga

hologram, volume hologram, multiplex hologram, white light reflection hologram.Measurementof strain, stress, bending moments and vibration by Holography, nondestructive testing, medicalanddental research, solid mechanics.

Text/ReferenceBooks

1. SemiconductorOptoelctronicDevices,SecondEdtion,PallabBhattacharya,PearsonEducation,NewDelhi, 2002.
2. OptoElectronics– AnIntroductionJ.WilsonJ.F.B.Hawkes,PrenticeHallofIndiaNewDelhi1996.
3. OpticalfibercommunicationsPrincipalsandPracticeJ.M.SeniorPrenticeHallofIndia,second Edition, 1996.
4. Fiberoptics– communicationandotherapplicationH.ZangerandC.ZangerMcGrawPublication
5. OpticalFiberCommunication,GerdKeiser
6. Chai Yeh, ‐Handbook offibreoptics‖ (1990)
7. Ghatak AKand Thyagrajan,India, ‐Laser theoryand applications‖, Macmillan (1988)
8. SawhneyA K, ‐A course in Electrical and Electronics Measurement Instrumentation‖, DhanpatRai and Sons, New Delhi (1993)
9. SilvanoD.‐ElectroopticalInstrumentation:SensingandmeasuringwithLASER‖,PHI, NewDelhi (2004)

BTEIOE704ABATCHPROCESSCONTROL 3Credits

Unit1:StandardsandcontrolsystemofBatchProcess **7 Hours**

Batchcontrolsystemterminology,characteristicsofbatchprocesses,hierarchicalbatchmodel,controlstructurefor batch systems

Unit2:StandardsforBatchProcess **7 Hours**

Role of standards in batch control systems, study of International Standards and Practices such asS88, S 95, USA FDAregulation, 21CFR 11 etc

Unit3:Controlof batchProcess **7 Hours**

Generalcontrolrequirements,safety interlocking,regulatory&discretecontrols,sequentialcontrol of batch processes, control activities and process management, information handling for abatchprocess.

Unit4:Designof batchcontrolsystems **7 Hours**Batchmanagement,recipemanagement,productionscheduling & informationmanagement.Batch controlsystemdesign, systemrequirements,system hardware/reliabilityrequirement.

Unit5:Specificationsanddatamanagement **7 Hours**Batch control system specifications and implementation, Information/display requirements, costjustification and benefits, data management, Generic implementation of batch processes,
casestudyofbatchcontrolsystemimplementationforapplicationsinfoodandbeverages,pharmaceutica lsetc.

Text/ReferenceBooks

1. Thomas.G.FisherWilliamM.Hawkins,―BatchControlSystems,ISAseries,1ed.,2008
2. Process/IndustrialInstrumentsandControlsHandbook,GregoryK.Macmillan,MCGrawHills t
3. Thomas.G.Fisher,WilliamM.Hawkins,―BatchControlSystems,ISAseries,2ed.,2012

BTEIOE704BINSTRUMENTATIONFORAGRICULTURE 3Credits

Unit1:Introduction **6 Hours**

Necessityofinstrumentationandcontrolforagriculturesensorrequirement,remotesensing,biosensorsi n agriculture,standards forfoodquality

Unit2:SoilProperties&Sensing **8 Hours**

Propertiesofsoil:fundamentaldefinitions&relationships,indexpropertiesofsoil,permeability&seepa geanalysis,shearstrength,Mohr‘scircleofstress,active&passiveearthpressures,

stability&slopes,Sensors:introductiontosonicanemometers,hygrometers,finewirethermocouples,open&close path gas analyzers

Unit3:Instrumentation inContinuous&Batchprocess 8 Hours Flow diagram of sugar plant, sensors & instrumentation set up, Flow diagram of fermenter &control (batch process), flow diagram of dairy industry & instrumentation set up for it, juiceextractioncontrol process &instrumentation set up.

InstrumentationinIrrigation: Waterdistribution&managementcontrol,Autodrip&sprinklerirrigationsystems,irrigationcanalmanagementsystems,upstream&downstreamcontrolconcept, SCADAforDAM parameters &control.

Unit4:GreenhouseParameters&Instrumentation 8 Hours Greenhouse effect, Concept & construction of green houses, merits & demerits, ventilation,cooling & heating, wind speed, temperature & humidity, soil moisture,rain gauge, carbondioxide enrichment measurement & control, Leaf area length evapo-transpiration, temperature,wetness&respirationmeasurement&datalogging,electromagneticradiationsphotosynthesis.

Unit5:Applicationsinagriculturaland foodproducts 8 Hours Automation in earth moving equipment & farm equipments, application of SCADA & PLC inpackingindustryandcoldstoragesystems,implementationofhydraulic,pneumatic&electronics control circuits in harvesters cotton pickers, tractor etc. classification of pumps: pumpcharacteristics,pump selection &installation.8

Text/ReferenceBooks

1. Industrial instrumentation, ‑Patranabis‖, TMH.
2. Instrumentation handbook-processcontrol, ‑B.G.Liptak‖, Chilton.
3. Processcontrol and instrumentation technology,‑C.D. Johnson‖, PHI
4. WillsB.A.,—MineralProcessingTechnology‖,4thEd.,PergamonPress
5. PrincipleofFarmMachinery,R.AKepner,RoyBainer;:CBSPublication
6. AgriculturalEngineering;RadheyLal:SarojPublication
7. EnvironmentalEngineering,Peary. II.S.andothers

BTEIOE704 CROBOTICSCONTROL 3Credits

Unit1:Introduction **7 Hours**

Introduction to robots, Robot manipulators, Mobile robots, Robot anatomy, Coordinate systems,Workenvelope,Types andclassification, Specifications,Sensors, Actuatorsand drives.

Unit2:ForwardandInverse Kinematics **7 Hours**IntroductionRepresentationofpositionandorientationofarigidbody,Homogeneoustransformations Forward and inverse kinematics problems, Denavit - Hartenberg (D-H) notationsand parameters Representation of joints, link representation using D-H parameters, Closed-formsolutions,Geometric andNumerical methods.

Unit3:VelocityandStaticsanalysis **7 Hours**

Linear and angular velocity of links Velocity propagation, Jacobians for robotic manipulators,Staticsand forcetransformation ofroboticmanipulators, Singularityanalysis.

Unit4:RobotDynamicanalysis **7 Hours**

Introduction, Forward and inverse dynamics, Mass and inertia of links, Lagrangian formulationfor equations of motion for robotic manipulators, Newton- uler formulation method, Dynamicmodelling,Statespacerepresentation of dynamic equations ofroboticmanipulators.

Unit5:Trajectory PlanningandControl **7 Hours**JointandCartesianspacetrajectoryplanningandgeneration– Classicalcontrolconceptsusingtheexampleofcontrolofasinglelink–IndependentjointPIDcontrol– Controlofamulti-linkmanipulator – Nonlinear model-based control schemes. Simulation and experimental case studiesonroboticmanipulators.

Text/ReferenceBooks

1. J.J.Craig,IntroductiontoRobotics:MechanicsandControl,JohnWiley&SonsInc.,2004
2. M.W.Spong,SethHutchinson,M.Vidyasagar,RobotModeling andControl,John Wiley&SonsInc., 2006.
3. J.R.Schilling,FundamentalsofRobotics:AnalysisandControlPrenticeHall India,1992.
4. K.Fu,R.GonzalezandC.S.G.Lee,Robotics:Control,Sensing,VisionandIntelligence,McGraw-Hill, 1987.

5. Ghosal,Robotics:FundamentalConceptsandAnalysis OxfordUniversityPress,2008.
6. W.StallingsandL.Brown,ComputerSecurity:PrinciplesandPractice(2ndEdition),PrenticeHall, 2011.
7. Menezes,P.Oorschot, S.Vanstone:HandbookofAppliedCryptography(individualchaptersarefreelyavailable onlineathttp://www.cacr.math.uwaterloo.ca/hac/)

BTHM705PROJECTMANAGEMENT 4Credits

Unit1:IntroductiontoProject management **7 Hours**Characteristics of projects, Definition and objectives of Project Management, Stages of ProjectManagement,Project PlanningProcess EstablishingProject organization.8

Unit2:Work definition **7 Hours**

Defining work content, Time Estimation Method, Project Cost Estimation and budgeting, ProjectRiskManagement

Unit3:ProjectschedulingandPlanningTools **7 Hours**

WorkBreakdownstructure, LRC,Ganttcharts,CPM/PERTNetworks

Unit4:ProjectCashflowanalysisandscheduling **7 Hours**Developing Project Plan (Baseline), Project cash flow analysis, Project scheduling with resourceconstraints:ResourceLevelingandResourceAllocation.TimeCostTradeoff:CrashingHeuristic.

Unit5:ProjectImplementation **7 Hours**

ProjectMonitoringandControlwithPERT/Cost,ComputersapplicationsinProjectManagement,ContractManagement,ProjectProcurementManagement, Post-ProjectAnalysis.

Text/ReferenceBook

1. Shtub,BardandGloberson,ProjectManagement:Engineering,Technology,andImplementation,PrenticeHall,India
2. Lock, Gower,ProjectManagementHandbook.
3. ClelandandKing,VNR ProjectManagementHandbook.
4. WiestandLevy,ManagementguidetoPERT/CPM,PrenticeHall. Ibdia
5. HoraldKerzner,Project Management:ASystemicApproachtoPlanning,Schedulingand

6. Controlling,CBSPublishers,2002.
7. S.Choudhury,ProjectSchedulingandMonitoringinPractice.
8. P.K.Joy,TotalProject Management:TheIndianContext,MacmillanIndiaLtd.

BTHM706ADVANCEENGINEERINGECONOMICS Audit Course

Unit1:IntroductiontoEconomics

IntroductiontoEconomics-Flowinaneconomy,Lawofsupply anddemand,ConceptofEngineering Economics – Engineering efficiency, Economic efficiency, Scope of engineeringeconomics – Element of costs, Marginal cost, Marginal Revenue, Sunk cost, Opportunity cost,Break-even analysis – V ratio, Elementary economic Analysis – Material selection for productDesignselection foraproduct, Process planning.

Unit2:ValueEngineering

Make or buy decision, Value engineering – Function, aims, and Value engineering procedure.Interestformulaeandtheirapplications–
Timevalueofmoney,Singlepaymentcompoundamount factor, Single payment present worth factor, Equal payment series sinking fund factor,EqualpaymentseriespaymentPresentworthfactor-equalpaymentseriescapitalrecoveryfactor
– Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all themethods.

Unit3:CashFlow

Methods of comparison of alternatives – present worth method (Revenue dominated cash flowdiagram), Future worth method (Revenue dominated cash flow diagram, cost dominated cashflowdiagram),Annualequivalentmethod(Revenuedominatedcashflowdiagram,costdominated cash flow diagram), rateofreturn method, Examples in allthemethods.

Unit4:ReplacementandMaintenanceAnalysis

Replacement and Maintenance analysis – Types of maintenance, types of replacement problem,determination of economic life of an asset, Replacement of an asset with a new asset – capitalrecovery with return and concept of challenger and defender, Simple probabilistic model foritemswhich fail completely.

Unit5:Depreciation

Depreciation-Introduction,Straightlinemethodofdepreciation,decliningbalancemethodofdepreciation-Sumoftheyearsdigitsmethodofdepreciation,sinkingfundmethodofdepreciation/Annuitymethodofdepreciation,serviceoutputmethodofdepreciation-Evaluationofpublicalternatives-introduction,Examples,Inflationadjusteddecisions–proceduretoadjustinflation,Examplesoncomparisonofalternativesanddeterminationofeconomiclifeofasset, Effectoftaxationoneconomicstudies,Incometaxanalysis,Costestimation,Decisionunderrisk and uncertainty.

Text/Referencebooks

1. Chan S. Park, ―ContemporaryEngineeringEconomics‖, PrenticeHall ofIndia, 2011.
2. Donald.G. Newman, Jerome.P.Lavelle, ―Engineering Economics and analysis‖Engg. Press,Texas, 2010.
3. Degarmo, E.P., Sullivan, W.G and Canada, J.R, ―Engineering Economy‖, Macmillan, NewYork, 2011.
4. ZahidA khan: Engineering Economy, ―Engineering Economy‖, Dorling Kindersley, 2012
5. EngineeringEconomy,(DeGarmo,Sullivan&Canada),CollierMacmillan.
6. EngineeringEconomy,(Thuesen&Fabrycky),Pearson.
7. EngineeringEconomics,(Panneerselvam),PHI.
8. EngineeringEconomicAnalysis,(Newnan,Eschenbach&Lavelle),OxfordUniversityPress.
9. EngineeringEconomy,(Blank &Tarquin),McGraw-Hill.