Bachelor of Technology (Electronics & CommunicationEngineering)(CreditBased)

KURUKSHETRAUNIVERSITYKURUKSHETRA

SchemeofStudies/ExaminationSemesterIV(w.e.f.session2021-2022)

S. No.	CourseNo.	Subject	L:T:P	Hours/ Week	Credits	ExaminationSchedule(Marks)				Duration of Exam(Hrs)
						Major Test	Minor Test	Practical	Total	
1	BS-204	HigherEngineeringMathematics	3:0:0	3	3	75	25	0	100	3
2	HTM-901	Universal Human Values II : Understanding Harmony	3:0:0	3	3	75	25	0	100	3
3	EC-202	DigitalCommunication	3:0:0	3	3	75	25	0	100	3
4	EC-204L	CommunicationLab	0:0:2	2	1	-	40	60	100	3
5	EC-206	AnalogCircuits	3:0:0	3	3	75	25	0	100	3
6	EC-208L	AnalogCircuitsLab	0:0:2	2	1	-	40	60	100	3
7	EC-210	Microprocessors&Microcontrollers	3:0:0	3	3	75	25	0	100	3
8	EC-212L	Microprocessors&MicrocontrollersLab	0:0:2	2	1	0	40	60	100	3
9	ES-202	BasicsofAnalogCommunication	3:0:0	3	3	75	25	0	100	3
10	*MC-902	ConstitutionofIndia	3:0:0	3	-	75	25	0	100	3
		Total		**27**	**21**	**450**	**270**	**180**	**900**	

***MC-902isamandatorycredit-lesscourseinwhichthestudentswillberequiredtogetpassinggrade.**

Note:Allthestudentshavetoundergo4to6weeksIndustrialTrainingafter4th semesterwhichwillbeevaluatedin5th semester

HTM-901	Universal Human Values II: Understanding Harmony						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3.0**	**75**	**25**	**100**	**3 Hours**
Purpose	Purposeandmotivationforthecourse,recapitulationfromUniversalHumanValues-I						
CourseOutcomes(CO)							
CO1	Developmentofaholisticperspectivebasedonself-explorationaboutthemselves(humanbeing),family,societyandnature/existence.						
CO2	Understanding(ordevelopingclarity)oftheharmonyinthehumanbeing,family,societyandnature/existence.						
CO3	Strengtheningofself-reflection.						
CO4	Developmentofcommitmentandcouragetoact.						

Module1:CourseIntroduction-Need,BasicGuidelines, ContentandProcessforValueEducation

1. Purposeandmotivationforthecourse,recapitulationfromUniversalHumanValues-I
2. Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' andExperiential Validation-as the process forself-exploration
3. ContinuousHappinessandProsperity- AlookatbasicHumanAspirations
4. Rightunderstanding,RelationshipandPhysicalFacility-thebasicrequirementsforfulfilmentofaspirationsofeveryhumanbeingwiththeircorrectpriority
5. UnderstandingHappinessandProsperitycorrectly-Acriticalappraisalofthecurrentscenario
6. MethodtofulfiltheabovehumanaspirationsunderstandingandlivinginharmonyatvariouslevelsS.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance forlivingwithresponsibility(livinginrelationship,harmonyandco-existence)ratherthanasarbitrarinessinchoicebasedonliking-disliking

Module2:UnderstandingHarmonyintheHumanBeing-HarmonyinMyself!

7. Understandinghumanbeingasaco-existenceofthesentient'I'andthematerial'Body'
8. UnderstandingtheneedsofSelf('I') and 'Body'-happinessandphysicalfacility
9. UnderstandingtheBodyasaninstrumentof'I'(Ibeingthedoer,seer andenjoyer)
10. Understandingthecharacteristicsandactivitiesof'I'andharmonyin'I'
11. Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs,meaningofProsperityindetail
12. Programstoensure SanyamandHealth.

Include practice sessions to discuss the role others have played in making material goods available tome. Identifying from one's own life. Differentiate between prosperity and accumulation. Discussprogramforensuringhealthvs dealingwithdisease

Module 3: Understanding Harmony in the Family and Society- Harmony in Human-

HumanRelationship

13. Understanding values in human-human relationship; meaning of Justice (nine universal values inrelationships)andprogramforitsfulfilmenttoensuremutualhappiness;TrustandRespectasthefoundationalvaluesofrelationship
14. UnderstandingthemeaningofTrust;Differencebetweenintentionandcompetence
15. Understanding the meaning of Respect, Difference between respect and differentiation; the othersalientvaluesinrelationship
16. Understanding theharmony inthesociety(societybeinganextensionoffamily): Resolution,Prosperity,fearlessness(trust)and co-existence ascomprehensive Human Goals
17. Visualizing a universal harmonious order in society- Undivided Society, Universal Order-fromfamilytoworldfamily.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family,reallifeexamples,teacher-studentrelationship,goalofeducationetc.Gratitudeasauniversalvalueinrelationships. Discusswithscenarios.Elicitexamplesfromstudents'lives

Module4:UnderstandingHarmonyintheNatureandExistence-WholeexistenceasCoexistence

18. Understandingtheharmony intheNature
19. Interconnectednessandmutualfulfilmentamongthefourordersofnature- recyclabilityandself-regulationinnature
20. UnderstandingExistenceasCo-existenceof mutuallyinteractingunitsinall-pervasivespace
21. Holisticperceptionofharmonyatalllevels ofexistence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" canbeused),pollution,depletionofresources androle oftechnologyetc.

Module5: ImplicationsoftheaboveHolisticUnderstandingofHarmonyonProfessionalEthics

22. Naturalacceptance ofhumanvalues
23. Definitiveness ofEthicalHumanConduct
24. BasisforHumanisticEducation,HumanisticConstitutionandHumanisticUniversalOrder
25. Competenceinprofessionalethics:a.Abilitytoutilizetheprofessionalcompetenceforaugmenting universal human order b. Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, c. Ability toidentify and develop appropriatetechnologiesandmanagementpatternsforabove productionsystems.
26. Casestudiesoftypicalholistictechnologies,managementmodelsandproductionsystems
27. Strategy for transition from the presentstate to Universal Human Order: a.At the level ofindividual: as socially and ecologically responsible engineers, technologists and managers b. Atthe levelofsociety:asmutuallyenrichinginstitutionsandorganizations
28. Sumup.

IncludepracticeExercisesandCaseStudieswillbetakenupinPractice(tutorial)Sessionseg.todiscusstheconductas anengineerorscientistetc.

READINGS:

TextBook

1. HumanValuesand ProfessionalEthicsbyRRGaur,RSangal,GP Bagaria,ExcelBooks,New Delhi,2010

ReferenceBooks

1. JeevanVidya:EkParichaya, ANagaraj, JeevanVidyaPrakashan, Amarkantak,1999.
2. HumanValues,A.N.Tripathi,NewAgeIntl.Publishers,NewDelhi,2004.
3. TheStoryofStuff(Book).
4. TheStoryofMyExperimentswithTruth-byMohandas KaramchandGandhi
5. SmallisBeautiful-E.FSchumacher.
6. SlowisBeautiful-CecileAndrews
7. EconomyofPermanence-JCKumarappa
8. BharatMeinAngrejiRaj-PanditSunderlal
9. RediscoveringIndia -byDharampal
10. HindSwarajor IndianHomeRule-byMohandas K.Gandhi
11. IndiaWinsFreedom-MaulanaAbdulKalamAzad
12. Vivekananda-RomainRolland(English)
13. Gandhi-RomainRolland(English)

MODEOFCONDUCT

Lecture hours are to be used for lecture/practice sessions.

Lectureshoursaretobeusedforinteractivediscussion, placingtheproposalsaboutthetopicsathandandmotivatingstudents toreflect,explore andverifythem.

Practicehoursaretobeusedforpracticesessions.

Whileanalysinganddiscussingthetopic,thefacultymentor'sroleisinpointingtoessential elementsto help in sorting them out from the surface elements. In other words, help the students explore theimportantorcriticalelements.

In the discussions, particularly during practice sessions, the mentor encourages the studentto connect with one's own self and do self-observation, self-reflection and self-exploration. Scenariosmay be used to initiate discussion. The student is encouraged to take up" ordinary" situations ratherthan" extra-ordinary" situations. Such observations and their analyses are shared and discussed withotherstudents andfacultymentor,inagroupsitting.

Practice experiments are important for the course. The difference is that the laboratoryis everyday life, and practical are how you behave and work in real life. Depending on the nature oftopics, worksheets, home assignment and/or activity are included. The practice sessionswould also provide support to a student in performing actions commensurate to his/her beliefs. It isintendedthatthiswouldleadtodevelopmentofcommitment,namelybehavingandworking basedonbasichuman values.

It is recommended that this content be placed before the student as it is, in the form

of a basicfoundation course, without including anything else or excluding any part of this content. Additionalcontentmaybe offeredinseparate,highercourses.
Thiscourseistobetaughtbyfacultyfromeveryteachingdepartment,includingHSSfaculty .Teacherpreparationwithaminimumexposuretoatleastone8-dayFDPonUniversalHumanValuesisdeemedessential.

ASSESSMENT:
This is a compulsory credit course. The assessment is to provide a fair state of development of thestudent, so participation in classroom discussions, self-assessment, peer assessment etc. will be usedinevaluation.
Example:
Assessmentby
facultymentor:5 marks
Self-assessment:5marks
Assessmentbypeers:5marks
Sociallyrelevantproject/GroupActivities/Assignments:10 marks
SemesterEndExamination: 75marks
Theoverallpasspercentageis40%. Incasethestudentfails,he/shemustrepeatthecourse.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING UNIVERSITY INSTITUTE OF ENGINEERING & TECHNOLOGY (U.I.E.T)
(A Constituent Autonomous Institute and Recognized by UGC under Section 12 (B) and 2 (f)); AICTE Approved; TEQIP -III)
Kurukshetra University, Kurukshetra (K.U.K) – 136119, Haryana, INDIA
(Established by the state Legislature Act XII of 1956; 'A+' Grade, NAAC Accredited) Phone: +91-1744-239155; Fa x: +91-1744-238967, Web:
http://www.uietkuk.org

A. Definition ofCredit:

1 Hour Lecture (L) per week	1 credit
1Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credit
2 Hours Practical (Lab) per week	1 credit

B. Range ofCredits:

A totalcreditof160isrequiredforastudenttobeeligibletogetUnderGraduatedegreein**ElectronicsandCommunication Engineering**.Astudentwillbe eligible to get Under Graduate degree **(B.Tech.) with Honours**, if he/she completes an additional 20 credits. These could be acquired through MOOCs at Swayamportalorwithin-houseexaminationbeingconducted.InordertohaveanHonoursdegree,astudentmaychooseminimum20creditsprovidedthatthe studentmustensurethecourseisapprovedbytheCompetentAuthority,GovernmentofIndia

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination
Semester VII (w.e.f. session 2021-2022)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration of Exam (Hrs)
						Major Test	Minor Test	Practical	Total	
1	HM- 904	Intellectual Property Rights for Technology Development & Management	3:0:0	3	3	75	25	0	100	3
2	ECP*	Program Elective-III	3:0:0	3	3	75	25	0	100	3
3	ECP*	Program Elective-IV	3:0:0	3	3	75	25	0	100	3
4	ECP*	Program Elective Labs-V	0:0:4	4	2	-	40	60	100	3
5	ECO*	Open Elective-III	3:0:0	3	3	75	25	0	100	3
6	EC-401L	Project Stage-I	0:0:8	8	4	-	40	60	100	3
7	**EC-403	Industrial Training-III	2:0:0	2	-	-	*100	-	*100	3
		Total		**26**	**18**	**300**	**180**	**120**	**600**	

*** The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

**EC-403 is a mandatory credit-less course in which the students will be evaluated for the industrial training undergone after 6th semester and students will be required to get passing marks to qualify.

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA

Scheme of Studies/Examination

Semester VIII(w.e.f. session 2021-2022)

S. No.	Course No.	Subject	L:T:P	Hours/ Week	Credits	Examination Schedule (Marks)				Duration Of Exam. (Hrs.)
						Major Test	Minor Test	Practical	Total	
1	ECP*	Program Elective-VI	3:0:0	3	3	75	25	0	100	3
2	ECP*	Program Elective-VII	3:0:0	3	3	75	25	0	100	3
3	ECO*	Open Elective-IV	3:0:0	3	3	75	25	0	100	3
4	ECO*	Open Elective-V	3:0:0	3	3	75	25	0	100	3
5	EC-402L	Project Stage-II	0:0:10	10	5	-	40	60	100	3
6	ECP*	Program Elective Labs-VIII	0:0:4	4	2		40	60	100	3
		Total		26	19	300	180	120	600	

***The course of both Program Elective and Open Elective will be offered at 1/3rd strength or 20 students (whichever is smaller) of the section.**

Bachelor of Technology (Electronics & Communication Engineering) (Credit Based) KURUKSHETRA UNIVERSITY KURUKSHETRA
Scheme of Studies/Examination

LIST OF OPEN ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
VII	**Open Elective-III**	
	ECO-9	Bio-informatics
	ECO-10	Electromechanical Energy Conversion
	ECO-11	Operating Systems
VIII	**Open Elective-IV**	
	ECO-12	Wavelets
	ECO-13	Soft Computing
	ECO-14	Neural Networks and Fuzzy Logic
	Open Elective-V	
	ECO-15	Statistics and Operational Research
	ECO-16	Mixed Signal Design
	ECO-17	Blockchain Technology

LIST OF PROGRAM ELECTIVES (B.TECH. ECE)		
SEM	**CODE**	**SUBJECT**
VII	**Program Elective-III**	
	ECP-10	Fiber Optic Communications
	ECP-11	Mobile Communication and Networks
	ECP-12	Adaptive Signal Processing
	ECP-13	Nano electronics
	Program Elective-IV	
	ECP-14	Microwave Theory and Techniques
	ECP-15	Embedded systems
	ECP-16	Robotics
	ECP-17	Digital Image Processing
	Program Elective Labs-V	
	ECP-14L	Microwave Communication Lab
	ECP-15L	Embedded System Lab
	ECP-16L	Robotics Lab
	ECP-17L	Digital Image Processing Lab
VIII	**Program Elective –VI**	
	ECP-18	Wireless Communication
	ECP-19	Biomedical Signal Processing
	ECP-20	Machine Learning
	ECP-21	Artificial Intelligence
	ECP-22	Internet of Things
	Program Elective –VII	
	ECP-23	Error correcting codes
	ECP-24	Satellite Communication
	ECP-25	High Speed Electronics
	ECP-26	Software Defined Radio
VIII	**Program Elective Labs-VIII**	
	ECP-18L	Wireless Communication Lab
	ECP-19L	Biomedical Lab
	ECP-20L	Machine Learning Lab
	ECP-21L	Artificial Intelligence Lab
	ECP-22L	Internet of Things Lab
	ECP-23L	Augmented Reality/Virtual Reality Lab

HM-904	Intellectual Property Rights forTechnology Development & Management						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3Hr.**

CourseOutcomes	
CO1	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.
CO2	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.
CO3	To understand different laws related to the Intellectual Property ,copyright act,trademarks,patent act,duration of patents law and policy considerations
CO4	Underastand New Developments in IPR ,administration of patent system,IPR of biological systems etc.

Unit-I

Nature of Intellectual Property: Patents, Designs, Trade and Copyright.Process of Patenting and Development: technological research, innovation,patenting, development. International Scenario: International cooperation onIntellectual Property. Procedure for grants of patents, Patenting under PCT.

Unit-II

Patent Rights: Scope of Patent Rights. Licensing and transfer oftechnology. Patent information and databases. Geographical Indications.

Unit-III

Law relating to Intellectual property: Introduction – meaning of intellectual property,main forms of IP, Copyright, Trademarks, Patents and Designs, Secrets; Law relating to Copyright in India including Historical evolution of Copy Rights Act, 1957, Meaning of copyright – computer programs, Ownership of copyrights and assignment, Criteria of infringement, Piracy in Internet – Remedies and procedures in India; Law relating to Patents under Patents Act, 1970 including Concept and historical perspective of patents law in India, Patentable inventions with special reference to biotechnology products, Patent protection for computer programs, Process of obtaining patent – application, examination, opposition and sealing of patents, Patent cooperation treaty andgrounds for opposition, Rights and obligations of patentee, Duration of patents – law and policy considerations, Infringement and related remedies;

Unit-IV

New Developments in IPR: Administration of Patent System. Newdevelopments in IPR; IPR of Biological Systems, Computer Software etc.Traditional knowledge Case Studies, IPR and IITs.

Text Books/Reference Books:-

- T. Ramappa (2010), Intellectual Property Rights Law in India, Asia Law House
- Wadhera (2004), Intellectual Property Rights, Universal Law Publishing Co
- Bare text (2005), Right to Information Act
- O.P. Malhotra, Law of Industrial Disputes, N.M. Tripathi Publishers
- Rustamji R.F., Introduction to the Law of Industrial Disputes, Asia Publishing House

Ethics in Engineering- M.W.Martin& R.Schinzinger, McGraw-Hill

ECO-9	BIOINFORMATICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**The Purpose of this course to provide focus on the key concepts of Bioinformatics like biological databases, Sequence Alignment, Phylogenetic Analysis, Plasmid Mapping And Primer Design and Predictive Methods using nucleotide sequences and protein sequences**						
Course Outcomes							
CO1	Students will be able to illustrate with the basic principles of various types of databases						
CO2	Students will be able to perform various tools related to sequence alignment and statistical significance of alignment						
CO3	Student will develop the knowledge of various software tools for sequence analysis and primer designing						
CO4	Students will be able to differentiate between predictive methods for nucleotides and protein sequence analysis						

UNIT I

Databases

a. Sequence Databases: introduction of Databases, primary and secondary databases, nucleotide and protein sequence databases: Genbank, EMBL, DDBJ, Swissprot, pfam, PIR

b. Structure Databases: Introduction to structures. PDB (Protein Data bank) Molecular Modeling database at NCBI. , visualizing structural information.

c. Sequence and Structure File Formats.

The Entrez system: Integrated information axis, Information retrieval from biological database, sequence database beyond NCBI. Medicaldatabases.

UNIT II

Sequence Alignment AND Database Searches

Introduction, the evolutionary basis of sequence alignment, Type of Aligmnents, Pair-wise Alignment, Multiple Alignment, The modular nature of proteins, Optimal alignment methods, substitution scores and gap penalties, statistical significance of alignment. FASTA, BLAST, low-complexity regions, repetitive elements, Tool of multiple sequence alignment: CLUSTAL W/X, progressive alignment method.

PhylogeneticAnalysis:

Elements of phylogenetic models, phylogenetic data analysis: alignment, substitution model building, tree building and tree evaluation, building the data model (alignment), determining the substitution model, tree- building methods, searching for trees, rooting trees, evaluation trees and data, phylogenic software (PHYLIP). phylogenetics online tool.

UNIT III

Sequence Analysis Using Software Resources:

Introduction. The Wisconsin package, the Seq Lab environment, analyzing sequences with operations and Wisconsin package programmes, viewing output, monitoring programme progress and troubleshooting problems, annotating sequences and graphically displaying annotations in the Seqlab Editor, saving sequences in the Seq Lab Editor, Example of analysis that can be undertaken in Seqlab,

UNIT IV

Plasmid Mapping And PrimerDesign

Restriction mapping, Mac Vector and OMIGA. primer design for PCR Sequencing, primer design programs andsoftware.

Predictive Methods using nucleotide sequences and protein sequences: Predictive methods using nucleotide sequences: Introduction, Gene prediction methods, Computational gene prediction in eukaryotes , identity based on composition, physical properties based on sequence, prediction of protein secondary and tertiary structures. Related software.

Text Books-

1. Bioinformatics by Andreas D.Boxevanis. Wiley Interscience,4th edition 2020.

2. Essential bioinformatics by Jin Xiong. Cambridge Uni Press 2020

3. Biocomputing Informatics and The Genome Projects by Smith D.W., Academic Press,2014.

4. Bioinformatics: A Biologists Guide to Computing and the Internet. by Stuart M. Brown, NKU Medical Center, NY USA,2000.

Note: The Examiner will be given the question paper template and will have to set the question paper according to the template provided along with the syllabus.

ECO-10	Electro-Mechanical Energy Conversion						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3**
Purpose	**To provide the constructional and working knowledge of various EMEC Devices.**						
Course Outcomes							
CO 1	**To study various fundamental concepts of EMEC& DC machines.**						
CO 2	**To study fundamental concepts and characteristics of Induction Machines.**						
CO 3	**To study the basics of S**ynchronous Machines						
CO 4	**To study working idea of some special electric motors with applications.**						

UNIT-I(Qualitative analysis only)

Introduction: Basic principles, conservation of energy, physical phenomenon involved in conversion, energy balance, energy stored in magnetic field, principles of Generating and motoring, prime movers, necessity of starters in motoring.

DC MACHINES:

DC generator: Basic construction, theory and working, commutation,generated EMF equation,Demagnetizing and cross magnetizing ampere turns, armature reaction,voltage build-up,brief idea of load characteristics of shunt, series and compound generator.

DC motor: Basic construction, theoryand working, concept of back EMF, torque and power equations, brief idea of load characteristics of shunt, series and compound motor, armature and field control methods of speed control of a DC shunt motor,3 point starter.

UNIT-II(Qualitative analysis only)

INDUCTION MACHINES:

3-phase induction motors:Rotating magnetic field, Basic construction, theory and working ofsquirrel cage and phase wound rotor types of3-phase I.M., slip, Torque- slip and load characteristics. Blocked rotor tests power and BHP developed at shaft. Star delta starting.

Single phase Induction Motor: Basic construction of, double revolving field theory, working of a capacitor start capacitor run Single phase Induction motor.

UNIT-III (Qualitative analysis only)

SYNCHRONOUS MACHINES:

Synchronous generator (alternator): Basic construction, theory and working, types of rotors&excitation systems.

Synchronous motor:Basic construction, theory and working of, locking operation, speed torque characteristics, V- Curves. Hunting -causes and remedies.

UNIT-IV(Qualitative analysis only)

SPECIAL ELECTRICAL MACHINES:

Basic concept and workingideas of:Stepper motor, permanent magnet brushless DC motor, permanent magnet synchronous motor, hysteresis motor, synchronous reluctance motor, repulsion motor.

Industrial and domestic applications and comparison of various types of motors.

Text/Reference Books

1. D.P Kothari and I.J Nagrath, “Electric Machines”, Tata McGraw Hill Publishers
2. P.S Bhimbra, “Electric Machines”, Khanna Publisher
3. AshfaqHussain, “Electric Machines”, DhanpatRai and Company
4. Fitzgerald &Kingsley, Electrical Machines, MGH publications.

ECO-11	Operating Systems						
Lecture	Tutorial	Practical	Credits	Major Test	Minor Test	Total	Time
3	0	0	3	75	25	100	3 Hr.
Course Outcomes							
CO1		Student will be able to understand structure and function of OS.					
CO2		Student will be able to understand the concept of OS					
CO3		Student will be able to understand the concurrent processing					
CO4		Student will be able to understand scheduling and deadlock in OS.					

Unit- I

Introduction:OS functions: as user/computer interface, interaction with OS, commands, efficient resource manager, security and protection, evolution of OS, OS structure and future trends.

Unit- II

OS Prerequisites: Important software resources, interaction with OS in mainframe systems: PSW,controlling i/o, interrupt, interrupt priority, interrupt cycle. Fundamental concept related to IPC.

Unit -III

Concurrent Processing : Introduction, process concept, process control block, exec sys, concurrent program, process state transitions, hierarchy of processes.

Unit-IV

Scheduling: CPU scheduling algorithms: allocation of different resources, scheduling queues, different scheduling algorithms.
Deadlock: Introduction, deadlock and starvation, resource allocation graph, way to solve deadlock.

Text Books:
1. P. P Choudhary, Operating Systems by PHI Learning Pvt Ltd.

Reference Books:
1. Operating Systems : Internals and Design Principles, William Stallings, Pearson
2.Operating System Concepts", Abraham Silberschatz, Peter Baer Galvin, and Greg Gagne, Wiley

Note: Question paper template will be provided to the paper setter.

ECO-12	Wavelets						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	**3**	**75**	**25**	**100**	**3**
Purpose	**To understand the concept of wavelet theory and applications.**						
Course Outcomes **At the end of this course, student will be able to**							
CO 1	Interpret stationary and non-stationary signals						
CO 2	Construct continuous wavelet transform						
CO 3	Develop discrete wavelet transform						
CO 4	Apply wavelets in different applications						

Unit-I

Introduction Stationary and non-stationary signals, Signal representation using basis and frames, Brief introduction to Fourier transform and Short time Fourier transform, Time- frequency analysis, Bases of time frequency: orthogonal, Filter banks, Multi resolution formulation: Wavelets from filters, Classes of wavelets: Haar, Daubechies, bi-orthogonal.

Unit-II

Continuous Wavelet Transform Continuous wavelet transform (CWT), Time and frequency resolution of the continuous wavelet transform, Construction of continuous wavelets: Spline, orthonormal, bi-orthonormal, Inverse continuous wavelet transform, Redundancy of CWT, Zoom property of the continuous wavelet transform, Filtering in continuous wavelet transform domain.

Unit-III

Discrete Wavelet Transform And Filter banks Orthogonal and bi- orthogonal two-channel filter banks, Design of two-channel filter banks, Tree-structured filter banks, Discrete wavelet transform, Non-linear approximation in the Wavelet domain, multi resolution analysis, Construction and Computation of the discrete wavelet transform, the redundant discrete wavelet transform.

Unit-IV

Multi Resolution Analysis Multirate discrete time systems, Parameterization of discrete wavelets, Bi-orthogonal wavelet bases, Two dimensional, wavelet transforms and Extensions to higher dimensions, wave packets, Application of wavelets in signal de-noising.

TEXT BOOKS:

1. A Wavelet Tour of Signal Processing, 2nd edition, S. Mallat, Academic Press, 1999.
2. Wavelets and Sub band Coding, M. Vetterli and J. Kovacevic, Prentice Hall, 1995.
3. Wavelet transforms: Introduction, Theory and applications, Raghuveer rao and Ajit S.Bopardikar, Pearson Education Asia, 2000.

REFERENCES:

1. Fundamentals of Wavelets: Theory, Algorithms, and Applications, J.C. Goswami and A.K. Chan, 2nd ed., Wiley, 2011.
2. Wavelets and their Applications, Michel Misiti, Yves Misiti, Georges Oppenheim, Jean- Michel Poggi, John Wiley & Sons, 2010 .
3. A premier on Wavelets and their scientific applications, J S Walker, CRC press, 2002.
4. Wavelets and signal processing: An application based introduction, Stark, Springer, 2005.
5. A friendly guide to Wavelets, Gerald keiser, Springer, 2011.
6. Multirate Systems and Filter Banks, P. P. Vaidyanathan, Pearson Education, 2004. Wavelets : from math too practice, Desanka.P.Radunovik, springer, 2009.
7. Insight into wavelets from theory to practice, K P Soman and KL Ramachandran, PHI, 2008.

ECO-13	Soft Computing						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3Hr
Purpose	To familiarize the students with the basics of Soft Computing						
Course Outcomes							
CO1	Motivation and historical background of Soft Computing.						
CO 2	Application of Fuzzy logic.						
CO 3	Biologically inspired algorithm such as neural networks, genetic algorithms, ant colony optimization, and bee colony optimization.						
CO 4	Hybrid systems of neural network, genetic algorithms and fuzzy systems.						

Unit-I

Soft Computing and Artificial Intelligence: Introduction of Soft Computing, Soft Computing vs. Hard Computing, Various Types of Soft Computing Techniques, Applications of Soft Computing, AI Search Algorithm, Predicate Calculus, Rules of Interference, Semantic Networks, Frames, Objects, Hybrid Models

Unit-II

Artificial Neural Networks and Paradigms: Introduction to Neuron Model, Neural Network Architecture, Learning Rules, Perceptrons, Single Layer Perceptrons, Multilayer Perceptrons, Back propagation Networks, Kohnen'sself-organizing networks, Hopfield network, Applications of NN.

Unit-III

Fuzzy Logic: Introduction, Fuzzy sets and Fuzzy reasoning, Basic functions on fuzzy sets, relations, rule-based models and linguistic variables, fuzzy controls, Fuzzy decision making, applications of fuzzy logic.

Unit-IV

Genetic Algorithms and Swarm Optimizations: Introduction, Genetic Algorithm, Fitness Computations, Cross Over, Mutation, Evolutionary Programming, Classifier Systems, Genetic Programming Parse Trees, Variants of GA, Applications, Ant Colony Optimization, Particle Swarm Optimization, Artificial Bee Colony Optimization.

Text Books:

1. Simon S. Haykin, Neural Networks, Prentice Hall, 2nd edition.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", McGraw Hill.
3. D.E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y.

Reference Books:

1. Zimmermann, “Fuzzy Set Theory and its Application”, 3rd Edition.
2. B. Yegnanrayana , “Artificial Neural Networks” , PHI.
3. Jacek M. Zurada, Introduction to Artificial Neural Systems, Jaico Publishing House.
4. Jang J.S.R., Sun C.T. and Mizutani E, "Neuro-Fuzzy and Soft computing", Prentice Hall.

ECO-14	Neural Networks and Fuzzy Logic						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	Understand the concept of Artificial Intelligence, search techniques and knowledge representation issues						
CO2	Understanding reasoning and fuzzy logic for artificial intelligence						
CO3	Students will be able to learn defuzzification and fuzzy measures						
CO4	Students will be able to learn the applications of fuzzy logic and hybrid soft computing techniques						

UNIT I – INTRODUCTION

Artificial neural network: Introduction, characteristics- learning methods – taxonomy – Evolution of neural networks- basic models - important technologies - applications. Fuzzy logic: Introduction - crisp sets- fuzzy sets - crisp relations and fuzzy relations: cartesian product of relation - classical relation, fuzzy relations, tolerance and equivalence relations, non-iterative fuzzy sets. Genetic algorithm- Introduction - biological background - traditional optimization and search techniques - Genetic basic concepts.

UNIT II - NEURAL NETWORKS

McCulloch-Pitts neuron - linear separability - hebb network - supervised learning network: perceptron networks – adaptive linear neuron, multiple adaptive linear neuron, BPN, RBF, TDNN- associative memory network: auto- associative memory network, hetero-associative memory network, BAM, hop field networks, iterative auto associative memory network & iterative associative memory network – unsupervised learning networks: Kohonen self organizing feature maps, LVQ – CP networks, ART network.

UNIT III - FUZZY LOGIC

Membership functions: features, fuzzification, methods of membership value assignments- Defuzzification: lambda cuts - methods - fuzzy arithmetic and fuzzy measures: fuzzy arithmetic - extension principle - fuzzy measures - measures of fuzziness -fuzzy integrals - fuzzy rule base and approximate reasoning : truth values and tables, fuzzy propositions, formation of rules-decomposition of rules, aggregation of fuzzy rules, fuzzy reasoning-fuzzy inference systems-overview of fuzzy expert system-fuzzy decision making.

UNIT IV - HYBRID SOFT COMPUTING TECHNIQUES & APPLICATIONS

Neuro-fuzzy hybrid systems - genetic neuro hybrid systems - genetic fuzzy hybrid and fuzzy genetic hybrid systems – simplified fuzzy ARTMAP - Applications: A fusion approach of multispectral images with SAR, optimization of traveling salesman problem using genetic algorithm approach, soft computing based hybrid fuzzy controllers.

References:

- Elaine Rich and Kevin Knight “Artificial Intelligence”, 2nd Edition, Tata Mcgraw-Hill, 2005.
- Stuart Russel and Peter Norvig, “Artificial Intelligence: A Modern Approach”, 3rd

Edition, Prentice Hall, 2009.

Text book(s) and/or required material

1. T1. Kliryvan- Fuzzy System & Fuzzy logic Prentice Hall of India, First Edition.
2. Lawrence Fussett- fundamental of Neural network Prentice Hall , First Edition. Reference Books: 1. Bart Kosko, ―Neural network and Fuzzy System‖ - Prentice Hall-1994.
2. J.Klin and T.A.Folger, ―Fuzzy sets‖ University and information- Prentice Hall -1996.
3. J.M.Zurada, ―Introduction to artificial neural systems‖-Jaico Publication house,Delhi 1994.
4. VallusuRao and HayagvnaRao , ―C++ Neural network and fuzzy logic‖-BPB and Publication, New Delhi,1996.
5. Intelligent Systems and Control-http://nptel.ac.in/courses/108104049/16

ECO-15	Statistics and Operational Research						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3Hr.**
CourseOutcomes							
CO1	The Objective of the paper is to introduce the basic concepts of Operational Research and linear programming to the students						
CO2	Student will be able to learn and apply different methods to solve Linear Programming Problem.						
CO3	Student will be able to learn moments, standard deviation ,correlation ,regression						
CO4	Students will be able large sample test for single proportion ,difference of means, difference of proportions						

UNIT-I

Basics of Operational Research: Origin & Development of Operational Research, Definition and Meaning of Operational Research, Different Phases of an Operational Research Study, Scope and Limitations of Operational Research, Mathematical Modeling of Real Life Problems.

UNIT-II

Linear Programming Problem: Formulation, solution by Graphical Method, Theory of Simplex Method, Simplex Algorithm, Two phase Method, Charnes-M Method, Degeneracy,

UNIT-III

Basic Statistics: Measures of Central tendency: Mean, median, quartiles, mode, Geometric mean, Harmonic mean, Measures of dispersion: Range, Quartile deviation, mean deviation, standard deviation, coefficient of variation, Moments, Skewness and Kurtosis, Correlation, Coefficient of correlation, methods of calculations, Lines of regression, Rank correlation.

UNIT-IV

Test of significance: Basic terminology, large sample test for single proportion, difference of proportions, single mean, difference of means, Small samples test for single mean, difference of means, Chi-square test for goodness of fit

References /Suggested Readings:

1. G. Hadley: Linear Programming. Narosa, Reprint, 2002.
2. G. Hadley: Linear Algebra, Narosa, Reprint, 2002.
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications.
4. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers.
5. Hamdy A. Taha: Operations Research-An Introduction, Prentice Hall, 9th Edition,2010.
6. Ravindran, D. T. Phillips and James J. Solberg: Operations Research- Principles and Practice, John Wiley & Sons, 2005.

F.S. Hillier. G.J. Lieberman: Introduction to Operations Research- Concepts and Cases, 9th Edition, Tata Mc-Graw Hill, 2010.

ECO-16	Mixed Signal Design						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	This course teaches how in real life applications both analog and digital circuits can be implemented for various system design.						
Course Outcomes							
CO1	To know basics and working of various Switched-Capacitor Circuits.						
CO2	To understand various PLL circuits.						
CO3	To gain knowledge on various D/A and A/D converters.						
CO4	To apply knowledge of different architectures in mixed signal circuits for real life problems.						

Unit-I

Switched-Capacitor Circuits

Introduction to Sampling Switches: MOSFETS as switches, speed considerations, precision considerations, charge injection cancellations. Switched-Capacitor Amplifiers: Unity Gain Sampler-Buffer, Noninverting Amplifier, Precision Multiply-by-Two Circuit. Switched-Capacitor Integrator, Switched-Capacitor Common-Mode Feedback.

Unit- II

Phase Locked Loop

Characterization of a comparator, basic CMOS comparator design, analog multiplier design, PLL-simple PLL, charge-pump PLL, Applications of PLL

Unit- III

D/A Converter

Sample-and-Hold Characteristics, DAC Specifications, DAC Architectures: Digital input Code, Resister Steering, R-2R Ladder Networks, Current Steering, Charge-Scaling DACs, Cyclic DACs, Pipeline DACs.

Unit- IV

A/D Converter

ADC Specifications, ADC Architectures: Flash, The Two-Step Flash ADC, The Pipeline ADC, Integrating ADCs, The Successive Approximation ADC, The Oversampling ADC. Applications of DACs and ADCs.

TEXT BOOKS:

1. Jacob Baker, “CMOS circuit design, layout and simulation”, John Wiley India.
2. Razavi, “Design of analog CMOS integrated circuits”, McGraw Hill, Edition 2002.

REFERENCE BOOKS:

1. CMOS Analog Circuit Design –Philip E. Allen and Douglas R. Holberg, Oxford University Press, International Second Edition/Indian Edition.
2. Gregorian, Temes, “Analog MOS Integrated Circuit for signal processing”, John Wiley & Sons, 1986.
3. Analog Integrated Circuit Design- David A. Johns,Ken Martin, Wiley Student Edition

ECO-17	Blockchain Technology						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Major Test	Minor Test	Total	Time
3	-	-	3	75	25	100	3Hr
Course Outcomes							
CO1	Understand how blockchain systems (mainly Bitcoin and Ethereum) work						
CO 2	To securely interact with them						
CO 3	Design, build, and deploy smart contracts and distributed applications						
CO 4	Integrate ideas from blockchain technology into their own projects.						

Unit I

Basics: Distributed Database, Two General Problem, Byzantine General problem and Fault Tolerance, Hadoop Distributed File System, Distributed Hash Table, ASIC resistance, Turing Complete. • Cryptography: Hash function, Digital Signature - ECDSA, Memory Hard Algorithm, Zero Knowledge Proof.

Unit II

Blockchain: Introduction, Advantage over conventional distributed database, Blockchain Network, Mining Mechanism, Distributed Consensus, Merkle Patricia Tree, Gas Limit, Transactions and Fee, Anonymity, Reward, Chain Policy, Life of Blockchain application, Soft & Hard Fork, Private and Public blockchain.

Unit III

Distributed Consensus: Nakamoto consensus, Proof of Work, Proof of Stake, Proof of Burn, Difficulty Level, Sybil Attack, Energy utilization and alternate.

Unit IV

Cryptocurrency: History, Distributed Ledger, Bitcoin protocols - Mining strategy and rewards, Ethereum - Construction, DAO, Smart Contract, GHOST, Vulnerability, Attacks, Sidechain, Namecoin

Text Book

1. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller and Steven Goldfeder, Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction, Princeton University Press (July 19, 2016).

2. Reference Books

1. Antonopoulos, Mastering Bitcoin: Unlocking Digital Cryptocurrencies
2. Satoshi Nakamoto, Bitcoin: A Peer-to-Peer Electronic Cash System
3. DR. Gavin Wood, “ETHEREUM: A Secure Decentralized Transaction Ledger,”Yellow paper.2014.
4. Nicola Atzei, Massimo Bartoletti, and Tiziana Cimoli, A survey of attacks on Ethereum smart contracts

ECP-10	Fiber Optic Communications						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	**Students will be able to understand the structure of fiber and the mechanism of light travelling in the fiber.**						
CO2	**Students will be able to analyze various losses associated with fibers.**						
CO3	**Students will learn about the optical sources and optical detecters.**						
CO4	**Students will be able to understand the various components and devices required in making optical networks**						

UNIT – I

INTRODUCTION : Optical Fibers: Structure, Propagation within the fiber, Numerical aperture of fiber, acceptance angle, step index and graded index fiber, Modes of propagation in the fiber, Single mode and multi mode fibers. Splices and connectors. Optical Power Launching and Coupling. Fiber-to-fiber joints.

UNIT –II

LOSSES IN OPTICAL FIBER : Attenuation, Absorption Losses, Scattering Losses, Leaky modes, Mode coupling losses, Bending Losses, Combined Losses in the fiber.

DISPERSION EFFECT : Effect of dispersion on the pulse transmission Intermodal dispersion, Material dispersion, Wave guide dispersion, Polarization Mode Dispersion, Total dispersion, Transmission rate. Dispersion Shifted Fibers, Dispersion Compensating Fibers.

UNIT – III

LIGHT SOURCES : LEDS, Laser Action in semiconductor Lasers, Semiconductor Lasers for optical communication – Laser modes, Spectral Characteristics, Power Voltage Characteristics, Frequency response.

DETECTORS : P-I-N Photodiode, APD, Noise Analysis in detectors, Coherent and non-coherent detection, Infrared sensors. Bit error rate.

UNIT – IV

The fiber-optic Communication System: Design considerations of fiber optic systems: Analog and digital modulation. Optical Devices: Optical coupler, space switches, linear divider-combiners, WDM: strategy, wavelength division multiplexer and demultiplexer, optical amplifier

OPTICAL NETWORKS: Elements and Architecture of Fiber-Optic Network, Optical link network-single hop, multihop, hybrid and photonic networks.

Suggested Books:

John Power, An Introduction to Fiber optic systems, McGraw Hill International.
John Gowar , Optical communication Systems.
R. Ramaswamy, Optical Networks, Narosa Publication
John M. Senior,Optical Fiber Communication
Gerd Keiser, Optical Fiber Communication

ECP-11	Mobile Communication and Networks						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	3	75	25	100	3 Hrs.
Course Outcomes (CO) To expose the students to the most recent technological developments in Mobile communication systems..							
CO1	To familiarize the students with the fundamental concepts of wireless, cellular technology And signal propagation in mobiles						
CO2	Students will able to learn the detail knowledge of GSM and GPRS.						
CO3	After this unit students will understand the wireless access techniques and standards						
CO4	Students will understand the concept of mobile receivers.						

UNIT-I

Cellular concepts: Cell structure, frequency reuse, cell splitting, channel assignment, handoff, interference, capacity, power control; Wireless Standards: Overview of 2G and 3G cellular standards.

Signal propagation: Propagation mechanism- reflection, refraction, diffraction and scattering, large scale signal propagation and lognormal shadowing. Fading channels-Multipath and small scale fading- Doppler shift, statistical multipath channel models, narrowband and wideband fading models

UNIT-II

Mobile System and Network Architectures GSM Services and Features – GSM system Architecture, GSM radio subsystem, Frame structure for GSM, Signal processing in GSM, GPRS Network architecture, GPRS services and features, 3G UMTS network architecture, UMTS services and features.

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UNIT-III

Wireless Standards Multiple access techniques: FDMA, TDMA and CDMA, Wireless networking, Design issues in personal wireless systems, Cordless systems and Wireless Local Loop (WLL), IEEE 802.16 Fixed Broadband Wireless Access standard, Mobile IP and Wireless Application protocol**.**

UNIT-IV

Receiver structure: Diversity receivers- selection and MRC receivers, RAKE receiver, equalization: linear-ZFE and adaptive, DFE. Transmit diversity-Altamonte scheme.

Text Books

1. Rappaport, T.S., "Wireless Communications", Principles and Practice, Prentice Hall, NJ, 1996.
2.William Stallings, "Wireless Communication and Networking", Pearson Education, 2002.

ECP – 12	Adaptive Signal Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
CourseOutcomes							
CO1	To understand various stochastic processes and models in adaptive signal processing.						
CO2	To understand the analysis of wiener filters, the concept of the linear prediction and steepest descent algorithms.						
CO3	To use Least-Mean-Square (LMS) & Recursive Least-Squares (RLS) algorithms for specific engineering problems.						
CO4	To apply the concept robustness and analysis the Finite-Precision effects on LMS and RLS algorithms.						

Unit -I

Stochastic Processes and Models: Partial Characterization of a Discrete-Time Stochastic Process, Mean Ergodic Theorem, Correlation Matrix, Correlation Matrix of Sine Wave Plus Noise, Stochastic Models, Wold Decomposition, Asymptotic Stationarity of an Autoregressive Process, Yule—Walker Equations.
Wiener Filters: Linear Optimum Filtering: Statement of the Problem, Principle of Orthogonality, Minimum Mean-Square Error, Wiener-Hopf Equations, Error-Performance Surface, Multiple Linear Regression Model.

Unit -II

Linear Prediction: Forward Linear Prediction, Backward Linear Prediction, Levinson-Durbin Algorithm, Properties of Prediction-Error Filters, Schur-Cohn Test.
Method of Steepest Descent: Basic Idea of the Steepest-Descent Algorithm, The Steepest-Descent Algorithm Applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Example, The Steepest-Descent Algorithm as a Deterministic Search Method, Virtue and Limitation of the Steepest-Descent Algorithm.

Unit -III

The Least-Mean-Square (LMS) Algorithm: Signal-Flow Graph, Optimality Considerations, Applications, Statistical Learning Theory, Transient Behavior and Convergence Considerations, Efficiency.
The Recursive Least-Squares (RLS) Algorithm: Some Preliminaries, The Matrix Inversion Lemma, The Exponentially Weighted RLS Algorithm, Selection of the Regularization Parameter, Update Recursion for the Sum of Weighted Error Squares, Example: Single-Weight Adaptive Noise Canceller.

Unit -IV

Robustness: Robustness, Adaptation, and Disturbances, Robustness: Preliminary Considerations Rooted in H∞ Optimization, Robustness of the LMS Algorithm, Robustness of the RLS Algorithm, Comparative Evaluations of the LMS and RLS Algorithms from the Perspective ofRobustness.

Finite-Precision Effects: Quantization Errors, Least-Mean-Square (LMS) Algorithm, Recursive Least-Squares (RLS) Algorithm, Summary and Discussion.

TEXT BOOKS:

1. S. Haykin, Adaptive filter theory,Pearson

REFERENCE BOOKS:

1. T. Adali and S. Haykin, Adaptive Signal Processing, WileyIndia
2. B. Widrow and S.D. Stearns, Adaptive signal processing, PrenticeHall.

ECP-13	NANOELECTRONICS							
Course No.	**Course Title**	**Teaching Schedule**			**Allotment of Marks**			**Duration of Exam (Hrs.)**
		L	**T**	**P**	**Major Test**	**Minor Test**	**Total**	
		3	**0**	**0**	**75**	**25**	**100**	**3**
Course Outcomes								
CO 1	Students will Understand the basic physics behind the nanoelectronics devices							
CO 2	Students be able learn various classification of the nano-materials.							
CO 3	To Understand various fabrication methods of nonmaterials.							
CO 4	Students will learn to characterize various nanomaterials using various characterization tools.							

UNIT-I

Introduction to nanotechnology, Impacts, Limitations of conventional microelectronics, Trends in microelectronics and optoelectronics, Mesoscopic physics, trends in microelectronics and optoelectronics, characteristic lengths in mesoscopic systems, Quantum mechanical coherence

UNIT- II

Classification of Nano structures, Low dimensional structures Quantum wells, wires and dots, Density of states and dimensionality, Basic properties of two dimensional semiconductor nanostructures, square quantum wells of finite depth, parabolic and triangular quantum wells.

UNIT-III

Introduction to methods of fabrication of nanomaterials, different approaches, physical vapour deposition, chemical vapour deposition, Molecular Beam Epitaxy, Ion Implantation, Formation of Silicon Dioxide-dry and wet oxidation methods.

UNIT-IV

Introduction to characterization of nanostructures, tools used for of nano materials characterization: Principle of operation of Scanning Tunnelling Microscope, Atomic Force Microscope, Scanning Electron microscope, Transmission Electron Microscope.

Text Books:

1. J.M. Martinez-Duart, R.J. Martin Palma, F. Agulle Rueda Nanotechnology for Microelectronics and optoelectronics, Elsevier, 2006
2. W.R. Fahrner, Nanotechnology and Nanoelctronics, Springer, 2005

References:

1. Chattopadhyay, Banerjee, Introduction to Nanoscience & Technology, PHI, 2012
2. George W. Hanson, Fundamentals of Nanoelectronics, Pearson Education, 2009.
3. K. Goser, P. Glosekotter, J. Dienstuhl, Nanoelectronics and nanosystems, Springer 2004.
4. Murty, Shankar, Text book of Nanoscience and Nanotechnology, Universities Press, 2012.
5. Poole, Introduction to Nanotechnology, John Wiley, 2006.
6. Supriyo Dutta, Quantum Transport- Atom to transistor, Cambridge, 2013.

ECP-14	Microwave Theory and Techniques						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes							
CO1	Learner will be able to mathematically design basic resonator cavities and will be able to measure microwave parameters such as impedance, frequency and VSWR etc						
CO2	Learner will learn the conventional methods to generate the microwaves.						
CO3	Learner will know about the importance of scattering parameters along with its applications in the analysis of basic microwave components.						
CO4	Learner will learn about transferred electron and avalanche transit time devices in detail.						

UNIT-I

Introduction to Microwaves-History of Microwaves, Microwave Frequency bands, Applications of Microwaves: Civil and Military, Medical, EMI/ EMC, Effect of Microwaves on Human Body.
Mathematical Model of Microwave Transmission-Concept of Mode, Features of TEM, TE and TM Modes, Losses associated with microwave transmission, Concept of Impedance in Microwave Transmission.
Review of waveguides in brief, Coaxial Transmission Line, Strip line, Microstrip line.
Microwave Resonators: Cavity Resonators: Rectangular, Cylindrical, and Coaxial, Excitation and Coupling of cavities, Q factor.

UNIT-II

Microwave Measurements: Measurement of frequency, impedance (using slotted section) Attenuation, power, dielectric constant, measurement of V.S. W. R., Insertion loss and Permeability.
Microwave Generators: Construction, characteristics, operating principle and typical applications of Klystron(two cavity, multicavity), Reflex Klystron, Magnetron(Cylindrical magnetron and description of ΠImode applications) and Traveling Wave Tube(TWT).

UNIT-III

Matrix Description of Microwave Circuits: Scattering Matrix: properties, measurement of scattering coefficients, scattering matrices for common microwave systems.
Passive and Active Microwave Devices- Microwave passive components: Directional Coupler, Power Divider, E Plane and H-Plane Tee, Magic Tee, Attenuator, Isolators, Circulator and Phase Shifter.
Microwave Active Components: Diodes, Transistors, Design Considerations of Filters, Amplifiers, Oscillators and Mixers (in Brief).

UNIT-IV

Solid State Microwave Devices: Transferred Electron Devices-Gunn Diode: Negative Differential Resistance Phenomenon, High Field Domain Formation. Avalanche Transit Time Devices: IMPATT, TRAPATT, BARITT diodes, Tunnel Diode, PIN Diode, Parametric amplifiers

Text Book: David M. Pozar, Microwave Engineering, John Wiley and sons Inc.

Reference Books:

1. Samuel Y. Liao, Microwave Devices and Circuits, Prentice-Hall of India.
2. Das. Annapurna & Sisir K. Das, Microwave Engineering, Tata McGraw-Hill.
3. R.E. Collins, Microwave Circuits, McGraw Hill.

ECP-15	EMBEDDED SYSTEMS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Course Outcomes							
At the end of the course students will be able to							
CO1	Acquire knowledge about different types of Microcontrollers and various Embedded System design examples of real- life problems.						
CO2	Understand the PIC, AVR, ARM and SHARC architectures.						
CO3	Understand different types of I/O devices, Timer Devices and Communication Interfaces.						
CO4	Acquire knowledge about the design of RTOS and various operating systems.						

UNIT I

INTRODUTION: Different types of Microcontrollers, 4-bit, 8-bit, 16-bit, and 32-bit Microcontrollers, Processor Architectures: Harvard & Princeton, CISC & RISC, Microcontrollers Memory Types, Microcontrollers Features, Criteria for Choosing a Microcontroller, Applications of Microcontrollers, Embedded System**:** Definition, Embedded Processors; Hardware Units, Devices and Software Tools in a System, Embedded System on Chip, Complex Systems Design and Processors, Design Challenges, Design Process and Design Examples.

UNIT II

PIC MICROCONTROLLER: Introduction to PIC16 Microcontroller Family, Features of PIC16C74, Architecture and Pin diagram of PIC16C74, Pipelining, Program Memory Considerations, Register File Structure, Addressing Modes, Instruction Sets; Advanced Architectures**:** Only Brief General Architecture of AVR, ARM and SHARC.

UNIT III

COMMUNICATION INTERFACES: I/O Devices Types and Examples, Serial Communication Devices, Parallel Device Ports, Wireless Devices, Timer and Counting Devices, Distributed Networked Embedded System Architecture, Serial Bus Communication Protocols-I^2C, CAN, USB, FireWire and Advanced Buses; Parallel Bus Device Protocols- ISA, PCI, ARM and Advanced Buses; Network Protocols- HTTP, TCP, UDP, IP and Ethernet; Wireless and Mobile System Protocols- IrDA, Bluetooth, 802.11 and Zigbee; Device Drivers.

UNIT IV

RTOS: Architecture of Kernel, Processes, Threads, Task and Thread States, Task and Data, Distinction Between Function, ISR, IST and Task; Semaphores, Mutex, Event Registers, Pipes, Signal, Timers, Memory Management, Priority Inversion Problem, Disabling and Enabling Function, Queues and Mailboxes, Pipe and Sockets Functions;

Basic Design using a RTOS, RTOS Task-Scheduling Model, OS Standards: POSIX, Off- the-Shelf Operating System, Embedded Operating Systems, Real –Time Operating Systems, Handhold Operating Systems.

Text Books:

1. Raj Kamal, "Embedded systems architecture, programming and design", 3rd Ed., McGraw-Hill

Companies.
2. John. B. Peatman, “Design with PIC Microcontroller”, Pearson Education, 2003.
3. Dr. K.V.K.K. Prasad, “Embedded/Real-Time Systems: Concepts, design and programming”, DreamTech Press.

References Books:

1. Myke Predko, “Programming and Customizing the 8051 Microcontroller”, TMH.
2. M.A. Mazidi, R. D. McKinlay,Causey,” The PIC microcontroller and Embedded Systems using assembly and C for PIC18”, 2nd Ed., Pearson.
3. D.P. Kothari, Shriram K. Vasudevan, Sundaram R. M. D., Murali N., “Embedded System”, New Age International (P) Limited, Publishers.
4. Shibu K V, “introduction to Embedded Systems”, 2nd Ed., McGraw Hill Education(India) private Limited.

Note: Separate question paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

ECP-16	ROBOTICS						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time(Hrs)**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3**
Course Prerequisites	Transducers and Microprocessors.						
Course Objectives	To enlighten the students about the fundamentals of robotic systems.						
Course Outcomes							
At the end of this course the student should be able to understand							
CO1	The basic concepts related to the Robot, parts of Robots, End Effectors and to make familiar with the various Drive systems for Robot.						
CO2	The operation of various Sensors and their Applications in Robots.						
CO3	The Machine Vision and its Applications, and various Control Systems used in Robots.						
CO4	The Robot Programming, Artificial Intelligence, Fuzzy Logic, Safety Standards of Robots and Industrial and Non-Industrial applications of Robots.						

UNIT I

FUNDAMENTALS OF ROBOT: Definition, History and Development in Robot Technology,Robot Technology: Characteristics, Basic Components, Robot Anatomy, Robot Generations, Robot Selection, Present and Future Applications.

ROBOTS DRIVE SYSTEMS AND END EFFECTORS: Robot Classification: Arm Geometry, Degrees of Freedom, Power Sources, Types of Motion, Path Control; Robot End Effectors: Mechanical Grippers, Vacuum, Magnetic, Adhesive; Special Purpose Grippers, Process Tooling, Compliance,Robot Drive Systems: Hydraulic, Pneumatic and Electric System.

UNIT II

SENSORS : Requirements of a Sensor, Sensor Classification; **Principle, Advantages, Disadvantages and Applications of the following Sensors**: Position Sensors - Potentiometer, Encoder, LVDT, Resolvers, LMDT and Hall–Effect Sensors; Velocity Sensors: Encoder, Tachometer and Differentiation of position signal; Acceleration Sensors, Force, Pressure Sensors: Piezoelectric, Force Sensing Resistor, Strain Gauge and Antistatic Foam; Torque Sensors, Micro Switches, Visible Light and Infrared Sensors, Touch and Tactile Sensors, Proximity Sensors: Magnetic, Optical, Ultrasonic, Inductive, Capacitive and Eddy Current; Range Finder: Ultrasonic, Light-base and GPS; Sniff Sensors, Taste Sensors, Vision Sensors, Voice Recognition Devices, Voice Synthesizers, RCC.

UNIT III

MACHINE VISION AND CONTROL SYSTEM: Visual Sensing, Architecture of Robotics Vision System, Machine Vision: Image Acquisition - Vidicon Tube and CCD; Digitization, Image Processing: Spatial Domain Operations, Noise Reduction and Edge Detection etc.; Image Analysis: Object Recognition by Features-Template Matching, Discrete Fourier Descriptors and Computed Tomography; Depth Measurement with Vision System, Image Interpretation, Segmentation by Region Growing and Region Splitting, Image Data Compression, Machine Vision Application, Other Optical Methods; Control Systems: Basic Robot Control System, PLC, PID, CNC, MPU, and URC.

UNIT IV

ROBOT PROGRAMMING, ARTIFICIAL INTELLIGENCEAND ROBOTS APPLICATIONS: Robot Programming: Programming Methods and Languages, Levels of Robot Programming, Space Position Programming, and Program Statements; Elements of Artificial Intelligence, System Architecture; Fuzzy Logic Control, Application of Fuzzy Logic in Robotics; Robot Safety, Safety Standards; Industrial Applications:

Automation in Manufacturing, Robot Applications: Material Handling, Processing Application, Assembly Application and Inspection Application; Evaluating the Potential of a Robot Application, Future Applications, Challenge, Innovations; Non-Industrial Application.

Text Books:

1. James G. Keramas, "Robot technology fundamentals", Delmar Publishers.
2. Saeed B. Niku, "Introduction to robotics analysis, control and applications", 2nd ed., Wiley India.
3. R. K. Mittal, I. J. Nagrath, "Robotics and Control", TMH Education Pvt.

Note: Separate question paper template will be provided to the paper setter for setting the question paper of end term semester examinations.

ECP-17	Digital Image Processing					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	Student will be able to explain basic concepts of image processing					
CO2	Student will be able to design evaluate image enhancement techniques					
CO3	Student will be able to analyze various compression and morphological operations					
CO4	Student will be able to describe various video processing systems					

Unit–I

Digital image processing fundamentals: Introduction, Image processing applications, Fundamental Steps in Digital Image Processing, Image Sampling and Quantization, Relationships between pixels, Color Fundamentals, color models.

Unit - II

Image Enhancement: Basics of intensity Transformations, Histogram processing, Spatial Domain filtering – Basics of Spatial Filtering, Smoothing and Sharpening Spatial Filtering.

Frequency Domain Filtering- Sampling and Fourier Transform of sampled functions, 2-D Sampling, Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters.

Unit - III

Image Compression: Fundamentals, Image Compression models, Error Free Compression – Huffman Coding, Arithmetic Coding, LZW Coding, Lossy Compression – Block transformcoding.

Morphological Image Processing: Introduction, Erosion and Dilation, Opening and Closing, Hit or Miss Transformations, Boundary Extraction. Image Segmentation: Fundamentals of image segmentation, Point, Line, and Edge Detection.

Unit - IV

Video Processing: video formation, Video Frame classifications- I, P and B frames, Application of motion estimation in video coding, Patterns and Pattern classes - Recognition based on matching.

Text Books:

1. Rafael C. Gonzales, Richard E. Woods, “Digital Image Processing”, Third Edition, Pearson Education, 2018.

Reference Books:

1.Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, “Digital Image Processing Using MATLAB”, Third Edition Tata Mc Graw Hill Pvt. Ltd., 2011

2. Anil Jain K. “Fundamentals of Digital Image Processing”, PHI Learning Pvt. Ltd., 2011.

3. M. Tekalp, Digital Video Processing. Signal Processing Series, Prentice Hall, 1995.

4. Malay K. Pakhira, “Digital Image Processing and Pattern Recognition”, First Edition, PHI Learning Pvt. Ltd., 2011.

Note: Question paper template will be provided to the paper setter.

ECP-14L	Microwave Communication Lab						
Lecture (Hrs.)	Tutorial (Hrs.)	Practical (Hrs.)	Credit	Practical	Minor Test	Total	Time
-	-	4	2	60	40	100	3 Hrs.

Course Outcomes (CO)

To give the students an idea about the study and analysis of components used in Microwave Engg.

CO1	Students will learn the steps to analyze microwave components.
CO2	Students will be able to find the characteristics of microwave components.
CO3	Students will learn the steps to analyze various antennas.
CO4	Students will be able to find the characteristics of various antennas.

List of Experiments:

1. To study microwave components.
2. To study the characteristics of the reflex Klystron tube and to determine its electronic tuning range.
3. To determine the frequency and wavelength in a rectangular waveguide working in TE 10 mode.
4. To determine the standing wave ratio and reflection coefficient.
5. To study the I-V characteristics of gunn diode.
6. To study the magic Tee.
7. To study the isolator and attenuator.
8. To measure the coupling coefficient and directivity of a waveguide directional coupler.
9. To measure the polar pattern and the gain of a waveguide horn antenna.
10. To measure the insertion loss and attenuation.

ECP-15L	Embedded Systems Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **To give the students an idea about the 8051/PIC/AVR/ARM microcontrollers**							
CO1	To familiarization with 8051,PIC, AVR and ARM Microcontrollers.						
CO2	Ability to write an embedded C language and assembly language program for 8051, PIC and AVR Microcontrollers.						
CO3	Ability to interfacing the various Peripheral to 8051, PIC and AVR Microcontrollers.						
CO4	Ability to design the embedded systems based on 8051, PIC and AVR Microcontrollers.						

List of Experiments

1. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing DC motor to rotateclockwise and anticlockwise directions.
2. Write an embedded C program using 8051/PIC/AVR Microcontroller forinterfacing stepper motor to rotateclockwise and anticlockwise directions.
3. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing LCD to display message "WELCOME" on LCD screen.
4. Write an embedded C program using 8051/PIC/AVR Microcontrollerfor interfacing a switch and a buzzer at two different pins of a Port such that the buzzer should sound as long as the switch is pressed.
5. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing keypad to port P0.Whenever a key is pressed; it should be displayed on LCD screen.
6. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing LEDs to glow them in different pattern.
7. Write an embedded C program for 8051/PIC/AVR Microcontroller to display 0 to 9 on 7 segment display.
8. Write an embedded C program using 8051/PIC/AVR Microcontroller for interfacing RTC module to display current date and time on LCD screen
9. Write an embedded C program using 8051/PIC microcontroller for interfacing temperature sensor LM35 todisplay the current temperature on LCD screen.
10. Design an embedded system for traffic light controller using 8051/PIC Microcontroller

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ECP-16L	Robotics lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO): **To expose the students to the most recent technological developments in industrial Robot.**							
CO1	**To familiarization with FIRE BIRD Robot.**						
CO2	**Abilities to interfacing various peripherals.**						
CO3	**Student will be able to write embedded C language programming..**						
CO4	**Ability to design the automatic system for robotics based application.**						

List of Experiments:

1. To get familiar with the AVR Studio 4.17 IDE and Fire Bird Robot.
2. Write a program for I/O interfacing to sense the pressing of push button Switch.
3. Write a program to alternately blink the set of LED
4. Write a program to display two digit numbers on LCD.
5. Write a program for obstacle detection of Robot
6. Write a program for controlling the speed of Fire Bird Robot.
7. Write a program for PWM based speed control of motor.
8. Write a program to design white line Follower Robot
9. To implement and design social distancing indicator and alarming system.
10. To Study implement the temperature based Fan speed controller.

ECP-17L	Digital Image Processing Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **To give the students an idea about the study and analysis of digitalimage processing**							
CO1	Students will be able to explain the basics of Digital Image processing						
CO2	Student will be able to explain sampling and quantization of digital image.						
CO3	Student will be able to analyze the image enhancement operations on digital image.						
CO4	Students will be able to analyze various image analysis and computer vision algorithm						

List of Experiments

1. Study of Image processing toolbox of MATLAB.
2. WAP to read and show various images of at least five different formats.
3. WAP to extract R, G, B component of Color Image.
4. WAP to convert a color image into gray scale and save it in new format.
5. WAP to invert a gray scale image.
6. WAP to implement Morphological operations on an image.
7. WAP to implement Histogram equalization.
8. WAP to implement various edge detection algorithms.
9. WAP to implement image segmentation.
10. WAP to implement boundary extraction of basic structure.

ECP-18	Wireless&MobileCommunication						
Lecture	**Tutorial**	**Practical**	**Credit**	**MajorTest**	**MinorTest**	**Total**	**Time**
3	0	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	Tointroducetheconceptsofwireless/mobilecommunicationusingcellularenvironment. Tomakethestudents to know aboutthe variousmodulationtechniques,propagationmethods,andmultiaccesstechniquesused inthemobilecommunication.						
CourseOutcomes							
CO 1	Itdealswiththefundamentalcellularradioconcepts and generations of modern wireless communication.						
CO 2	Thisalsodemonstratestheprincipleoftrunkingefficiencyandhowtrunkingandinterference issuesbetweenmobileandbasestationscombinetoaffecttheoverallcapacityof cellularsystems.						
CO 3	ItprovidesideaaboutMultiple access techniquesusedinwirelesscommunication.						
CO 4	ItpresentsdifferentwaystoWireless Standards and mobility management.						

Unit–I

Introduction to Wireless Communication Systems: Evolution of mobile radiocommunications,examples of wireless comm. systems, paging systems, Cordless telephonesystems, comparison ofvariouswirelesssystems.

ModernWirelessCommunicationSystems:Secondgenerationcellularnetworks,thirdgeneration wireless networks, wireless inlocal loop, wireless local area networks, Blue tooth andPersonalAreanetworks.

Unit–II

IntroductiontoCellularMobileSystems:SpectrumAllocation,basicCellularSystems,performanceCriteria,Operationofcellularsystems,analogcellularsystems,digitalCellularSystems.

CellularSystemDesignFundamentals:FrequencyReuse,channelassignment strategies,handoff Strategies, Interference and system capacity, tracking andgrade off service, improvingcoverageandcapacity.

Unit–III

MultipleAccessTechniquesforWirelessCommunication:Introductionto MultipleAccess,FDMA,TDMA,Spread Spectrum multipleAccess,spacedivisionmultipleaccess, packet ratio,capacityofacellularsystems.

Unit-IV

Wireless Standards-GSM, IS-95, UMTS-IMT-2000, Signaling, Call Control, Mobility ManagementandlocationTracing.

SuggestedBooks:

1. TheodoreS.Reppeport,WirelessCommunicationsPrinciplesandPractice,IEEEPress,P

rentice Hall.

2. WilliamC.Y.Lec,MobileCellularTelecommunications,AnalogandDigitalSystems,Mc-GrawHillInc.

3 Kamilo Feher, Wireless Digital Communications, Modernization & Spread SpectrumApplications,PrenticeHallof India,NewDelhi.

4 KavehPahlavanandAllenH.Levesque“WirelessInformationNetworks”,WileySeries,JohnWileyand Sons Inc.

ECP-19	Bio-Medical Signal Processing						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	-	-	**3**	**75**	**25**	**100**	**3**
Purpose	**To understand the concept of Bio-Medical Signal Processing.**						
Course Outcomes **At the end of this course, student will be able to**							
CO 1	Interpret signals and systems						
CO 2	Acquire Biomedical Signals such as ECG						
CO 3	Apply adaptive filtering algorithms in biomedical applications						
CO 4	Analyze different kinds of events and waveforms of biomedical origin						

Unit – I

Signals and Information: Definitions and properties of Laplace transform, Basic of DFT and FFT, z-transform, Sampling theorem.
Linear Time-Invariant (LTI) Systems: definitions and properties; causality, stability, impulse response, convolution, poles and zeros, frequency response, group delay, phase delay, Applications of Digital Signal Processing.

Unit – II

Introduction to Biomedical Signal: General measurement and diagnostic system, classification of signals, introduction to biomedical signals, Biomedical signal acquisition and processing.
ECG: ECG signal origin, ECG parameters-QRS detection different techniques, ST segment analysis, Arrhythmia, Arrhythmia analysis, Arrhythmia monitoring system.

Unit – III

Adaptive Filtering: Introduction, General structure of adaptive filters, LMS adaptive filter, adaptive noise cancellation, cancellation of ECG from EMG signal, Cancellation of maternal ECG in fetal ECG.
EEG: EEG signal characteristics, Sleep EEG classification and epilepsy.

Unit – IV

Event Detection and waveform analysis: Need for event detection, Detection of events & waves, Correlation analysis of EEG signals, Identification of heart sounds, Morphological analysis of ECG waves.
Frequency Domain Analysis: Introduction, Spectral analysis, linear filtering, Removal of high frequency noise (power line interference), motion artifacts (low frequency) and power line interference in ECG.

Text Book:

1. Biomedical Signal Analysis" A case study approach, Rangaraj M Rangayyan, John Wiley publications.

Reference Books:

1. "Biomedical Signal Processing Time and Frequency Domains Analysis (Volume I)", Arnon Cohen, CRC press.
2. "Biomedical Signal Processing Principles and Techniques" D.C.Reddy, Tata Mc Graw-Hill
3. "Biomedical Digital Signal Processing", Willis J. Tompkins, PHI

.

ECP-20	Machine Learning					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	Recite and understand the knowledge of classification and associated algorithms					
CO2	Explain and apply algorithms of statistical pattern recognition and supervised Learning					
CO3	Explain, implement and apply algorithms of non-parametric learning, feature extraction and selection					
CO4	Understand, explain and apply un-supervised learning, estimation and comparison of different classifiers					

UNIT-I

Classification: The Classification Process, Features, Training and Learning, Supervised Learning and Algorithm Selection, Approaches to Classification, Examples.

Nonmetric Methods: Introduction, Decision Tree Classifier, Information, Entropy, Impurity, Information Gain, Decision Tree Issues, Strengths and Weaknesses, Rule-Based Classifier, Other Methods.

UNIT-II

Statistical Pattern Recognition: Measured Data and Measurement Errors, Probability Theory, Simple Probability Theory, Conditional Probability and Bayes' Rule, Naive Bayes Classifier, Continuous Random Variables, The Multivariate Gaussian, The Covariance Matrix, The Mahalanobis Distance.

Supervised Learning: Parametric and Non-parametric Learning, Parametric Learning, Bayesian Decision Theory, Discriminant Functions and Decision Boundaries, MAP (Maximum A Posteriori) Estimator.

UNIT-III

Nonparametric Learning: Histogram Estimator and Parzen Windows, k-Nearest Neighbor (k-NN) Classification, Artificial Neural Networks, Kernel Machines.

Feature Extraction and Selection: Reducing Dimensionality, Preprocessing, Feature Selection, Inter/Intraclass Distance, Subset Selection, Feature Extraction, Principal Component Analysis, Linear Discriminant Analysis.

UNIT-IV

Unsupervised Learning: Clustering, k-Means Clustering, Fuzzy c-Means Clustering, (Agglomerative) Hierarchical Clustering.

Estimating and Comparing Classifiers: Comparing Classifiers and the No Free Lunch Theorem , Bias and Variance, Cross-Validation and Resampling Methods: The Holdout Method , k-Fold Cross-Validation, Bootstrap, Measuring Classifier Performance, Comparing Classifiers, ROC Curves, McNemar's Test, Other Statistical Tests, The Classification Toolbox, Combining Classifiers.

Text/References Books:

1. Geoff Dougherty: Pattern Recognition and Classification An Introduction, 2013, Springer.

2. Christopher M. Bishop: Pattern Recognition and Machine Learning, Springer.

ECP-21	Artificial Intelligence						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3Hr.**

CourseOutcomes	
CO1	To familiarize the students with the fundamental concepts of Artificial Intelligance.
CO2	Students will able to learn the detail knowledge ofSupervised and Unsupervised Learning.
CO3	After this unit students will be able to understand the concepts of Genetic Algorithm and Object Detection and Tracking
CO4	Students will be able to understand the concept of Artificial Neural Networks and reinforcement learning.

UNIT-I

Introduction to Artificial Intelligence, need of AI, Applications of AI, Branches of AI, Defining intelligence using Turing Test, Classification, Preprocessing data, Label encoding, Logistic Regression classifier, Naïve Bayes classifier, Support Vector Machines.

UNIT-II

Regression, Building a single variable regressor, Building a multivariable regressor, Supervised and Unsupervised Learning, Detecting Patterns with Unsupervised Learning, Clustering data with K-Means algorithm, Estimating the number of clusters with Mean Shift algorithm,

UNIT-III

Genetic Algorithms, Fundamental concepts in genetic algorithms, Generating a bit pattern with predefined parameters Object Detection and Tracking: Frame differencing, Tracking objects using colorspaces, Object tracking using background subtraction, Face detection and tracking, Eye detection and tracking.

UNIT-IV

Artificial Neural Networks, Building a Perceptron based classifier, Constructing a single layer neural network, Constructing a multilayer neural network, Reinforcement Learning, Reinforcement learning versus supervised learning, Building blocks of reinforcement learning.

Text Book:

1. Introduction to Artificial Intelligence by Philip C. Jackson · 1974

Reference Book:

2. Artificial Intelligence by Chris Neil · 2020
3. Artificial Intelligence with Python by Prateek Joshi.

ECP -22	Internet of Things						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3Hr.**

CourseOutcomes	
CO1	Understand what IoT technologies are used for today, and what is required in certain scenarios.
CO2	Understand the types of technologies that are available and in use today and can be utilized to implement IoT solutions.
CO3	Understand the type of protocols and challenges for designing IoT systems.
CO4	Apply these technologies to tackle scenarios in teams of using an experimental platform for implementing prototypes and testing them as running applications. Understand operating system requirements of IOT.

Unit 1

Introduction to IoT: Defining IoT, Characteristics of IoT, Functional blocks of IoT, Physical and logical design of IoT, Smart cities and IoT revolution, ,Difference between IoT and M2M, M2M and peer networking concepts Ipv4 and IPV6, Software Defined Networks SDN,

Unit 2

Developing IoTs: IoT design methodology, case study on IoT system for weather monitoring. IoT system Management,

Developing IoT applications through embedded system platform: Introduction to sensors, IoT physical devices and endpoints, Raspberry pi, Raspberry pi interfaces, Arduino, arduino interfaces.

Unit 3

Protocols for IoT- messaging protocols, transport protocols, Ipv4, Ipv6, URI, Cloud for IoT: IoT with cloud, challenges, introduction to fog computing, cloud computing,

Challenges in IoT: Design challenges, development challenges, security and legal considerations.

Unit 4

Logic design using Python: Introduction to python, data types, data structures, control flow, functions, modules, file handling and classes., implementing IotT concepts with python,

Applications of IoT, Connected cars IoT Transportation, Smart Grid and Healthcare sectors using IoT,

References:

1) A Bahaga, V. Madisetti, “Internet of Things- Hands on approach”, University press, 2014.
2) S.K.Vasudevan, A.S.Nagarajan, “Internet of Things”, Wiley, 2019.
3) CunoPfister, “Getting started with Internet of Things”, Maker Media, 1st edition, 2011. Samuel Greenguard, “Internet of things”, MIT Press, 2015.

Web resources:

1) http://www.datamation.com/open-source/35-open-source-tools-for-the-internet-of-things-1.html
2) https://developer.mbed.org/handbook/AnalogIn
3) http://www.libelium.com/50_sensor_applications
4) M2MLabs Mainspring http://www.m2mlabs.com/framework Node-RED http://nodered.org/

ECP-23	Error Correcting Codes					
Lecture	**Tutorial**	**Practical**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**75**	**25**	**100**	**3 Hr.**
Course Outcomes						
CO1	Student will be able to evaluate linear codes					
CO2	Student will be able to evaluate cyclic codes					
CO3	Student will be able to evaluate BSH and RS codes					
CO4	Student will be able to evaluate convolution codes					

Unit- I

Basic concepts of linear codes: Three fields, linear codes , generator and parity matrix, dual codes, weights and distances, puncturing codes, extending c odes, shortening codes, direct sums,permutation equivalent codes, Golay codes, RM Codes

Unit- II

Cyclic Codes: polynomials and euclidean algorithm, primitive elements, finite fields, subfields, field automorphism. clotomic cosets and minimal polynomials, factoring x^n -1, zeros of cyclic code, minimum distance of cyclic codes.

Unit -III

BCH and RS codes: BCH codes, RS Codes, generalized RS codes, decoding BCH codes,burst error, concatenated and interleaving codes.

Unit-IV

Convolution codes: generator matrices and encoding, veterbi decoding: state diagram, trellis, diagram and viterbi algorithm, canonical generator matrices, free distance.
Soft decision and iterative decoding: AWGN, soft decision viterbi decoding, general viterbi algorithm, two way app decoding.

Text Books:
1.W. Cary Huffman, Fundamentals of Error-Correcting Codes by Cambridge University Press

Reference Books:
1. Ranjan Bose, Information Theory and Coding, McGraw Hill
2. W. Wesley Peterson and E. J. Weldon, *Error-Correcting Codes, The MIT Press*

Note: Question paper template will be provided to the paper setter.

ECP-24	Satellite Communication						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**0**	**0**	**3**	**75**	**25**	**100**	**3 Hr.**
Purpose	**To familiarize the students with the concepts of Satellite communication and various terms, laws and multiple access schemes used in its working.**						
Course Outcomes							
CO1	**To understand the concept of basics of satellite communication and various basic laws and terms of satellite communication.**						
CO2	**To understand the concept and processes of various communication satellites used in satellite communication.**						
CO3	**To familiarize with the concept and design issues of satellite link design and satellite access.**						
CO4	**To familiarize with the concepts of Multiple access schemes used in satellite communication.**						

Unit -I

SATELLITE ORBITS: Orbital Mechanics- Kepler's laws ,locating the satellite in the Orbit, locating the satellite with respect to the earth, Orbital elements, look angle determination, Sub satellite point, Azimuth and elevation angle calculation, Orbital perturbations, Longitudinal and Inclination changes; Launches and launch vehicles-ELV's, Placing the satellite into geostationary orbit, Doppler shift, range variations, solar eclipse, sun transit outage.

Unit -II

COMMUNICATION SATELLITES: Satellite Subsystems, Attitude and Orbit Control system(AOCS), Telemetry, Tracking, Command and Monitoring (TTC&M), Power System, Communication Subsystems-description, Transponders, satellite antennas-basic antenna types, basic antennas in practice.

Unit -III

Satellite link design and Satellite access: Basic transmission theory**,** system noise temperature and G/T ratio; Downlink design-link budget; Uplink design; design for specified C/N, uplink and downlink attenuation in rain, communication link design procedure; system design examples.

Unit –IV

Multiple access schemes: FDMA, TDMA, CDMA, DAMA; VSAT systems-basic techniques, VSAT earth station engineering, system design; DBS systems-C-band and Ku band home TV, digital DBS; satellite mobile systems; GPS

Text Books:

1. Timothy Pratt, Satellite Communications, Wiley India edition

Reference Books:

2. Anil K Maini, Satellite Communication, Wiley India edition.
3. Siegmund M. Redl, Mathias K. Weber, Malcolm W. Oliphant, "An Introduction to GSM", Artech House Publishers, 1995.
4. Kraus, J.D., "Antennas", II Edition, John Wiley and Sons, NY, 1977. 5. Collin, R.E. and Zucker, F., - "Antenna theory: Part I", Tata McGraw Hill, NY, 1969.

ECP-25	High Speed Electronics						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hour**
Course Outcomes							
CO 1	**Understand significance and the areas of application of high-speed electronics circuits.**						
CO 2	**Understand the properties of various components used in high speed electronics**						
CO 3	**Design High-speed electronic system using appropriate components.**						
CO 4	**To be able to understand the effect of scaling on high speed VLSI circuits.**						

UNIT-I

Transit time of charge carriers, junction capacitances, ON-resistances and their dependence on the device geometry and size, carrier mobility, doping concentration and temperature. Contact resistance and interconnection/interlayer capacitances in the Integrated Electronics Circuits.

UNIT-II

Introduction to high-speed digital design: Frequency, time and distance - Capacitance and inductance effects - High seed properties of logic gates - Speed and power - Modelling of wires -Geometry and electrical properties of wires - Electrical models of wires - transmission lines - lossless LC transmission lines - lossy LRC transmission lines

UNIT-III

Devices: Passive and active, Lumped passive devices, Active : low frequency and high frequency models RF Amplifier Design, Stability, Low Noise Amplifiers, Broadband Amplifiers and Power Amplifiers, Class A, B, AB and C, D, E .

UNIT-IV

Impact of scaling on High Speed VLSI Circuit, Inter-Die Variation, Intra-Die Variation, Fail Causes Optimization Techniques for High Speed VLSI: Mathematic Optimization, Circuit optimization, CAD tool for optimization

Books:

1. Stephen H. Hall, Garrett W. Hall, James A. McCall “High-Speed Digital System Design: A Handbook of Interconnect Theory and Design Practices”, August 2000, Wiley-IEEE Press
2. . Kerry Bernstein & et. al., High Speed CMOS Design Styles, Kluwer, 1999
3. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
4. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
5. Masakazu Shoji; High Speed Digital Circuits, Addison Wesley Publishing Company, 1996
6. William S. Dally & John W. Poulton; Digital Systems Engineering, Cambridge University Press, 1998
7. Howard Johnson & Martin Graham; High Speed Digital Design: A Handbook of Black Magic, Prentice Hall PTR, 1993
8. Thomas H. Lee, “The Design of CMOS Radio-Frequency Integrated Circuits”, CambridgeUniversity Press, 2004, ISBN 0521835399.
9. Behzad Razavi, “RF Microelectronics”, Prentice-Hall 1998, ISBN 0-13-887571-5.
10. Guillermo Gonzalez, “Microwave Transistor Amplifiers”, 2nd Edition, Prentice Hall.

11. Kai Chang, “RF and Microwave Wireless systems”, Wiley.
12. R.G. Kaduskar and V.B.Baru, Electronic Product design, Wiley India, 2011 Course Outcomes:

ECP-26	Software Defined Radio						
Lecture	**Tutorial**	**Practical**	**Credit**	**Major Test**	**Minor Test**	**Total**	**Time**
3	**-**	**-**	**3**	**75**	**25**	**100**	**3 Hrs.**
Purpose	**To understand the underlying principles of Software Defined Radios and Cognitive Radio Networks.**						
Course Outcomes							
CO1	Understand the principles behind the Software Defined Radios over the conventional Cognitive Radios						
CO2	Ability to analyze Software Defined Networking protocols and cognitive radio techniques						
CO3	Understand the data traversal over SDN						
CO4	Design algorithms for Software Defined Radio and cognitive radio environments						
CO5	Understand the various types of key routing and switching techniques used in adaptive networks.						

UNIT I

SOFTWARE DEFINED RADIO CONCEPTS

Need for Software Radios - Characteristics and Benefits of a Software Radio - Design Principles of a Software Radio - RF Receiver Front-End Topologies - Importance of the Components to Overall Performance - Transmitter Architectures and Their Issues - Noise and Distortion in the RF Chain ADC and DAC Distortion - Flexible RF Systems

UNIT II

SDR AS A PLATFORM FOR COGNITIVE RADIO

Hardware Architecture: Baseband Processors - Hardware Architecture: Multi-Core Systems - Software Architecture: Design Philosophies - GNU Radio - Software Communications Architecture - Application Software - Component Development - Waveform Development - Cognitive Waveform Development

UNIT III

COGNITIVE RADIO: TECHNOLOGIES REQUIRED

Software Capable Radios - Software Programmable Radios - SDR Examples - Aware Adaptive and CRs - Radio Capabilities and Properties Comparison - Spectrum Awareness and Frequency Occupancy - Software Technology - Funding and Researches in CRs - Directions and Standards

UNIT IV

OBJECT ORIENTED REPRESENTATION OF RADIOS

Introduction to Network Resources - Network Resources - Object Oriented Programming - Object Request Broker Architecture - Object Brokers and Software Radios - Mobile Application Environments - Security in Software Radios - Joint Tactical Radio Systems - SCA Architectures.

REFERENCES

1. Software Radio: A Modern Approach to Radio Engineering By Jeffrey H. Reed Pearson Education Low Price Edition

2. “Cognitive Radio Technology”, Bruce A Fette, Academic Press, 2009

3. Cognitive Radio Networks by Wyglinski, Alexander M. Nekovee, Maziar, Hou, Y. Thomas, 2010 Elsevier.

4. “Cognitive Radio, Software Defined Radio and Adaptive wireless system, Huseyin Arslan , Springer, 1 edition ,September 24, 2007

ECP-18L	Wireless Communication Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**

Course Outcomes (CO)

To give the students an idea about the Wireless communication theory and technology using the NI-Labview software and RF communication module.

CO1	To study the wireless communication using NI-Labview
CO2	To learn about the functioning of Universal Software Radio Peripheral (USRP)
CO3	To learn the implementation of different analog modulation schemes using the USRP
CO4	To learn the implementation of different digital modulation schemes using the USRP.

List of Experiments:

1. Introduction to NI-LabVIEW and familiarization with its basic functions.
2. Study of modulation toolkit and its usage in Wireless Communication.
3. Study the interfacing of hardware (USRP module) with the PC and configuring the same.
4. Implementation of AM using Software Defined Radio (SDR).
5. Implementation of FM using SDR with application such as transfer of files
6. Implementation of M-PSK transmitter using SDR concept.
7. Implementation of M-PSK receiver using SDR
8. Implementation of M-QAM transmitter using SDR.
9. Demonstrates the use of the Bluetooth functions to set up data transfer via Bluetoothbetween a server VI and a client VI.
10. Design two-dimensional convolution to perform image edge detection.
11. Implementation of M-QAM receiver using SDR.
12. Implementation of PSK Modulation system with Convolutional Coding.
13. Implementation of FSK Modulation system with BCH Coding.
14. Implementation of QAM Modulation system with Golay Coding

ECP-19L	Biomedical lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **At the end of the course, student will be able to**							
CO1	**Elaborate various biomedical signals**						
CO2	**Acquire and simulate ECG ,EMG and EEG biomedical signals**						
CO3	**Simulate ECG Pulse missing detector**						
CO4	**Demonstrate the functions of defibrillator and pacemaker**						

List of Experiments:

1. Familiarization of various biomedical signals.
2. To simulate Electrocardiogram Waveform
3. To simulate Electroencephalogram Signal
4. To simulate Electromyogram Signal
5. To Simulate Defibrillator
6. To simulate Pacemaker
7. To simulate Haemodialysis Machine
8. To simulate Biopotential Amplifier
9. To simulate ECG Pulse missing detector.
10. To simulate 12 Lead ECG Signals.

ECP-20L	Machine Learning Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **At the end of the course, student will be able to**							
CO1	Elaborate machine learning fundamentals						
CO2	Implement different classification/regression algorithms						
CO3	Design and develop artificial neural networks for different applications						
CO4	Develop clustering algorithms						

List of Experiments:

1. To get familiarize with machine learning.
2. Implement and demonstratethe FIND-Salgorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file
3. For a given set of training data examples stored in a .CSV file, implement and demonstrate the Candidate-Elimination algorithmto output a description of the set of all hypotheses consistent with the training examples.
4. Write a program to demonstrate the working of the decision tree based ID3 algorithm.Use an appropriate data set for building the decision tree and apply this knowledge toclassify a new sample.
5. Build an Artificial Neural Network by implementing the Backpropagationalgorithm and test the same using appropriate data sets.
6. Write a program to implement the naïve Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets.
7. Assuming a set of documents that need to be classified, use the naïve Bayesian Classifier model to perform this task. Built-in MATLAB/Python/Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set
8. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for

clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering. You can add MATLAB/Java/Python ML library classes/API in the program.

9. Write a program to implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. MATLAB/Java/Python ML library classes can be used for this problem
10. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

ECP-21L	Artificial Intelligence Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor test**	**Total**	**Time**
0	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hr.**
Course Outcomes **At the end of the course student will be able to**							
CO1	Implement AND/OR&NOT gate using single layer perception						
CO2	Implement XOR gate using multilayer perception						
CO3	Demonstrate the function of fuzzification/defuzzification processes						
CO4	Demonstrate different case studies in the domain						

List of Experiments:

1. Implementation of AND/OR/NOT Gate using Single Layer Perceptron
2. Implementation of XOR Gate Using Multi-Layer Perceptron/ Error Back Propagation
3. Implementation of XOR Gate Using Radial Basis Function Network
4. Understanding the concepts of Perceptron Learning Rule
5. Understanding the concepts of Hebbiann Learning Rule
6. Understanding the concepts of Correlation Learning Rule
7. Understanding the working of Kohonen's Self Organising Maps
8. Understanding the functioning of Fuzzification process
9. Implementation of different method of Defuzzification process
10. Case study explaining function of Fuzzy Inference System
11. Case study explaining function of Optical Character Recognition

ECP-22L	Internet of Things Lab						
Lecture	**Tutorial**	**Practical**	**Credit**	**Practical**	**Minor test**	**Total**	**Time**
-	**0**	**4**	**2**	**60**	**40**	**100**	**3 Hr.**
Course Outcome: Students will be able to get the idea of Internet of Things technology.							
CO1	**Student will be able to get familiarize with Arduino and Raspberry Pi**						
CO2	**Student will be able to implement interfacing different sensorss with Arduino and Raspberry Pi**						
CO3	**Student will be able to understand the concept of cloud**						
CO4	**Student will be able to design module based on Internet of Things application**						

List of Experiments

1. Familiarization with concept of IoT, Arduino/Raspberry Pi and perform necessary software installation.
2. To interface LED/ Buzzer using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF LED/Buzzer.
3. To interface Push button/Digital sensor (IR/LDR) with Arduino/Raspberry Pi and write a program to turn ON LED when push button is pressed.
4. To interface Analog sensors(Temperature/Humidity/ Ultrasonic) with Arduino/Raspberry Pi and write a program to display sensors data on the computer screen.
5. To interface OLED with Arduino/Raspberry Pi and write a program to print sensor data on it.
6. To interface sensor with Arduino/Raspberry Pi and write a program to turn ON/OFF Relay when sensor data is detected.
7. To interface motor using relay with Arduino/Raspberry Pi and write a program to turn ON/OFF motor when push button is pressed.
8. To interface Bluetooth with Arduino/Raspberry Pi and write a program to send sensor data on smart phone using Bluetooth.
9. To interface Bluetooth with Arduino/Raspberry Pi and write a program to turn LED ON/OFF when a 1/0 is received from smartphone using Bluetooth.
10. Write a program to upload sensor data on cloud.
11. Write a program to retrieve sensor data from cloud.

Components required-

1. Arduino with cable
2. Raspberry Pi with cable and memory card
3. Node MCU
4. Sensors-IR, LDR, DHT11 sensor, Push button, Pressure senser, Temperature sensor, Vibration, Rotation, Location, Torque, Sound, Weight etc.
5. Actuators-LED, Buzzer, Relay Switch, Motors, Motor Drivers, OLED, Display, Linear Actuator,
6. Bluetooth Module, Wi-fi Module, Ethernet Module
7. Smart Phone
8. Computer
9. Power Supply-5V, 12V, 3.3V
10. Internet facility

ECP-23L	Augmented Reality/Virtual Reality Lab						
Lecture (Hrs.)	**Tutorial (Hrs.)**	**Practical (Hrs.)**	**Credit**	**Practical**	**Minor Test**	**Total**	**Time**
-	**-**	**4**	**2**	**60**	**40**	**100**	**3 Hrs.**
Course Outcomes (CO) **To expose the students to the most recent technology i.e. Augmented Reality and Virtual Reality.**							
CO1	**Student will be able to familiarization of basics of Augmented Reality and Virtual Reality**						
CO2	**Student will be able to Design 3D Objects**						
CO3	**Student will be able to get an idea about the Vuforia.**						
CO4	**Student will be able to design Game in Unity 3D Project.**						

List of Experiments

1. To get familiarization with the basics of AR/VR
2. Introduction to Unity 3D, and its game objects, materials, cameras, standard assets, asset store, adjusting size, position and rotation of game objects .
3. Program to Design 3D Modelling, Importing 3D models in Unity 3D, and to add buttons.
4. Program to Design of animating 3D models, adding material to 3d models
5. Program to Design User Interface using Unity 3D and customizing the colour, size, background, text etc. of the UI elements
6. To learn about Scripting, Adding scripts to game objects, controlling objects with scripts, button functionality with scripting.
7. Program to design Prefabs/Physics Elements, Creating prefabs, adding physics to game objects.
8. To learn about Vuforia SDK, Vuforia integration with Unity 3D, selecting a perfect image for AR development.
9. To design 2D game on Unity 3D
10. To learn about Scene Management in Augmented Reality Applications, MultiScene Arrangement in Augmented Reality Applications

Note: the above mentioned experiments are not limited. Teacher may introduce new experiments