ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK20-REGULATIONS
ELECTRONICS and COMMUNICATION ENGINEERING (ECE)
(Effective for the batches admitted in 2020-21)

INDUCTION PROGRAM (3 weeks duration)
❖ Physical activity
❖ Creative Arts
❖ Universal Human Values
❖ Literary
❖ Proficiency Modules
❖ Lectures by Eminent People
❖ Visits to local Areas
❖ Familiarization to Dept./Branch and Innovations

I Semester (B.Tech –I year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	BSC	20ABS9901	Algebra and Calculus	3	0	0	3	30	70	100
2	BSC	20ABS9902	Applied Physics	3	0	0	3	30	70	100
3	HSMC	20AHS9901	Communicative English	3	0	0	3	30	70	100
4	*ESC	20AES0304	Engineering Workshop Practice	1	0	4	3	30	70	100
5	ESC	20AES0501	Problem Solving and Programming	3	0	0	3	30	70	100
6	HSMC	20AHS9902	Communicative English Laboratory	0	0	3	1.5	30	70	100
7	BSC	20ABS9907	Applied Physics Laboratory	0	0	3	1.5	30	70	100
8	ESC	20AES0503	Problem Solving and Programming Laboratory	0	0	3	1.5	30	70	100
						TOTAL	**19.5**	**240**	**560**	**800**

II Semester (B.Tech –I year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	BSC	20ABS9906	Differential Equations and Vector Calculus	3	0	0	3	30	70	100
2	BSC	20ABS9904	Chemistry	3	0	0	3	30	70	100
3	ESC	20AES0201	Network Theory	3	0	0	3	30	70	100
4	ESC	20AES0502	Data Structures	3	0	0	3	30	70	100
5	ESC	20AES0301	Engineering Graphics	1	0	4	3	30	70	100
6	ESC	20AES0203	Network Theory Laboratory	0	0	3	1.5	30	70	100
7	BSC	20ABS9909	Chemistry Laboratory	0	0	3	1.5	30	70	100
8	ESC	20AES0504	Data Structures Laboratory	0	0	3	1.5	30	70	100
9	MC	20AMC9902	Constitution of India`	3	0	0	0	30		30
						TOTAL	**19.5**	**270**	**560**	**830**

III Semester (B.Tech –II year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	BSC	20ABS9912	Transform Techniques and Complex Variables	3	0	0	3	30	70	100
2	PCC	20APC0401	Electronic Devices and Circuits	3	0	0	3	30	70	100
3	PCC	20APC0402	Switching Theory and Logic Design	3	0	0	3	30	70	100
4	PCC	20APC0403	Signals and Systems	3	0	0	3	30	70	100
5	HSMC	20AHSMB01	Managerial Economics and Financial Analysis	3	0	0	3	30	70	100
6	PCC	20APC0404	Electronic Devices and Circuits Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0405	Signals and Systems Laboratory	0	0	3	1.5	30	70	100
8	PCC	20APC0406	Switching Theory and Logic Design Laboratory	0	0	3	1.5	30	70	100
9	SOC	20ASC0401	Electronic Circuit Design	1	0	2	2	100	-	100
10	MC	20AMC9901	Biology for Engineers	3	0	0	0	30		30
TOTAL							**21.5**	**370**	**560**	**930**

IV Semester (B.Tech –II year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	ESC	20AES0509	Basics of Python Programming	3	0	0	3	30	70	100
2	PCC	20APC0407	Probability Theory and Stochastic Process	3	0	0	3	30	70	100
3	PCC	20APC0408	Electromagnetic Theory and Transmission Lines	3	0	0	3	30	70	100
4	PCC	20APC0409	Analog Communication Systems	3	0	0	3	30	70	100
5	PCC	20APC0410	Electronic Circuit Analysis	3	0	0	3	30	70	100
6	ESC	20AES0510	Basics of Python Programming Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0411	Analog Communication Systems Laboratory	0	0	3	1.5	30	70	100
8	PCC	20APC0412	Electronic Circuit Analysis Laboratory	0	0	3	1.5	30	70	100
9	SOC	20ASC0402	Internet of Things	1	0	2	2	100	-	100
10	HSC	20AHS9905	Universal Human Values	2	1	0	3	30	70	100
TOTAL							**24.5**	**370**	**630**	**1000**

Community service Project with credits

(To visit the selected community to conduct survey (Socio-economic & domain survey) and conduct sensitization/awareness program/activities at the end of IV- semester before commencement of V-semester and complete immersion programme also during V-Semester and submit report in V - semester. Assessment will be done at the end of V-Semester)

V Semester (B.Tech –III year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	PCC	20APC0413	Antennas and Wave Propagation	3	0	0	3	30	70	100
2	PCC	20APC0414	Digital Communication Systems	3	0	0	3	30	70	100
3	PCC	20APC0415	Integrated Circuits and Applications	3	0	0	3	30	70	100
4	OEC	20APC0515	Operating Systems	3	0	0	3	30	70	100
		20AOE0202	Programmable Logic Controllers							
		20APC0213	Control Systems							
5	PEC	20APE0401	VLSI Design	3	0	0	3	30	70	100
		20APE0402	Computer Organization							
		20APE0403	Digital System Design							
6	PCC	20APC0416	Digital Communication Systems Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0417	Integrated Circuits and Applications Laboratory	0	0	3	1.5	30	70	100
8	SOC	20AHE9902	Principles of Effective Public Speaking	1	0	2	2	100	-	100
9	MC	20AMC9904	Professional Ethics and Human Values	3	0	0	0	30	-	30
10	CSP	20CSP0401	Community Service Project	0	0	0	1.5	100	-	100
TOTAL							**21.5**	**440**	**490**	**930**

S. No.	Open Elective*(OE/JOE come for NPTEL)
1	The Joy of Computing Using Python
2	Computer Architecture
3	An Introduction to Artificial Intelligence
4	Environment and Development
5	Soft Skills
6	Public Speaking
7	Ethical Hacking
8	Cloud Computing
9	Electronic Systems for Cancer Diagnosis
10	Remote Sensing Essentials
11	Sustainable Transportation Systems

Student shall register any number of MOOC courses listed above (Open) by the department as approved by the BOS from III year. But student is required to submit the pass certificate on NPTEL platform for at least one course with in the Programme duration (Before IV-II examination notification released).

VI Semester (B.Tech –III year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	PCC	20APC0418	Microprocessors and Microcontrollers	3	0	0	3	30	70	100
2	PCC	20APC0419	Digital Signal Processing	3	0	0	3	30	70	100
3	PCC	20APC0420	Microwave and Optical Communications	3	0	0	3	30	70	100
4	PEC	20APE0404	Low Power VLSI Circuits and Systems	3	0	0	3	30	70	100
		20APE0405	MEMS and Microsystems							
		20APE0406	Industrial Electronics							
5	PCC	20APC0421	Microprocessors and Microcontrollers Laboratory	0	0	3	1.5	30	70	100
6	PCC	20APC0422	Digital Signal Processing Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0423	Microwave and Optical Communications Laboratory	0	0	3	1.5	30	70	100
8	SOC	20ASA0501	Basics of Cloud Computing	1	0	2	2	100	-	100
9	MC	20AMC9903	Environmental Studies	3	0	0	0	30	-	30
TOTAL							**18.5**	**340**	**490**	**830**
Internship 2 Months (Mandatory) during summer vacation										

VII Semester (B.Tech –IV year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	PC	20APC0424	Pattern Recognition and Applications	3	0	0	3	30	70	100
2	PEC	20APE0407	Digital Image Processing	3	0	0	3	30	70	100
		20APE0408	Adaptive Signal Processing							
		20APE0409	Television Engineering							
3	PEC	20APE0410	Electronic Measurements and Instrumentation	3	0	0	3	30	70	100
		20APE0418	Sensors and IOT							
		20APE0412	RF Integrated Circuits							
4	PEC	20APE0413	Radar Systems	3	0	0	3	30	70	100
		20APE0414	Satellite Communications							
		20APE0415	Wireless Communications							
5	OEC	20APC0516	Computer Networks	3	0	0	3	30	70	100
		20APE0203	Neural Networks and Fuzzy Logic							
		20AOE0402	Bio Medical Instrumentation							
6	OEC	20APC0502	Data Base Management Systems	3	0	0	3	30	70	100
		20APE0416	Computer System Architecture							
		20AOE0301	Robotics							
7	SOC	20ASA0401	Embedded Systems and Unmanned Aerial Vehicle	1	0	2	2	100	-	100
8	PR	20APR0401	Evaluation of Industry Internship (III-II Summer Internship)	0	0	0	3	100	-	100
TOTAL							**23**	**380**	**420**	**800**

VIII Semester (B.Tech –IV year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	MOOCS	20AOE0401	MOOC-NPTEL	0	0	0	3	25	75	100
2	PR	20APR0402	Internship	0	0	0	3	100	-	100
3	PR	20APR0403	Project work	0	0	0	9	60	140	200
TOTAL							**15**	185	215	400
Grand Total							**163**	2595	3925	6520

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

LIST OF COURSES FOR HONOURS in B.Tech -ECE

Note: Students can choose a few courses from the following list approved by BOS 4 credit courses based on the availability in SWYAM-NPTEL portal, and secure minimum of 20 credits on passing the selected courses.

S.NO	SUB.CODE	COURSE NAME	WEEKS	CREDITS
1	20AHN0401	Automotive Electronics	12 Weeks	4
2	20AHN0402	Detection and Estimation of Signals	12 Weeks	4
3	20AHN0403	Probability Foundations for Electrical Engineers	12 Weeks	4
4	20AHN0404	Micro Electromechanical Systems	12 Weeks	4
5	20AHN0405	VLSI Testing and Testability	12 Weeks	4
6	20AHN0406	Scripting Languages	12 Weeks	4
7	20AHN0407	Artificial Neural networks	12 Weeks	4
8	20AHN0408	System on Chip Architecture	12 Weeks	4
9	20AHN0409	Machine learning	12 Weeks	4
10	20AHN0410	Data Analysis	12 Weeks	4
		TOTAL		**20**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

MINOR DEGREE IN ECE FOR CSE, AIDS, AIML, CE & ME

Note: Students of other programmes to get "minor in ECE" shall pass a few SWAYAM-NPTEL courses listed below which are approved by BOS and obtain 15 credits and submitting a minor discipline project in AIDS for scoring 5 credits is compulsory and all together total credits requirement count to be minimum of 20.

S.NO	SUB.CODE	COURSE NAME	WEEKS	CREDITS
1	20AMN0401	Signals and Systems	12 Weeks	4
2	20AMN0402	Electronics Devices and Circuits	12 Weeks	4
3	20AMN0403	Digital Electronics and Logic Design	12 Weeks	4
4	20AMN0404	Digital Communications	12 Weeks	4
5	20AMN0405	Digital Signal Processing	12 Weeks	4
6	20AMN0406	Microprocessors and Micro Controllers	12 Weeks	4
7	20AMN0407	Sensors and IOT	12 Weeks	4
8	20AMN0408	Industrial Electronics	12 Weeks	4
9	20AMN0409	Internet of Things	12 Weeks	4
10	20AMN0410	**MINOR DISCIPLINE PROJECT IN ECE (COMPULSORY)**	-	4
		TOTAL		**20**

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INDUCTION PROGRAM (3 weeks duration)
❖ Physical activity
❖ Creative Arts
❖ Universal Human Values
❖ Literary
❖ Proficiency Modules
❖ Lectures by Eminent People
❖ Visits to local Areas
❖ Familiarization to Dept./Branch and Innovations

I B. Tech – I Semester

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	BSC	20ABS9901	Algebra and Calculus	3	0	0	3	30	70	100
2	BSC	20ABS9902	Applied Physics	3	0	0	3	30	70	100
3	HSMC	20AHS9901	Communicative English	3	0	0	3	30	70	100
4	*ESC	20AES0304	Engineering Workshop Practice	1	0	4	3	30	70	100
5	ESC	20AES0501	Problem Solving and Programming	3	0	0	3	30	70	100
6	HSMC	20AHS9902	Communicative English Laboratory	0	0	2	1.5	30	70	100
7	BSCL	20ABS9907	Applied Physics Laboratory	0	0	3	1.5	30	70	100
8	ESC	20AES0503	Problem Solving and Programming Laboratory	0	0	3	1.5	30	70	100
TOTAL							**19.5**	**240**	**560**	**800**

AK20 Regulations

Year : I **Semester** : I **Branch of Study : Common to All**

Subject Code: 20ABS9901	**Subject Name: Algebra and Calculus**	**L T P** **3 0 0**	**Credits** **3**	**CLC** **3**

Course Outcomes: After studying the course, Student will be able to:

CO1. Apply the matrix algebra techniques for solving various linear equations.
CO2. Analyze the linear transformations of quadratic forms and mean value theorems.
CO3. Apply the fundamental concepts of partial derivatives for multi variable functions.
CO4. Evaluate the multiple integrals in cartesian, polar, cylindrical, and spherical co-ordinate systems.
CO5. Evaluate the improper integrals using special functions like Beta and Gamma.

CO	**Action Verb**	**Knowledge Statement**	**Condition**	**Criteria**	**Blooms level**
1	Apply	the matrix algebra techniques	for solving various linear equations		**L3**
2	Analyze	the linear transformations of quadratic forms and mean value theorems.			**L4**
3	Apply	the fundamental concepts of partial derivatives	for multi variable functions		**L3**
4	Evaluate	the multiple integrals	in cartesian, polar, cylindrical, and spherical co-ordinate systems		**L5**
5	Evaluate	the improper integrals	using special functions like Beta and Gamma		**L5**

Unit I : Matrix Operations and Solving Systems of Linear Equations
Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem.

Unit II : Quadratic Forms and Mean Value Theorems
Diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.
Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof).

Unit III: Multivariable calculus
Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

Unit IV: Multiple Integrals
Double integrals, change of order of integration, double integration in polar coordinates, change of Variables in double integration (Cartesian to polar), areas enclosed by plane curves. Evaluation of triple integrals.

Unit V: Special Functions
Beta and Gamma functions and their properties, relation between beta and gamma functions, Bessel functions, Bessel's equation, Recurrence formulae or $J_n(x)$, Generating function- Orthoganality of Bessels functions.

Textbooks:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

References:

1. Dr.T.K.VIyengar, B.Krishna Gandhi, S. Ranganathamamd M.V.S.S.N Prasad, Mathematics – 1, S.Chand publications.
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
3. B.V.Ramana, Higher Engineering Mathematics, McGraw Hill Education.
4. N.Bali, M.Goyal, C.Watkins, Advanced Engineering Mathematics, Infinity Science Press.

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1		3										
2	3											
3	3											
4		3										
5		3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	14	21.21	3	Apply	L3	PO2	Apply (L3)	3
2	10	15.15	2	Analyze	L4	PO2	Analyze (L4)	3
3	14	21.21	3	Apply	L3	PO1	Apply (L3)	3
4	14	21.21	3	Evaluate	L5	PO1	Apply (L3)	3
5	14	21.21	3	Evaluate	L5	PO1	Apply (L3)	3

Justification:

CO1: Apply the matrix algebra techniques for solving various linear equations**.**
Action Verb: Analyze **(L4)**
PO2 Verbs: Analyze (L4)
CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO2: Analyze the linear transformations of quadratic forms and mean value theorems**.**
Action Verb: Analyze **(L4)**
PO2 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO3: Apply the fundamental concepts of partial derivatives for multi variable functions**.**
Action Verb: Apply **(L3)**
PO2 Verbs: Analyze (L4)
CO3 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO4: Evaluate the multiple integrals in cartesian, polar, cylindrical, and spherical co-ordinate systems.
Action Verb: Evaluate (L5)
PO1 Verb: **Apply** (L3)
CO4 Action Verb is high level to PO1 verb; Therefore correlation is high (3).

CO5: Evaluate the improper integrals using special functions like Beta and Gamma**.**
Action Verb: Evaluate (L5)
PO1 Verb: **Apply** (L3)
CO5 Action Verb is high level to PO1 verb; Therefore correlation is high (3).

Annamacharya Institute of Technology & Sciences (Autonomous), Tirupati

AK20 Regulations

Course Code	**APPLIED PHYSICS**	L	T	P	C
20ABS9902		**3**	**0**	**0**	**3**
Regulation: **AK20**	Common to I B.Tech ECE, EEE, AI&DS, AI&ML, and CSD(Sem-1), CSE & CIC (Sem-2)				

Course Outcomes (CO): After studying the course, Student will be able to:

1. **Understand the properties of light and electromagnetic waves.**
2. **Analyze the fundamentals of Lasers and optical fibers.**
3. **Analyze the properties of dielectric and magnetic materials.**
4. **Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.**
5. **Apply the basic concepts of superconductors and nanomaterials for engineering problems.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	**The properties of light and electromagnetic waves.**			**L2**
2	**Analyze**	**The fundamentals of Lasers and optical fibers.**			**L4**
3	**Analyze**	**The properties of dielectric and magnetic materials.**			**L4**
4	**Analyze**	**The charge carrier dynamics in semiconductors.**	**By implementing the equations of state.**		**L4**
5	**Apply**	**The basic concepts of superconductors and nanomaterials**		**for engineering problems.**	**L3**

Unit I: Optics and EM Theory **10 Hrs**

Interference of light -principle of superposition-Conditions for sustained
Interference-Interference in thin films (reflected light) - Newton's Rings -Determination of Wavelength.
Diffraction-Fraunhofer diffraction- Single slit and double slit- Diffraction Grating.
Divergence and Curl of Electric and Magnetic Fields - Gauss' theorem for divergence and Stokes' theorem for curl - Maxwell's Equations (Quantitative) – Electromagnetic wave - propagation in non-conducting medium - Poynting's Theorem.

Unit II : Lasers and Fiber Optics **10 Hrs**

Lasers – Introduction – Characteristics – Spontaneous and Stimulated Emission – Einstein Coefficients – Population Inversion – Excitation Mechanism and Optical Resonator - He-Ne Laser -Nd:YAG Laser – Semiconductor Diode Laser – Applications of Lasers.

Introduction to Optical Fibers – Total Internal Reflection – Critical angle of propagation –Acceptance angle – Numerical Aperture – Classification of fibers based on Refractive index profile – Propagation of electromagnetic wave through optical fiber – modes – importance of V-number-Attenuation, Block Diagram of Fiber optic Communication – Industrial Applications –Fiber optic Sensors.

Unit III : Dielectric and Magnetic Materials **8 Hrs**

Introduction—Dielectric polarization-Dielectric polarizability, Susceptibility and Dielectric constant-Types of polarizations : Electronic and Ionic,(Quantitative), Orientation Polarizations (Qualitative) - Frequency dependence of polarization-Lorentz (internal) field-Claussius-Mosotti equation-Applications of Dielectrics: Ferroelectricity.
Introduction-Magnetic dipole moment - Magnetization-Magnetic susceptibility and permeability-Origin of permanent magnetic moment – Classification of Magnetic materials - Weiss theory of ferromagnetism (qualitative) – Hysteresis– soft and hard magnetic materials – Magnetic memory device applications.

Unit IV: Semiconductors **8 Hrs**

Origin of Energy bands (Qualitative)-Intrinsic and Extrinsic semiconductors –Direct and indirect band gap semiconductors- Density of charge carriers – Fermi energy–-Dependence of Fermi energy on carrier concentration and temperature – Electrical conductivity – Drift and Diffusion currents – Continuity equation - Hall effect - Applications of Hall effect and Semiconductors.

Unit V: Superconductors and Nanomaterials

Superconductors-Properties-Meissner'seffect-BCSTheory(Qualitative) -Josephson effect (AC&DC)-Types of Superconductors-Applications of superconductors.
Nanomaterials–Significanceofnanoscale–: Physical, Mechanical, Magnetic, Optical propertiesof nanomaterials – Synthesisofnanomaterials:Top-down-BallMilling,Bottom-up-Chemical vapour deposition–Characterization of nanomaterials : X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM)-Applications of Nanomaterials.

Textbooks:

1. M. N. Avadhanulu, P. G. Kshirsagar &TVS Arun Murthy" A Text book of Engineering Physics"-S. Chand Publications,11th Edition2019.
2. B.K.Pandey and S.Chaturvedi, Engineering Physics, Cengage Learning,2012.

References:

1. K Thyagarajan "Engineering Physics",-Mc Graw Hill Publishing Company Ltd, 2016
2. Shatendra Sharma, Jyotsna Sharma, " Engineering Physics", Pearson Education,2018
3. David J.Griffiths,"Introduction to Electrodynamics"-4/e, Pearson Education, 2014
4. T Pradeep, "A Text book of NanoScience and NanoTechnology"-Tata Mc Graw Hill 2013.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	3			3										
3	3			3										
4	3			3										
5	3													

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**correlation**	**Verb**	**BTL**			
1	**16**	**23.8**	**3**	**Understand**	**L2**	PO1	PO1: Apply (L3)	2
2	**11**	**16.4**	**2**	**Analyze**	**L4**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
3	**12**	**17.9**	**2**	**Analyze**	**L4**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
4	**13**	**19.4**	**2**	**Analyze**	**L4**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
5	**15**	**22.3**	**3**	**Apply**	**L3**	PO1, PO4	PO1: Apply (L3)	3
	67							

CO1: 1. Understand the properties of light and electromagnetic waves.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

CO2: Analyze the fundamentals of Lasers and optical fibers.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3);
PO4 Verbs: Analyze (L4);
CO2 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).
CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO3: Analyze the properties of dielectric and magnetic materials.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3);
PO4 Verbs: Analyze (L4);
CO3 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).
CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO4: Analyze the charge carrier dynamics in semiconductors by implementing the equations of state.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3); PO4 Verbs: Analyze (L4);
CO4 Action Verb is greater than PO1 verb; Therefore, correlation is high (3).
CO4 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO5: 5. Apply the basic concepts of superconductors and nanomaterials for engineering problems.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO5 Action verb is equal to PO1 verb; therefore, the correlation is high (3).

Year: I B.Tech **(Common to all branches)** Semester: I

Subject Code	Subject Name	L T P	Credit: 3
20AHS9901	**COMMUNICATIVE ENGLISH**	3 0 0	

Course Outcomes (CO): After studying the course, Student will be able to:

CO1. Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English (Listening and Writing)

CO2: Apply grammatical structures to formulate sentences and correct word forms (Grammar)

CO3: Analyze discourse markers to speak clearly on a specific topic in informal discussions (Speaking)

CO4: Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.(Reading and Writing)

CO5: Create a coherent paragraph interpreting a figure/graph/chart/table (Writing)

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the context, topic, and pieces of specific information from social or transactional dialogues	spoken by native speakers of English.		L2
2	**Apply**	grammatical structures to formulate sentences and correct word forms.			L3
3	**Analyze**	discourse markers to speak clearly on a specific topic in informal discussions.			L4
4	**Evaluate**	reading/listening texts and to write summaries		based on global comprehension of these texts.	L5
5	**Create**	a coherent paragraph		interpreting a figure/graph/chart/table.	L6

UNIT -1

Lesson: On the Conduct of Life: William Hazlitt

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing : Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.
Grammar and Vocabulary- I : Parts of Speech, Content words and function words; word forms: verbs, nouns, adjectives and adverbs; nouns: countable and uncountable; singular and plural; basic sentence structures; simple question form – wh questions; word order in sentences.
Vocabulary -2: Formal/academicwords and phrases.

UNIT -2

Lesson: The Brook: Alfred Tennyson
Listening: Answering a series of questions about main idea and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structured talks.
Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.
Writing: Paragraph writing (specific topics) using suitable cohesive devices;
mechanics of writing - punctuation, capital letters.
Grammar & Vocabulary building-1: Cohesive devices - linkers, sign posts and transition signals; use of articles and zero article; prepositions.
Vocabulary building:2 Idioms and Phrases, Homonyms, Homophones and Homographs.

UNIT -3

Lesson: The Death Trap: Saki
Listening: Listening for global comprehension and summarizing what is listened to.
Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed
Reading: Readinga text in detail by making basic inferences - recognizing and interpreting specific context clues;strategies to use text clues for comprehension.
Writing: Summarizing – identifying main idea/s and rephrasing what is read.
Grammar and Vocabulary building-II: Direct and indirect speech, reporting verbs for academic purposes.
Technical Writing-1: personal experiences, unforgettable incidents, travelogues. (Imaginative, Narrative and Descriptive)

UNIT-4

Lesson: Innovation: Muhammad Yunus
Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.
Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions
Reading: Studying the use of graphic elements in texts to convey information, reveal trends / patterns / relationships, communicate processes or display complicated data.
Writing: Letter Writing: Official Letters/Report writing**, *e-mail writing***
Grammar and Vocabulary: Quantifying expressions - adjectives and adverbs; comparing and contrasting; Voice - Active & Passive Voice.
Vocabulary:2 : Jigsaw Puzzles, Vocabulary Activities through Web tools

UNIT -5

Lesson: Politics and the English Language: George Orwell
Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.
Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.
Reading: Reading for comprehension.
Writing: Writing structured essays on specific topics using suitable claims and evidences.
Grammar and Vocabulary: Editing short texts –identifying and correcting common errors in grammar and usage.

Technical Writing-2: Narrative short story, Newspaper articles on science fiction.

Text Book:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book
4. Hewings, Martin. Cambridge Academic English (B2).CUP, 2012.
5. Oxford Learners Dictionary, 12th Edition, 2011
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler

Web links

www.englishclub.com
www.easyworldofenglish.com
www.languageguide.org/english/
www.bbc.co.uk/learningenglish
www.eslpod.com/index.html
www.myenglishpages.com

Correlation of COs with the POs & PSOs

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Communicative English	CO1										3		
	CO2									2	3		
	CO3										3		
	CO4										3		
	CO5										3		

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	10	20	2	**Understand**	**L2**	PO10	Thumb Rule	2
2	10	20	2,2	**Apply**	**L3**	PO9, PO10	Thumb Rule Thumb Rule	2, 2
3	10	20	**3**	**Analyze**	**L4**	PO10	Thumb Rule	3
4	10	20	**3**	**Evaluate**	**L5**	PO10	Thumb Rule	3
5	10	20	**3**	**Create**	**L6**	PO10	Thumb Rule	3

CO1: Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO2: Apply grammatical structures to formulate sentences and correct word forms.

Action Verb: Apply (L3)

CO2 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2)

CO3: Analyze discourse markers to speak clearly on a specific topic in informal discussions

Action Verb: Analyze (L4)

CO3 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3).

CO4: Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.

Action Verb: Evaluate (L5)

CO4 Action Verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

CO5: Create a coherent paragraph interpreting a figure/graph/chart/table

Action Verb: Create (L6)

CO5 Action Verb Create is of BTL 6. Using Thumb rule, L6 correlates PO6 to PO12 as high (3).

I.B.Tech **Semester: I&I** **AK20 Regulations**

Subject Code	Subject Name	L T P	Credits: 3
20AES0304	ENGINEERING WORKSHOP PRACTICE	1 0 4	

Course Outcomes: After studying the course, Student will be able to:

CO1. Understand workshop tools and operational capabilities.
CO2. Apply wood working skills to prepare different joints.
CO3. Apply sheet metal operations to prepare different components in real world applications.
CO4. Apply fitting operations for various applications.
CO5. Apply basic electrical engineering knowledge for house wiring practice.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	workshop tools and operational capabilities			**L2**
2	Apply	wood working skills to prepare different joints			**L3**
3	Apply	sheet metal operations to prepare different components in real world applications.			**L3**
4	Apply	fitting operations in various applications			**L3**
5	Apply	basic electrical engineering knowledge for house wiring practice			**L3**

List of Experiments

WOOD WORKING: (CO1& CO2)
Familiarity with different types of woods and tools used in wood working and make following joints
a) Half – Lap joint
b) Mortise and Tenon joint
c) Corner Dovetail joint or Bridle joint

SHEET METAL WORKING: (CO1&CO3)
Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets
a) Tapered tray
b) Conical funnel
c) Elbow pipe
d) Brazing

FITTING: (CO1&CO4)
Study the difference types of fits and tolerances, surface finishing materials. Familiarity with different types of tools used in fitting and do the following fitting exercises
a) V-fit
b) Dovetail fit
c) Semi-circular fit
d) Bicycle tyre puncture and change of two wheeler tyre

ELECTRICAL WIRING: (CO1& CO5)
Study the different types of circuits and connections, Familiarities with different types of basic electrical circuits and make the following connections
a) Parallel and series
b) Two-way switch
c) Godown lighting
d) Tube light
e) Three phase motor

f) Soldering of wires

Mapping of COs to POs and PSOs

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
ENGINEERING WORKSHOP PRACTICE	CO 1	2												2	2
	CO 2	3	3	3			2			2				2	2
	CO 3	3	3	3			2			2				2	2
	CO 4	3	3	3			2			2				2	2
	CO 5	3	3	3			2			2				2	2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	**L2**	PO1	Apply (L3)	2
2	Apply	**L3**	PO1 PO2 PO3 PO6 PO9	Apply (L3) Identify (L3) Develop (L3) TR TR	3 3 3 2 2
3	Apply	**L3**	PO1 PO2 PO3 PO6 PO9	Apply (L3) Identify (L3) Develop (L3) TR TR	3 3 3 2 2
4	Apply	**L3**	PO1 PO2 PO3 PO6 PO9	Apply (L3) Identify (L3) Develop (L3) TR TR	3 3 3 2 2
5	Apply	**L3**	PO1 PO2 PO3 PO6 PO9	Apply (L3) Identify (L3) Develop (L3) TR TR	3 3 3 2 2

CO-PO mapping justification:
CO1: Understand workshop tools and operational capabilities.
Action Verb: Understand **(L2)**
PO1 Verb: Apply (L3)
CO1 Action Verb is less than one to PO1; Therefore correlation is medium (2)

CO2: Apply wood working skills to prepare different joints.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore, correlation is high (3)
PO2 verb: Identify (L3)
CO2 Action Verb is equal to PO2 verb; Therefore, correlation is high (3)

PO3 Verb: Develop (L3)
CO2 Action Verb is equal to PO3 verb; Therefore, correlation is high (3)
PO6: TR,
CO2 co-relates with PO6 moderately. Therefore correlation is chosen as medium (2)
PO7: TR
CO2 co-relates with PO7 moderately. Therefore correlation is chosen as medium (2)

CO3: Apply sheet metal operations to prepare different components in real world applications.
Action Verb: Apply(L3)
PO1 Verb: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore, correlation is high (3)
PO2 verb: Identify (L3)
CO3 Action Verb is equal to PO2 verb; Therefore, correlation is high (3)
PO3 Verb: Develop (L3)
CO3 Action Verb is equal to PO3 verb; Therefore, correlation is high (3)
PO6: TR,
CO3 co-relates with PO6 moderately. Therefore correlation is chosen as medium (2)
PO7: TR
CO3 co-relates with PO7 moderately. Therefore correlation is chosen as medium (2)

CO4: Apply fitting operations for various applications.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4 Action Verb is equal to PO1 verb; Therefore, correlation is high (3)
PO2 verb: Identify (L3)
CO4 Action Verb is equal to PO2 verb; Therefore, correlation is high (3)
PO3 Verb: Develop (L3)
CO4 Action Verb is equal to PO3 verb; Therefore, correlation is high (3)
PO6: TR,
CO4 co-relates with PO6 moderately. Therefore correlation is chosen as medium (2)
PO7: TR
CO4 co-relates with PO7 moderately. Therefore correlation is chosen as medium (2)

CO5: Apply basic electrical engineering knowledge for house wiring practice**.**
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO5 Action Verb is equal to PO1 verb; Therefore, correlation is high (3)
PO2 verb: Identify (L3)
CO5 Action Verb is equal to PO2 verb; Therefore, correlation is high (3)
PO3 Verb: Develop (L3)
CO5 Action Verb is equal to PO3 verb; Therefore, correlation is high (3)
PO6: TR,
CO5 co-relates with PO6 moderately. Therefore correlation is chosen as medium (2)
PO7: TR
CO5 co-relates with PO7 moderately. Therefore correlation is chosen as medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Problem Solving And Programming	L	T	P	C
20AES0501	I-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO 1: **Understand** the Programming and Algorithms concepts to Perform Basic operations.
CO 2: **Apply** the problem solving approaches to generate different algorithms.
CO 3: **Understand** the various operators to perform mathematical operations.
CO 4: **Apply** the Pointers and Array Techniques to manipulate the data.
CO 5: **Analyze** the Sorting and Searching Techniques to arrange the data in sorted order.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Programming and Algorithms concepts		to Perform Basic operations.	L2
CO2	Apply	the problem solving approaches		to generate different algorithms	L3
CO3	Understand	the various operators		to perform mathematical operations	L2
CO4	Apply	the Pointers and Array Techniques		to manipulate the data	L3
CO5	Analyze	the Sorting and Searching Techniques		to arrange the data in sorted order.	L4

UNIT - I		8 Hrs
Computer Fundamentals: What is a Computer, Evolution of Computers, Generations of Computers, Classification of Computers, Anatomy of a Computer, Memory revisited, Introduction to Operating systems, Operational overview of a CPU. Introduction to Programming, Algorithms and Flowcharts: Programs and Programming, Programming languages, Compiler, Interpreter, Loader, Linker, Program execution, Fourth generation languages, Fifth generation languages, Classification of Programming languages, Structured programming concept, Algorithms, Pseudo-code, Flowcharts, Strategy for designing algorithms, Tracing an algorithm to depict logic, Specification for converting algorithms into programs.		
UNIT - II		9Hrs
Introduction to computer problem solving: Introduction, the problem-solving aspect, top-down design, implementation of algorithms, the efficiency of algorithms, and the analysis of algorithms. **Fundamental algorithms**: Exchanging the values of two variables, counting, summation of a set of numbers, factorial computation, sine function computation, generation of the Fibonacci sequence, reversing the digits of an integer.		
UNIT - III		8Hrs
Types, Operators, and Expressions: Variable names, data types and sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence and order of evaluation. **Input and output**: standard input and output, formatted output-Printf, formatted input-Scanf. Control Flow: Statements and blocks, if-else, else-if, switch, Loops-while and for, Loops-Do- while, break and continue, Goto and labels. **Functions and Program Structure**: Basics of functions, functions returning non-integers, external variables, scope variables, header variables, register variables, block structure, initialization, recursion, the C processor.		
UNIT - IV		9Hrs
Factoring methods: Finding the square root of a number, the smallest divisor of a number, the greatest common divisor of two integers, generating prime numbers. **Pointers and arrays**: Pointers and addresses, pointers and function arguments, pointers and arrays, address arithmetic, character pointers and functions, pointer array; pointers to pointers, Multi-dimensional arrays, initialization of arrays, pointer vs. multi-dimensional arrays, command line arguments, pointers to functions, complicated declarations. **Array Techniques**: Array order reversal, finding the maximum number in a set, removal of duplicates from an order array, finding the kth smallest element		
UNIT - V		9 Hrs
Sorting and Searching: Sorting by selection, sorting by exchange, sorting by insertion, sorting by partitioning, binary search. **Structures**: Basics of structures, structures and functions, arrays of structures, pointers to structures, self referential structures, table lookup, typedef, unions, bit-fields. **Some other Features**: Variable-length argument lists, formatted input-Scanf, file access, Error handling-stderr and exit, Line Input and Output, Miscellaneous Functions.		
Textbooks:		

1. Pradip Dey, and Manas Ghosh, "Programming in C", 2018, Oxford University Press.
2. R.G. Dromey, "How to Solve it by Computer". 2014, Pearson.
3. Brian W. Kernighan, and Dennis M. Ritchie, "The C Programming Language", 2nd Edition, Pearson.

Reference Books:

1. RS Bichkar "Programming with C", 2012, Universities Press.
2. Pelin Aksoy, and Laura Denardis, "Information Technology in Theory", 2017, Cengage Learning.
3. Byron Gottfried and Jitender Kumar Chhabra, "Programming with C", 4th Edition, 2019, McGraw Hill Education.

Online Learning Resources:

www.nptel.ac.in

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3												
CO2	3	2	3									2		
CO3	2	3										2		
CO4	3	3	3									2		
CO5	3	3	3									2		

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	19	25%	3	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	10	14%	2	CO2: Apply	L3	PO1 PO2 PO3 PO12	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO12: Thumb rule	3 2 3 2
3	19	25%	3	CO3: Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review (L2) PO12: Thumb rule	2 3 2
4	15	20%	2	CO4: Apply	L3	PO1 PO2 PO3 PO12	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO12: Thumb rule	3 3 3 2
5	12	16%	2	CO5: Analyze	L4	PO1 PO2 PO3 PO12	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO12: Thumb rule	3 3 3 2
	75	100 %						

Justification Statements :

CO1: Analyze the Programming and Algorithms concepts to Perform Basic operations.

Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2 Verb: Review (L2)
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

CO2: Applythe problem solving approaches to generate different algorithms.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2)
PO3: Develop (L3)
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
Some of the Algorithm knowledge are used to solve various problems. Therefore, the correlation is medium (2)

CO3: Understand the various operators to perform mathematical operations.
Action Verb: Understand(L2)
PO1: Apply (L3)
CO3 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2: Review (L2)

CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO12: Thumb rule

For some mathematical operations to perform operators are used to create programs. Therefore, the correlation is medium (2)

CO4: Apply the Pointers and Array Techniques to manipulate the data.

Action Verb: Apply (L3)

PO1: Apply (L3)

CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2: Review (L2)

CO4 Action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3)

PO3: Develop (L3)

CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO12: Thumb rule

For some mathematical operations to perform Pointers and Array Techniques are used to create programs. Therefore, the correlation is medium (2)

CO5: Analyze the Sorting and Searching Techniques to arrange the data in sorted order.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO5 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)

PO2: Review (L2)

CO5 Action verb is greater than PO2 verb by one level. Therefore, the correlation is high (3)

PO3: Develop (L3)

CO5 Action verb is greater than PO3 verb by one level. Therefore, the correlation is high (3)

PO12: Thumb rule

For some Data Structures operations to perform Sorting and Searching Techniques are used to create programs. Therefore, the correlation is medium (2)

Year: I B.Tech **(Common to all branches)** Semester: I & II

Subject Code	Subject Name	L T P	Credit:	CLC
20AHS9902	**COMMUNICATIVE ENGLISH LAB**	0 0 3	1.5	1

Pre-Requisites	Communicative English Lab	Semester	**I & II**

Course Outcomes (CO): After studying the course, Student will be able to:

CO1. Evaluate the awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

CO2. Understand the different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions.

CO3. Apply the knowledge of vocabulary and skills in various language learning activities.

CO4. Analyze the speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension.

CO5. Evaluate the acceptable etiquette essentials in social and professional presentations.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Evaluate**	the awareness on mother tongue influence and neutralize it	in order to improve fluency in spoken English		**L5**
2	**Understand**	the different aspects of the language with emphasis on LSRW skills and		make use of different strategies in discussions	**L2**
3	**Apply**	the knowledge of vocabulary and skills		in various language learning activities	**L3**
4	**Analyze**	the speech sounds, stress, rhythm, intonation and syllable division	for better listening and speaking comprehension		**L4**
5	**Evaluate**	the acceptable etiquette essentials in social and professional presentations			**L5**

Unit 1

1. Phonetics (CO1)
2. Non - verbal communication (CO2)
3. Vocabulary (word formation, one word substitutes, words often misused & confused, collocations idioms & phrases) (CO3)

Unit 2

1. Reading Comprehension (CO2, CO4)
2. JAM (CO2, CO3)
3. Distinction between Native and Indian English accent (Speeches by TED and Kalam). (CO4)

Unit 3

1. Situational dialogues/Giving Directions (CO1)
2. Describing objects/places/persons (CO2, CO3)

Unit 4

1. Fun – Buzz (Tongue twisters, riddles, puzzles etc) (CO3)
2 Formal Presentations (CO5)

Unit 5

1. Debate (Contemporary / Complex topics) (CO2)
2. Group Discussion (CO2)

Software Source:

K-Van Solutions Software

Reference:

Teaching English - British Council

***3: Highly Correlated, 2: Moderately Correlated, 1: Weakly Correlated**

Course Title	Course Outcomes COs	Programme Outcomes(POs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO 7	PO8	PO9	PO1 0	PO11	PO12
Communicative English Lab	CO1										3		
	CO2									2			
	CO3										2		
	CO4										3		
	CO5										3		

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours (Approx. Hrs)**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
		%	**corr**	**Verb**	**BTL**			
1	9	25	3	**Evaluate**	**L5**	PO10	Thumb Rule	3
2	6	16	2	**Understand**	**L2**	PO9	Thumb Rule	2
3	6	16	**2**	**Apply**	**L3**	PO10	Thumb Rule	2
4	6	16	**3**	**Analyze**	**L4**	PO10	Thumb Rule	3
5	9	25	**3**	**Evaluate**	**L5**	PO10	Thumb Rule	3

CO1: Evaluate awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.
Action Verb: Evaluate (L5)

CO1 Action Verb **Evaluate** is of BTL 5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

CO2: Understanding the different aspects of the language with emphasis on LSRW skills and make use of different strategies in discussions
Action Verb: Understand(L2)
CO2 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2)

CO3: Apply knowledge of vocabulary and skills in various language learning activities
Action Verb: Apply (L3)
CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2).

CO4: Analyze speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension
Action Verb: Analyze (L4)
CO4 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3).

CO5: : Evaluate the acceptable etiquette essentials in social and professional presentations.
Action Verb: Evaluate (L5)

CO5 Action Verb Evaluate is of BTL 5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY SCIENCES: TIRUPATI
(Autonomous)
I B.Tech **AK20 Regulations**
Common to I Sem ECE/EEE/AI&DS/AI&ML/CSD& II Sem CSE/CIC

Subject Code:20ABS9907	Subject Name: **Applied Physics Lab**	L T P 0 0 3	Credits:1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the properties of light for solving engineering problems.
CO2: Understand the basic concepts of electromagnetic induction.
CO3: Evaluate the crystallite size using X-ray diffraction.
CO4: Analyze the basic properties of dielectric and magnetic behavior of the given material.
CO5: Evaluate the basic parameters of a given semiconductor material.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Analyze**	**The properties of light for solving engineering problems.**			**L4**
2	**Understand**	**The basic concepts of electromagnetic induction.**			**L2**
3	**Evaluate**	**The crystallite size**	**using X-ray diffraction.**		**L5**
4	**Analyze**	**The basic properties of dielectric and magnetic behavior of the given material.**			**L4**
5	**Evaluate**	**The basic parameters of a given semiconductor material.**			**L5**

List of Experiments:

1. Determination of the thickness of the wire using wedge shape method.**(CO1)**
2. Determination of the radius of curvature of the lens by Newton's ring method.**(CO1)**
3. Determination of wavelength by plane diffraction grating method.**(CO1)**
4. Dispersive power of a diffraction grating.**(CO1)**
5. Study of the Magnetic field along the axis of a circular coil carrying current.**(CO2)**
6. Study the variation of B versus H of the magnetic material (B-H curve) **(CO4)**
7. Determination of the numerical aperture of a given optical fiber and angle of acceptance.**(CO1)**
8. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect.**(CO5)**
9. Determination of the energy gap of a semiconductor.**(CO5)**
10. Determination of crystallite size using X-Ray diffraction spectra.**(CO3)**
11. Determination of Wavelength of LASER using diffraction grating.**(CO1)**
12. Determination of particle size using LASER.**(CO1)**
13. Determination of the resistivity of semiconductor by Four probe method.**(CO5)**
14. Determination of dielectric constant by charging and discharging method. **(CO4)**
15. Study the temperature dependence of resistance of a thermister.**(CO5)**

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.
References:

1. S. Balasubramanian, M.N.Srinivasan, "A Text book of Practical Physics"-S Chand Publishers, 2017.

2. http://vlab.amrita.edu/index.php-VirtualLabs, Amrita University.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3			3										
2	2			1										
3	3			3										
4	3			3										
5	3			3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	9	25	3	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
2	6	16	2	Understand	L2	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	2 1
3	6	16	2	Evaluate	L5	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
4	9	25	3	Analyze	L4	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
5	6	16	2	Evaluate	L5	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
	36							

CO1: Analyze the properties of light for solving engineering problems.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO1 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
CO1 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).
CO2: Understand the basic concepts of electromagnetic induction.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO2 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO2 Action Verb is greater than PO1 verb by two levels; Therefore correlation is low (1).

CO3: Evaluate the crystallite size using X-ray diffraction.
Action Verb: Evaluate(L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO3 Action Verb level isgreater than PO1 action verb by two levels; Therefore correlation is high (3).
CO3 Action Verb level is greater than PO4 action verb by one level; Therefore correlation is high (3).
CO4: Analyze the basic properties of dielectric and magnetic behavior of the given material.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)
CO4 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
CO4 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
CO5: Evaluate the basic parameters of a given semiconductor material.
Action Verb: Evaluate (L5)
PO1 and PO4 Verb: Apply (L3)
CO5 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Problem Solving And Programming Lab	L	T	P	C
20AES0503	I-I		0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO 1: Analyze the basics of computer and concepts of C for writing simple programs.

CO 2: Analyze the control statements for solving the problems using C

CO 3: Design the algorithm for implementing complex problems using C.

CO 4: Analyze the arrays to store and retrieve the elements.

CO 5:Apply the different sorting techniques for solving real world problems.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Analyze**	the basics of computer and concepts of C		for writing simple programs	L4
CO2	**Analyze**	the control statements	using C	for solving the problems	L4
CO3	**Design**	the algorithm	using C	for implementing complex problems	L6
CO4	**Analyze**	the arrays		to store and retrieve the elements.	L4
CO5	**Apply**	the different sorting techniques		for solving real world problems	L3

List of Experiments

1. Assemble and disassemble parts of a Computer**(CO1)**
2. Design a C program which reverses the number**(CO1)**
3. Design a C program which finds the second maximum number among the given list of numbers. **(CO2)**
4. Construct a program which finds the kth smallest number among the given list of numbers. **(CO2)**
5. Design an algorithm and implement using C language the following exchanges a ← b ← c ← d ← a**(CO2)**
6. Develop a C Program which counts the number of positive and negative numbers separately and also compute the sum of them. **(CO2)**
7. Implement the C program which computes the sum of the first n terms of the series Sum = 1 – 3 + 5 -7 + 9**(CO2)**
8. Design a C program which determines the numbers whose factorial values are between 5000 and 32565. **(CO2)**
9. Design an algorithm and implement using a C program which finds the sum of the infinite series1 – x2/2! + x4/4! – x6/6! + …. **(CO3)**
10. Design a C program to print the sequence of numbers in which each number is the sum of the three most recent predecessors. Assume first three numbers as 0, 1, and 1. **(CO3)**
11. Implement a C program which converts a hexadecimal, octal and binary number to decimal number and vice versa. **(CO3)**
12. Develop an algorithm which computes the all the factors between 1and100 for a given number and implement it using C. **(CO3)**
13. Construct an algorithm which computes the sum of the factorials of numbers between m and n. **(CO3)**
14. Design a C program which reverses the elements of the array. **(CO4)**
15. Given a list of n numbers, Design an algorithm which prints the number of stars equivalent to the value of the number. The starts for each number should be printed horizontally. **(CO4)**
16. Implement the sorting algorithms a. Insertion sort b. Exchange sort c. Selection sort d. Partitioning sort. **(CO5)**
17. Illustrate the use of auto, static, register and external variables. **(CO5)**
18. Design algorithm and implement the operations creation, insertion, deletion, traversing on a singly linked list. **(CO5)**
19. Develop a C program which takes two numbers as command line arguments and finds all the common factors of those two numbers. **(CO5)**
20. Design a C program which sorts the strings using array of pointers. **(CO5)**

Instructors may add some experiments to the above list. Moreover, 50% of the experiments are to be changed every academic year. Instructors can choose the experiments, provided those experiments are not repetitions.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**											**2**	
CO2	**3**	**3**	**3**	**3**	**3**								**2**	
CO3	**3**	**3**	**3**	**3**	**3**							**3**	**2**	
CO4	**3**	**3**	**3**	**3**	**3**							**3**	**2**	**2**
CO5	**3**	**3**	**3**	**2**	**3**								**2**	**2**

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
1	CO1: Analyze	L4	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	3 3
2	CO2: Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
3	CO3: Design	L6	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Formulate (L6) PO3: Design(L6) PO4: Analyze (L4) PO5: Create (L6) PO12: Thumb rule	3 3 3 3 3 3
4	CO4: Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO12: Thumb rule	3 3 3 3 3 3
5	CO5: Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 2 3

Justification Statements :

CO1: Analyze the basic concepts of C for writing simple programs.

Action Verb:Analyze(L4)

PO1 Verb: Apply (L3)

CO1 Action verb is Greater than PO1 verb. Therefore, the correlation is high(3)

PO2 Verb: Review(L2)

CO1 Action verb is greater thanPO2 verb. Therefore, the correlation is high (3)

CO2: Analyze the control statements for solving the problems.

Action Verb: Analyze (L4)

PO1: Apply (L3)

CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)

PO2: identify(L3)

CO2 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)

PO3: Develop (L3)

CO2 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)

PO5: Apply (L3)

CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO3: Design the algorithm for implementing complex problems using C.

Action Verb: Design (L6)

PO1: Apply (L3)

CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)

PO2: Formulate(L6)

CO3 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

PO3: Design (L6)

CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is greater than as PO4 verb. Therefore, the correlation is high (3)

PO5: create (L6)

CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

PO12: Thumb rule

Algorithms analysis is learning process to find the solution better manner the correlation is high (3)

CO4: Analyze the arrays to store and retrieve the elements.

Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: idetify(L3)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO4 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
Data analysis is the trending approach in the current days Therefore, the correlation is high (3)

CO5:Apply the different sorting techniques for solving real world problems.

Action Verb: Apply (L3)
PO1: Apply (L3)
CO5 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2: identify(L3)
CO5 Action verb is same as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)
PO5: Apply (L3)
CO5 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

II Semester (B.Tech –I year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	BSC	20ABS9906	Differential Equations and Vector Calculus	3	0	0	3	30	70	100
2	BSC	20ABS9904	Chemistry	3	0	0	3	30	70	100
3	ESC	20AES0201	Network Theory	3	0	0	3	30	70	100
4	ESC	20AES0502	Data Structures	3	0	0	3	30	70	100
5	ESC	20AES0301	Engineering Graphics	1	0	4	3	30	70	100
6	ESC	20AES0203	Network Theory Laboratory	0	0	3	1.5	30	70	100
7	BSC	20ABS9909	Chemistry Laboratory	0	0	3	1.5	30	70	100
8	ESC	20AES0504	Data Structures Laboratory	0	0	3	1.5	30	70	100
9	MC	20AMC9902	Constitution of India`	3	0	0	0	30		30
						TOTAL	**19.5**	**270**	**560**	**830**

AK20 Regulations

Year: I **Semester**: II **Branch of Study: ECE, EEE,ME,CE**

Subject Code:20ABS9906	Subject Name: Differential Equations and Vector Calculus	L T P 3 0 0	Credits 3

Course Outcomes (CO): After studying the course, Student will be able to:

1. Analyze the mathematical concepts of ordinary differential equations of higher order.
2. Apply the methods of linear differential equations related to various engineering problems.
3. Analyze the partial differential equations of first and higher order.
4. Understand the vector differential operators such as gradient, curl, divergent.
5. Evaluate the vector integral theorems by using line, surface, and volume integrals.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Analyze**	the mathematical concepts of ordinary differential equations	of higher order		**L4**
2	**Apply**	the methods of linear differential equations	related to various engineering problems		**L3**
3	**Analyze**	the partial differential equations	of first and higher order		**L4**
4	**Understand**	the vector differential operators such as gradient, curl, divergent.			**L2**
5	**Evaluate**	the vector integral theorems	by using line, surface, and volume integrals		**L5**

UNIT I: Linear Differential Equations of Higher Order

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral (e^{ax}, sinax (or) cosax, X^k, $e^{ax}v$, x v(x)), method of variation of parameters.

UNIT II: Equations Reducible to Linear Differential Equations and Applications

simultaneous linear equations with constant coefficients ,Cauchy's and Legendre's linear equations, Applications to oscillations of a spring, L-C-R Circuit problems and Mass spring system.

UNIT III: Partial Differential Equations of First order and Higher Order

Linear Equations of First order P.D.E: Method of Grouping, Method of Multipliers.
Non-linear Equations of First Order PDE: f (p , q) = 0, f (z, p ,q) = 0, f (x , p) = F (y , q) and z = px +qy + f (p , q) OR Clairaut's Equation.
Homogenous Linear P.D.E with constant coefficients of Higher order: Finding complementary function, Particular Integrals of e^{ax+by}, Sin (ax+by) Or Cos (ax +by), X^mY^n and for any function of F (x, y). Non-Homogenous Linear P.D.E of constant coefficient.

UNIT IV:Vector differentiation

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V: Vector integration

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books :

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.

References:

1. Dr.T.K.V.Iyengar, Engineering Mathematics-I,S.Chand publishers
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics,Laxmipublication,2008
4. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1		3										
2	3											
3		3										
4	2											
5		3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping:

CO	**Percentage of contact hours over the total planned contact hours**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**correlation**	**Verb**	**BTL**			
1	**14**	20.8	3	**Analyze**	**L4**	PO2	**Analyze (L4)**	3
2	**15**	22.3	3	**Apply**	**L3**	PO1	**Apply (L3)**	3
3	**14**	20.8	**3**	**Analyze**	**L4**	PO2	**Analyze (L4)**	3
4	**9**	13.4	**2**	**Understand**	**L2**	PO1	**Apply (L3)**	2
5	**15**	22.3	**3**	**Evaluate**	**L5**	PO2	**Analyze (L4)**	3

Justification:

CO1: Analyze the mathematical concepts of ordinary differential equations of higher order.
Action Verb: Analyze (L4)
PO2 Verbs: Analyze (L4)
CO1 Action Verb is equal to PO2 verb Therefore correlation is high (3).

CO2:.Apply the methods of linear differential equations related to various engineering problems.
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the partial differential equations of first and higher order.
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Understand the vector differential operators such as gradient, curl, divergent.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO4 Action Verb is low level to PO1 to one level; Therefore correlation is moderate (2).

CO5: Evaluate the vector integral theorems by using line, surface, and volume integrals**.**
Action Verb: Evaluate (L5)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI
(Autonomous)
(Effective for the batches admitted from 2022-23)

Year: I B.Tech **Common to I Sem- CSE & CIC, II Sem EEE, ECE**

Subject Code: 20ABS9904	**Subject Name:** Chemistry	L 3	T 0	P 0	Credits: 3	CLC 3

Course Code	**CHEMISTRY**		L	T	P	C
20ABS9904			**3**	**0**	**0**	**3**
Pre-Requisites		Semester	**I**			

Course Outcomes (CO): After studying the course, Student will be able to:

1. **Understand the interaction of energy levels between atoms and molecules**
2. **Apply the electrochemical principles to the construction of batteries, fuel cells and electrochemical sensors**
3. **Analyze the preparation and mechanism of polymers**
4. **Analyze the separation of gaseous and liquid mixtures using instrumental methods**
5. **Apply the purification technique to remove hardness of water and to check the quality of water**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	**The interaction of energy levels between atoms and molecules**			**L2**
2	**Apply**	**The electrochemical principles to the construction of batteries, fuel cells and electrochemical sensors**			**L3**
3	**Analyze**	**The preparation and mechanism of polymers**			**L4**
4	**Analyze**	**The separation of gaseous and liquid mixtures**		**Using instrumental methods**	**L4**
5	**Apply**	**The purification technique to remove hardness of water**		**to check the quality of water**	**L3**

Unit 1: Structure and Bonding Models **(10 hrs)**

Planck's quantum theory, Schrodinger wave equation, significance of Ψ^1 and Ψ^2 , applications to hydrogen, particle in a box and their applications for conjugated molecules, crystal field theory – salient features – energy level diagrams for transition metal ions – splitting of orbital's in tetrahedral and octahedral complexes, magnetic properties, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O_2 , N_2 and CO, calculation of bond order.

Unit 2: Electrochemistry and Applications **(10 hrs)**

Electrodes – concepts, reference electrodes (Calomel electrode, Ag/AgCl electrode and glass electrode) electrochemical cell, Nern'st equation, cell potential calculations, numerical problems, concept of pH, pH meter and applications of pH metry (acid-base titrations), potentiometry- potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), photovoltaic cell – working and applications, photogalvanic cells with specific examples. Electrochemical sensors – potentiometric sensors with examples, amperometric sensors with examples.

Primary cells – Zinc-air battery, alkali metal sulphide batteries, Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

Secondary cells – lead acid, nickel-metal hydride and lithium ion batteries- working of the batteries including cell reactions, button cells,

Unit 3: Polymer Chemistry **(10 hrs)**

Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation.

Plastics - Thermoplastics and Thermosettings, Preparation, properties and applications of – Bakelite, urea-formaldehyde, Nylon-66, carbon fibres, Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylene, polyaniline, polypyrroles – mechanism of conduction and applications.

Unit 4: Instrumental Methods and Applications **(10 hrs)**

Principle and applications of Colorimetry, AAS, AES, UV-Viscible spectrophotometry (Beer-Lambert's law, Instrumentation ,Principles and applications of Chromatographic techniques(GC & HPLC), separation of gaseous mixtures and liquid mixtures(GC & HPLC methods).

Unit 5: Water Technology **(10 hrs)**

Introduction –Soft Water and hardness of water, Estimation of hardness by EDTA Method - Boiler troubles - scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

Text books:

1. Jain and Jain, Engineering Chemistry, 16/e, Dhanpat Rai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference books:

1. J. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
2. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
3. Ben L. Feringa and Wesley R. Browne, Molecular Switches, 2/e, Wiley-VCH, 2011.
4. Willard Merritt Dean Settle, 7 th Edition Instrumental methods for analysis

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2													
2	3													
3		3												
4		3												
5	3													

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**				**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Register (Hrs)	**Lesson Plan (Hrs)**	**%**	**corr**	**Verb**	**BTL**			
1	**10**	**10**	**15.6**	**2**	**Understand**	**L2**	PO1	PO1: Apply (L3)	2
2	**10**	**17**	**26.5**	**3**	**Apply**	**L3**	PO1	PO1: Apply (L3)	3
3	**10**	**12**	**18.7**	**3**	**Analyze**	**L4**	PO2	PO2: Analyze (L4)	3
4	**10**	**13**	**20.3**	**3**	**Analyze**	**L4**	PO2	PO2: Analyze (L4)	3
5	**10**	**12**	**18.7**	**3**	**Apply**	**L3**	PO1	PO1: Apply (L3)	3
	50	**64**							

CO1: Understand the interaction of energy levels between atoms and molecules

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

CO2: Apply the electrochemical principles to the construction of batteries, fuel cells and electrochemical sensors

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the preparation and mechanism of polymers

Action Verb: Analyze (L4)

PO2 Verb: Analyze (L4)

CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Analyze the separation of gaseous and liquid mixtures using instrumental methods

Action Verb: Analyze (L4)

PO2 Verb: Analyze (L4)

CO4 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO5: Apply the purification technique to remove hardness of water and to check the quality of water

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO5 Action verb is equal to PO1 verb; therefore the correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year-Semester: I-II
Branch of Study: ECE

Course Name: NETWORK THEORY
Subject Code: 20AES0201

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES: After studying the course, Student will be able to:

CO1: Understand the fundamental concepts and operational analysis of electrical circuits.
CO2: Apply the different network theorems for electrical circuits to study its properties.
CO3: Evaluate the transient response of R-L, R-C and R-L-C circuits.
CO4: Analyze the Resonance and Coupled circuit properties in steady state domain.
CO5: Evaluate two port network parameters and Pole-Zero location from transfer function.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
1	Understand	Fundamental concepts and operational analysis of electrical circuits.			L2
2	Apply	Different Network theorems for electrical circuits to study its properties.			L3
3	Evaluate	Transient response of R-L, R-C and R-L-C circuits.			L5
4	Analyze	The Resonance and Coupled circuit properties	steady state domain		L3
5	Evaluate	Two port network parameters and Pole-Zero location from transfer function.			L5

SYLLABUS:

UNIT I: INTRODUCTION TO ELECTRICAL CIRCUITS

Passive components and their V-I relations, Energy sources - Ideal, Non-ideal, Independent and dependent sources, Source transformation Kirchhoff's laws, Star–to-Delta or Delta-to Star Transformations, Mesh analysis and Nodal analysis problem solving, Super node and Super mesh for DC Excitations

UNIT II: NETWORK THEOREMS

Superposition theorem, Thevenin & Norton theorems, Maximum power transfer theorem, Reciprocity theorem, Millman theorem, Tellegan's Theorem, Compensation theorem - problem solving using dependent sources also, Duality and dual networks.

UNIT III: TRANSIENTS

First order differential equations, Definition of time constants, R-L circuit, R-C circuit with DC excitation, evaluating initial conditions procedure, second order differential equations, homogeneous, non- homogenous, problem solving using R-L-C elements with DC excitation. Solutions using Laplace transform method.

UNIT IV: RESONANCE AND COUPLED CIRCUITS

Self-inductance, Mutual inductance, dot rule, coefficient of coupling, Analysis of multi winding coupled circuits, series & parallel connection of coupled inductors. Resonance: Introduction, Definition of Q, Series resonance, Bandwidth of series resonance, Parallel resonance, Condition for maximum impedance, current in anti-resonance, Bandwidth of parallel resonance, general case resistance present in both branches, anti-resonance at all frequencies.

UNIT V: TWO PORT NETWORKS & NETWORK FUNCTIONS

Two Port Networks, relationship of two port variables, impedance parameters, admittance parameters, transmission parameters, hybrid and inverse hybrid parameters, relationship between parameters, interconnection of two port networks. Concept of complex frequency, driving point and transfer functions for one port and two port network, poles & zeros of network functions, Restriction on Pole and Zero locations of network function

TEXTBOOKS:

1. W. H. Hayt and J. E. Kemmerly, —Engineering Circuit Analysis¦, McGraw Hill

Education, 2013.
2. M. E. Van Valkenburg, —Network Analysis¦, Prentice Hall, 2006.

REFERENCE BOOKS:

1. D. Roy Choudhury, —Networks and Systems¦, New Age InternationalPublications,1998.
2. Network lines and Fields by John. D. Ryder 2nd edition, Asia publishing house.
3. Bhise, Chadda, Kulshreshtha,—Engineering network analysis and filter design Umesh Publication, 2000.
4. 4. Joseph Edminister and Mahmood Nahvi, —Electric Circuits¦, Schaum‘s Outline Series, Fourth Edition, Tata McGraw Hill Publishing Company, New Delhi, 2003.

Mapping of course outcomes with program outcomes

CourseTitle	COs	Program Outcomes (POs)&Programme Specific Outcomes (PSOs)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
NETWORK THEORY	CO1	2	1				2							2	
	CO2	3	2				1							2	
	CO3	3	3				1							2	
	CO4	3	2	1			1							2	
	CO5	3	3				1							2	

Justification Table:

CO	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	19	22.89	3	Understand	L2	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze (L4) PO6: Thumb Rule	2 1 2
2	15	18.07	2	Apply	L3	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	3 2 1
3	17	20.48	2	Evaluate	L5	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	3 3 1
4	17	20.48	2	Analyze	L4	PO1, PO2, PO3, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO3: Design (L6) PO6: Thumb Rule	3 3 1 1
5	15	18.07	2	Evaluate	L5	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	3 3 1
	83							

CO1: Understand the fundamental concepts and operational analysis of electrical circuits.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)
CO1 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO6: Using thumb rule, CO1 correlates to PO6 as moderate (2).

CO2: Apply the different network theorems for electrical circuits to study its properties.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action Verb is same as PO1 verb by one level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO6: Using thumb rule, CO2 correlates to PO6 as Low (1).

CO3: Evaluate the transient response of R-L, R-C and R-L-C circuits.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO3 Action Verb is Greater than PO1 verb by two level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO3 Action Verb is Greater than PO2 verb by one level; Therefore, correlation is high (3).
PO6: Using thumb rule, CO3 correlates to PO6 as Low (1).

CO4: Analyze the Resonance and Coupled circuit properties in steady state domain.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action Verb is Greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO4 Action Verb is same as PO2 verb; Therefore, correlation is high (3).
PO3: Design (L6)
CO4 Action Verb is Less than PO3 verb by two level; Therefore, correlation is low (1)
PO6: Using thumb rule, CO4 correlates to PO6 as Low (1).

CO5: Evaluate two port network parameters and Pole-Zero location from transfer function.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO5 Action Verb is Greater than PO1 verb two level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO5 Action Verb is Greater than PO2 verb by one level; Therefore, correlation is high (3).
PO6: Using thumb rule, CO5correlates to PO6 as Low (1).

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(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year &Sem	Data Structures (common to CSE,CIC,CSE(DS))	L	T	P	C
20AES0502	I-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO 1: Understand the basic concepts of an Algorithm to measure its performance

CO 2: Apply th Linear Data Structure to arrange the data in memory

CO 3: Apply the Non-Linear Data Structure to organize the data in hierarchical structure

CO 4: Evaluate the real time problems using graphs and hashing techniques

CO 5: Apply the File handling and sorting methods to rearrange the data**.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the basic concepts of an Algorithm		to measure its performance	L2
CO2	**Apply**	the Linear Data Structure		to arrange the data in memory	L3
CO3	**Apply**	the Non-Linear Data Structure		to organize the data in hierarchical structure	L3
CO4	**Evaluate**	the Real Time Problems	using Graphs and Hashing Techniques		L5
CO5	**Apply**	the File handling and sorting methods		to rearrange the data	L3

UNIT– I		9Hrs
Introduction		
Algorithm Specification, Performance analysis, Performance Measurement. Arrays: Arrays, Dynamically Allocated Arrays. Structures and Unions. Sorting: Motivation, Quick sort, how fast can we sort, Merge sort, Heap sort		
UNIT–II		9Hrs
Stack, Queue and Linked lists		
Stacks, Stacks using Dynamic Arrays, Queues, Circular Queues Using Dynamic Arrays, Evaluation of Expressions, Multiple Stacks and Queues. Linked lists: Singly Linked Lists and Chains, Representing Chains in C, Linked Stacks and Queues, Additional List Operations, Doubly Linked Lists.		
UNIT–III		9Hrs
Trees		
Introduction, Binary Trees, Binary Tree Traversals, Additional Binary Tree Operations, Binary Search Trees, Counting Binary Trees, Optimal Binary search Trees, AVL Trees. B-Trees: B- Trees, B + Trees.		
UNIT–IV		9Hrs
Graphs and Hashing		
The Graph Abstract Data Type, Elementary Graph Operations, Minimum Cost Spanning Trees, Shortest Paths and Transitive Closure Hashing: Introduction to Hash Table, Static Hashing, Dynamic Hashing.		
UNIT–V		9Hrs
Files and Advanced sorting		
File Organization: Sequential File Organization, Direct File Organization, Indexed Sequential File Organization. Advanced sorting: Sorting on Several keys, List and Table sorts, Summary of Internal sorting, External sorting.		
Textbooks:		
1.Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures in C”, 2nd Edition, Galgotia Book Source, Pvt. Ltd., 2004. 2.Alan L. Tharp, “File Organization and Processing”, Wiley and Sons, 1988.		
ReferenceBooks:		
1.D. Samanta, “Classic Data Structures”, 2nd Edition, Prentice-Hall of India, Pvt. Ltd., India, 2012. 2.Peter Bras, “Advanced Data Structures”, Cambridge University Press, 2016 3.RichardF.Gilberg, BehrouzA.Forouzan, “Data Structures A Pseudo code Approach with C”, Second Edition, Cengage Learning 2005.		

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	
CO2	3	3		3								2	2	1
CO3	3	3		3								2	2	1
CO4	1	2	3	3			3					3	2	2
CO5	3	3	3	2								3	2	2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	18	24%	3	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	14	19%	2	CO2: Apply	L3	PO1 PO2 PO4 PO12	PO1: Apply(L3) PO2: Review (L2) PO4: Develop (L3) PO12: Thumb rule	3 3 3 2
3	15	20%	2	CO3: Apply	L3	PO1 PO2 PO4 PO12	PO1: Apply(L3) PO2: Review (L2) PO4: Develop (L3) PO12: Thumb rule	3 3 3 2
4	13	18%	2	CO4: Evaluate	L5	PO1 PO2 PO3 PO4 PO7 PO12	PO1: Apply(L3) PO2: Formulate (L6) PO3: Develop (L3) PO4: Analyze(L4) PO7: Thumb rule PO12: Thumb rule	1 2 3 3 3 3
5	14	19%	2	CO5: Apply	L3	PO1 PO2 PO3 PO4 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4) PO12: Thumb rule	3 3 3 2 3
	74	100 %						

Justification Statements :

CO1: Understand the basic concepts of an Algorithm to measure its performance
Action Verb: Understand (L2)

PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2 Verb: Review (L2)
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

CO2: Apply the Linear Data Structure to arrange the data in memory
Action Verb: Apply (L3)

PO1: Apply (L3)
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L2)
CO2 Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2)
PO4: Develop (L3)
CO2 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Linear Data Structure applications, array and structure concepts are used to write programs. Therefore, the correlation is medium (2)

CO3: Apply the Non-Linear Data Structure to organize the data in hierarchical structure
Action Verb: Apply (L3)

PO1: Apply (L3)
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L2)
CO3 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO4: Develop (L3)
CO3 Action verb is same level as PO4 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Non-Linear Data Structure applications, array and structure concepts are used to write programs. Therefore, the correlation is medium (2)

CO4: Evaluate the real time problems using graphs and hashing techniques
Action Verb: Evaluate (L5)

PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by two levels. Therefore, the correlation is low (1)
PO2: Review (L2)
CO4 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb. Therefore, the correlation is high (3)
PO7: Thumb rule
For some of Real Time problems Data Structure applications, Graph concept is indirectly used to sustainable environment development. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Real Time problems Data Structure applications, Graph and Hash concepts are used to write programs and evaluation. Therefore, the correlation is high (3)

CO5:Apply the File handling and sorting methods to rearrange the data.
Action Verb: Apply (L3)

PO1: Apply(L3)
CO5 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is less than PO4 verb by one level. Therefore, the correlation is medium (2)
PO12: Thumb rule
For some of data manipulations Sorting and File Organization methods are used to solve storage problems. Therefore, the correlation is high (3)

Year:I Semester: II Branch of Study: ME

Subject Code	Subject Name	L	T	P	Credits
20AES0301	**Engineering Graphics**	**1**	**0**	**4**	**3**

Course Outcomes: After studying the course, Student will be able to:

CO1. Apply the concepts of engineering curves for technical drawing
CO2. Understand the quadrant system to locate the position of points and projection of lines
CO3. Analyze the projection of planes as well as solids located in quadrant system
CO4. Analyze the sectional views and development of surfaces of regular solids
CO5. Apply orthographic and isometric projections concepts to construct the given object.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
CO1	Apply	the concepts of engineering curves		for technical drawing	L3
CO2	Understand	the quadrant system to locate the position of points and projection of lines			L2
CO3	Analyze	drawthe projection of planes as well as solids		located in quadrant system	L4
CO4	Analyze	the sectional views and development of surfaces		of regular solids	L4
CO5	Apply	orthographic and isometric projections concepts to construct the given object			L3

Unit I:*Introduction to Engineering graphics*: Principles of Engineering Graphics and their significance Conventions in drawing-lettering - BIS conventions.
a) Conic sections including the rectangular hyperbola- general method only,
b) Cycloid, epicycloids and hypocycloid

Unit II: *Projection of points, lines*: Projection of points in any quadrant, lines inclined to one or bothplanes, finding true lengths, angle made by line, traces.

Unit III:*Projections of Planes*: Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.
Projections of Solids: Projections of regular solids inclined to one or both planes by rotational or auxiliaryviews method.

Unit IV:*Sections of solids*: Section planes and sectional view of right regular solids- prism, cylinder,pyramid and cone. True shapes of the sections.
Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, coneand their sectional parts.
Unit V:*Orthographic Projections*: Systems of projections, conventions and application to orthographicprojections.
Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views -lines, planes, figures, simple and compound solids.

Text Books:
1. K.L.Narayana&P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers
3. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill
4. Shah and Rana, Engineering Drawing, 2/e, Pearson Education
5. BasantAgarwal&C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill

Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Engineering Graphics	CO1	3		3							3			2	2
	CO2	2		2							3			2	2
	CO3	2		2							3			2	2
	CO4	3		3							3			2	2
	CO5	3		3							3			2	2

Correlation Matrix:

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	18	24	3	Apply	L3	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2
2	15	20	2	Understand	L2	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	2 2 1 2 2
3	15	20	2	Analyze	L4	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2
4	15	20	2	Analyze	L4	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2
5	12	16	2	Apply	L3	PO1 PO3 PO10 PSO1 PSO2	Apply (L3) Develop (L3) TR TR TR	3 3 1 2 2

Justification Statements:

CO1:Apply the concepts of engineering curves for technical drawing
Action Verb: Apply (L3)
PO1Verb:Apply(L3)
CO1Actionverbissame level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Develop (L3)
CO1Actionverbissame level as PO2 verb. Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO1: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO2: Understand the quadrant system to locate the position of points and projection of lines.
Action Verb: Understand (L2)
PO1Verb:Apply(L3)
CO2:ActionverbislessthanPO1verbbyone level. Therefore, the correlation is medium(2)
PO2 Verb: Develop (L3)
CO2:ActionverbislessthanPO2verbbyone level .Therefore, the correlation is medium(2)

PO10 Verb: Thumb Rule (TR)
CO2: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO3:Analyze the projection of planes as well as solids located in quadrant system.
Action Verb :Analyze(L4)
PO1Verb:Apply(L3)
CO3:Actionverbissamelevel asPO1verb.Therefore, the correlation is high (3)
PO2 Verb: Develop (L3)
CO3:Actionverbissamelevel asPO2verb.Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO3: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO4:Analyze the sectional views and development of surfaces of regular solids
Action Verb: Analyze(L4)
PO1Verb:Apply(L3)
CO4:Actionverbissamelevel asPO1verb.Therefore, the correlation is high (3)
PO2 Verb: Develop (L3)
CO4:Actionverbissamelevel asPO2verb.Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO4: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO5:Apply orthographic and isometric projections concepts to construct the given object.
Action Verb: Apply (L3)
PO1Verb:Apply(L3)
CO5:Actionverbissamelevel asPO1verb.Therefore, the correlation is high (3)
PO2 Verb: Develop (L3)
CO5:Actionverbissamelevel asPO2verb.Therefore, the correlation is high (3)
PO10 Verb: Thumb Rule (TR)
CO5: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year-Semester: I-II
Branch of Study: ECE

Course Name: NETWORK THEORY LABORATORY
Subject Code: 20AES0203

L	T	P	Credits
0	0	3	1.5

COURSE OUTCOMES: After studying the course, Student will be able to:

CO1: Applythe KVL, KCL, Mesh and Nodal analysis for the electrical circuits.
CO2: Apply the different Network theorems for the electrical circuits.
CO3: Evaluate the parameters of RL, RC and RLC circuits under different damping conditions.
CO4: Analyze the frequency response RL, RC and RLC circuits to find f_O, Bandwidth and Q-factor.
CO5: Evaluate the Z, Y, Transmission and Hybrid parameters of two port network.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
1	Apply	The KVL, KCL, Mesh and Nodal analysis for the electrical circuits			L3
2	Apply	The different Network theorems for the electrical circuits			L3
3	Evaluate	The parameters of RL, RC and RLC circuits	under different damping conditions		L5
4	Analyze	the frequency response RL, RC and RLC circuits		to find fO, Bandwidth and Q-factor	L4
5	Evaluate	the Z, Y, Transmission and Hybrid parameters of two port network			L5

SYLLABUS:

List of Experiments:

Any 10 of the following experiments are to be conducted in Hardware & Simulation (Multisim/Open source software):

1. Verification of Kirchhoff's Laws-(CO1).
2. Apply Mesh & Nodal Analysis techniques for solving electrical circuits (problems with dependent sources also)-(CO1).
3. Verification of Superposition & Reciprocity Theorem-(CO2).
4. Verification of Thevenin's and Norton's Theorem-(CO2).
5. Verification of Maximum Power Transfer Theorem-(CO2).
6. Measure and calculate RC time constant for a given RC circuit-(CO3).
7. Measure and calculate RL time constant for a given RL circuit-(CO3).
8. Measure and analyze (settling time, overshoot, undershoot, etc.) step response of for a given series RLC circuit for following cases :-(CO3).
    a. =1 (critically damped system)
    b. >1(over damped system)
    c. <1 (under damped system)
9. Choose appropriate values of R, L, and C to obtain each of above cases one at a time-(CO4).
10. Design a series RLC resonance circuit. Plot frequency response and find resonance frequency, Bandwidth, Q – factor-(CO4).
11. Design a parallel RLC resonance circuit. Plot frequency response and find resonance frequency, Bandwidth, Q – factor-(CO4).
12. Measure and calculate Z, Y parameters of two-port network-(CO5).
13. Measure and calculate ABCD & h parameters of two-port network-(CO5).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year-Semester: I-II
Branch of Study: ECE

Mapping of course outcomes with program outcomes.

CourseTitle	COs	ProgrammeOutcomes(POs)&ProgrammeSpecificOutcomes(PSOs)												
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
NETWORK THEORY LABORATORY	CO1	3	2		2					2				2	
	CO2	3	2		2					2				2	
	CO3	3	3		2					3				3	
	CO4	3	3		3					3				3	
	CO5	3	3		2					3				3	

Justification Table:

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Apply	L3	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Analyze(L4) PO9: Thumb Rule	3 2 2 2
2	Apply	L3	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Analyze(L4) PO9: Thumb Rule	3 2 2 2
3	Evaluate	L5	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Design (L6) PO9: Thumb Rule	3 3 2 3
4	Analyze	L4	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Analyze(L4) PO9: Thumb Rule	3 3 3 3
5	Evaluate	L5	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Design (L6) PO9: Thumb Rule	3 3 2 3

CO1: Apply the KVL, KCL, Mesh and Nodal analysis for the electrical circuits.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO1 Action Verb is same as PO1 verb; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO1 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO1 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).
PO9: Using Thumb Rule, CO1 correlates to PO6 as moderate (2).
CO2: Apply the different Network theorems for the electrical circuits.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action Verb is same as PO1 verb; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO2 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).

PO9: Using Thumb Rule, CO1 correlates to PO6 as moderate (2).

CO3: Evaluate the parameters of RL, RC and RLC circuits under different damping conditions.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO3 Action Verb is Greater than PO1 verb by two level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO3 Action Verb is Greater than PO2 verb by one level; Therefore, correlation is high (3).
PO4: Design (L6)
CO3 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).
PO9: Using Thumb Rule, 3 correlates to PO6 as high (3).

CO4: Analyze the frequency response RL, RC and RLC circuits to find f_o, Bandwidth and Q-factor.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO4 Action Verb is Greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO4 Action Verb is same as PO2 verb; Therefore, correlation is high (3).
PO4: Analyze (L4)
CO3 Action Verb is same as PO4 verb; Therefore, correlation is high (3).
PO9: Using Thumb Rule, 3 correlates to PO6 as high (3).

CO5: Evaluate the Z, Y, Transmission and Hybrid parameters of two port network.
Action Verb: Evaluate (L5)
PO1: Apply (L3)
CO5 Action Verb is Greater than PO1 verb by two level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO5 Action Verb is Greater than PO2 verb by one level; Therefore, correlation is high (3).
PO4: Design (L6)
CO5 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).
PO9: Using Thumb Rule, CO5 correlates to PO6 as high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY & SCIENCES: TIRUPATI

(Autonomous)

I.B.Tech **AK20 Regulations**

Common to I Sem – CSE, CIC, II Sem ECE/EEE

Subject Code 20ABS9909	Subject Name CHEMISTRY LAB	L T P 0 0 3	Credits:1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the hardness of ground water sample.
CO2: Apply the internal and external indicators in volumetric analysis.
CO3: Analyze the preparation and applications of advanced polymer materials.
CO4: Apply the electro analytical technique to measure the strength of acids.
CO5: Analyze the mixture of components by chromatographic techniques.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	The Hardness of ground water sample.			**L4**
2	Apply	The internal and external indicators		In volumetric analysis	**L3**
3	Analyze	The preparation and applications advanced polymer materials			**L4**
4	Apply	The electro analytical technique to measure the strength of acids			**L3**
5	Analyze	The Mixture of components	By chromatographic techniques		**L4**

List of Experiments:

1. Determination of Hardness of a groundwater sample. (CO1)
2. Estimation of iron (II) using Diphenylamine indicator (Dichrometry – Internal indicator method) (CO2)
3. Determination of pH metric titration of strong acid vs. strong base (CO4)
4. Conductometric titration of strong acid vs. strong base (CO4)
5. Determination of Fe (II) in Mohr's salt by potentiometric method. (CO4)
6. Determination of percentage of Iron in Cement sample by colorimetry
7. Determination of Strength of an acid in Pb-Acid battery (CO2)
8. Preparation of phenol-formaldehyde resin (CO3)
9. Preparation of TIO_2/ZnO nano particles (Precipitation Method) (CO3)
10. Estimation of Calcium in port land Cement (CO2)
11. Adsorption of acetic acid by charcoal (CO2)
12. Thin layer chromatography (CO5)

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.

Reference:

- "Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition" Pearson Publicationsby J. Mendham, R.C.Denney, J.D.Barnes and B. Sivasankar

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1				3										
2				3										
3				3										
4				3										
5				3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Analyze	**L4**	PO4	PO4: Analyze (L4)	3
2				Apply	**L3**	PO4	PO4: Analyze (L3)	2
3				Analyze	**L4**	PO4	PO4: Analyze (L4)	3
4				Apply	**L3**	PO4	PO4: Analyze (L3)	2
5				Analyze	**L4**	PO4	PO4: Analyze (L4)	3

CO1: Analyze the hardness of ground water sample.

Action Verb: Analyze **(L4)**

PO4 Verb: Analyze (L4)

CO1 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO2: Apply the internal and external indicators in volumetric analysis.

Action Verb: Apply **(L3)**

PO4 Verb: Analyze (L3)

CO2 Action Verb is less than PO4 verb; therefore, correlation is less (2)

CO3: Analyze the preparation and applications of advanced polymer materials.

Action Verb: Analyze **(L4)**

PO4 Verb: Analyze (L4)

CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO4: Apply electro analytical technique to measure the strength of acids.

Action Verb: Apply **(L3)**

PO4 Verb: Analyze (L4)

CO4 Action Verb is less than PO4 verb; therefore, correlation is less (2)

CO5: Analyze mixture of components by chromatographic techniques.

Action Verb: Analyze **(L4)**

PO4 Verb: Analyze (L4)

CO5 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Data Structures Lab	L	T	P	C
20AES0504	I-II		0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO 1: Apply the sorting and searching algorithms using suitable data structure

CO 2: Design the algorithms to solve real time problems using Linked lists

CO 3: Design the solutions for computational problems using stacks and queues

CO 4: Evaluate the operations of breadth first search using queues

CO 5:Designthe algorithms to perform operations on trees and graphs

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Apply**	sorting and searching algorithm	using suitable data structure		L3
CO2	**Design**	the algorithms	using Linked lists	To solve real time problems	L6
CO3	**Design**	the solutions for computational problems	using stacks and queues		L6
CO4	**Evaluate**	the operations of breadth first search	using queues		L5
CO5	**Design**	the algorithms		to perform operations on trees and graphs	L6

List of Experiments

1. String operations using array of pointers**(CO1)**
2. Searching Algorithms (With the Number of Key Comparisons) Sequential, Binary and Fibonacci Search Algorithms.**(CO1)**
3. Sorting Algorithms: Insertion Sort, Selection Sort, Shell Sort, Bubble Sort, Quick Sort, Heap Sort, Merge Sort, and Radix Sort. Using the system clock, compute the time taken for sorting of elements. The time for other operations like I/O etc should not be considered while computing time.**(CO1)**
4. Implementation of Singly Linked List, Doubly Linked List, Circular Linked List**(CO2)**
5. Stack implementation using arrays**(CO3)**
6. Stack implementation using linked lists**(CO3)**
7. Queue implementation using arrays. Implement different forms of queue. While implementing youshould be able to store elements equal to the size of the queue. No positions should be left blank.**(CO3)**
8. Queue implementation using linked lists**(CO3)**
9. Creation of binary search tree, performing operations insertion, deletion, and traversal.**(CO4)**
10. Breadth first search**(CO4)**
11. Depth first search**(CO4)**
12. Travelling sales man problem**(CO4)**
13. File operations**(CO4)**
14. Indexing of a file**(CO4)**
15. Reversing the links (not just displaying) of a linked list.**(CO4)**
16. Consider a linked list consisting of name of a person and gender as a node. Arrange the linked list using 'Ladies first' principle. You may create new linked lists if necessary.**(CO5)**
17. An expression can be represented in three ways: infix, prefix and postfix. All the forms are necessary in different contexts. Write modules to convert from one form to another form.**(CO5)**
18. A table can be defined as a collection of rows and columns. Each row and column may have a label. Different values are stored in the cells of the table. The values can be of different data types. Numerical operations like summation, average etc can be performed on rows/columns which contain numerical data. Such operations are to be prevented on data which is not numeric. User may like to insert row/columns in the already existing table. User may like to remove row/column. Create table data type and support different operations on it.**(CO5)**

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**	**3**		**3**								**2**	
CO2	**3**	**3**	**3**	**3**	**3**							**3**	**2**	**1**
CO3	**3**	**3**	**3**	**3**	**3**							**3**	**2**	**1**
CO4	**3**	**3**	**2**	**3**	**2**		**3**					**3**	**2**	**2**
CO5	**3**	**3**	**3**	**3**	**3**							**3**	**2**	**2**

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO12)	Level of Correlation (0-3)
1	CO1: Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review(L2)	3
			PO3	PO3:Develop (L3)	3
			PO5	PO5:Apply(L3)	3
2	CO2: Design	L6	PO1	PO1: Apply(L3)	3
			PO2	PO2: Develop (L3)	3
			PO3	PO3: Design (L6)	3
			PO4	PO4: Design (L6)	3
			PO5	PO5:Create(L6)	3
			PO12	PO12: Thumb rule	3
3	CO3: Design	L6	PO1	PO1: Apply(L3)	3
			PO2	PO2: Develop (L3)	3
			PO3	PO3: Design (L6)	3
			PO4	PO4: Design (L6)	3
			PO5	PO5:Create(L6)	3
			PO12	PO12: Thumb rule	3
4	CO4: Evaluate	L5	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review (L2)	3
			PO3	PO3: Design (L6)	3
			PO4	PO4: Analysis(L4)	2
			PO5	PO5:Create(L6)	2
			PO7	PO7: Thumb rule	3
			PO12	PO12: Thumb rule	3
5	CO5: Design	L6	PO1	PO1: Apply(L3)	3
			PO2	PO2: Review(L2)	3
			PO3	PO3: Design(L6)	3
			PO4	PO4: Analysis(L4)	3
			PO5	PO5:Create(L6)	3
			PO12	PO12: Thumb rule	3

Justification Statements :

CO1: Apply the sorting and searching algorithms using suitable data structure
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action verb is same as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: Review(L2)
CO1 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Develop(L3)
CO1 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: Apply (L3)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)

CO2: Design the algorithms to solve real time problems using Linked lists
Action Verb: Design (L6)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop (L6)
CO2 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Design(L3)
CO2 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Design (L6)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

CO3: Design the solutions for computational problems using stacks and queues
Action Verb: Design (L6)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Develop (L3)

CO3 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: Design(L6)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Design (L6)
CO3 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Data Structure applications, stacks concepts are used to manage data in the memory. Therefore, the correlation is high (3)

CO4: Evaluate the operations of breadth first search using queues

Action Verb: Evaluate (L5)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is less than PO3 verb by one level. Therefore, the correlation is medium (2)
PO4: Analysis (L4)
CO4 Action verb is greater than PO4 verb by one level. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO4 Action verb is greater than PO5 verb. Therefore, the correlation is medium (2)
PO7: Thumb rule
For some of Real Time problems Data Structure applications, queues concept is indirectly used to sustainable environment development. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of Real Time problems Data Structure applications, queues concepts are used to write programs and evaluation the memory operations. Therefore, the correlation is high (3)

CO5:Designthe algorithms to perform operations on trees and graphs

Action Verb: Design (L6)
PO1: Apply(L3)
CO5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO4: Analysis (L4)
CO5 Action verb is greater than PO4 verb. Therefore, the correlation is high (3)
PO5 Verb: Create(L6)
CO1 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO12: Thumb rule
For some of data manipulations tree and graphs concepts are used to solve data storage problems. Therefore, the correlation is high (3)

Year: I B.Tech **(Common to all branches)** Semester: II

Subject Code **20AMC9902**	Subject Name **CONSTITUTION OF INDIA**	L T P 3 0 0	Credit: 0

Course Outcomes (CO): After studying the course, Student will be able to:

1. Understand the historical background of the Constitution making and its importance for building a democratic India.
2. Remember the basic features of Indian Constitution
3. Understand the fundamental rights and duties for becoming a good citizen of India.
4. Understand the Powers and functions of Governor, President, and Judiciary.
5. Understand the functions of local administration bodies.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the historical background of the Constitution making and its importance	for building a democratic India.		**L2**
2	**Remember**	the basic features of Indian Constitution			**L1**
3	**Understand**	the fundamental rights and duties	for becoming a good citizen of India.		**L2**
4	**Understand**	the Powers and functions	of Governor, President, and Judiciary.		**L2**
5	**Understand**	the functions of local administration bodies			**L2**

Unit:1

History of Making of the Indian Constitution - History Drafting Committee, (Composition & Working)

Unit:2

Philosophy of the Indian Constitution - Preamble Salient Features

Unit:3

Contours of Constitutional Rights & Duties - Fundamental Rights - Right to Equality - Right to Freedom - Right against Exploitation - Right to Freedom of Religion - Cultural and Educational Rights - Right to Constitutional Remedies - Directive Principles of State Policy - Fundamental Duties.

Unit:4

Organs of Governance - Parliament – Composition - Qualifications and Disqualifications - Powers and Functions **-** Executive, President, Governor **-** Council of Ministers **-**Judiciary, Appointment and Transfer of Judges, Qualifications - Powers and Functions.

Unit:5

Local Administration - District's Administration head: Role and Importance - Municipalities: Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation - Panchayati raj: Introduction, PRI: Zilla Panchayat - Elected officials and their roles, CEO Zilla Panchayat: Position and role - Block level: Organizational Hierarchy (Different departments) - Village level: Role of Elected and Appointed officials - Importance of grass root democracy.

Suggested books for reading:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis, 2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis, 2015.

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	**4**	14	2	**Understand**	**L2**	PO6, PO12	Thumb Rule Thumb Rule	2 2
2	**4**	14	1	**Remember**	**L1**	PO6, PO7	Thumb Rule Thumb Rule	1 1
3	**8**	**26**	**2**	**Understand**	**L2**	PO8, PO12	Thumb Rule Thumb Rule	2 2
4	**8**	**26**	**2**	**Understand**	**L2**	PO6, PO12	Thumb Rule Thumb Rule	2 2
5	**6**	**20**	**2**	**Understand**	**L2**	PO6, PO12	Thumb Rule Thumb Rule	2 2
	30							

CO1: Understand the historical background of the Constitution making and its importance for building a democratic India.
Action Verb: Understand (L2)
CO1 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO2: Remember the basic features of Indian Constitution
Action Verb: Remember (L1)
CO2 Action Verb is Remember of BTL 1. Using Thumb rule, L1 correlates PO6 to PO12 as low (1).

CO3: Understand the fundamental rights and duties for becoming a good citizen of India.
Action Verb: Understand (L2)
CO3 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO4: Understand the Powers and functions of Governor, President, and Judiciary.
Action Verb: Understand (L2)

CO4 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).
CO5: Understand the functions of local administration bodies.
Action Verb: Understand (L2)
CO5 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

III Semester (B.Tech –II year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	BSC	20ABS9912	Transform Techniques and Complex Variables	3	0	0	3	30	70	100
2	PCC	20APC0401	Electronic Devices and Circuits	3	0	0	3	30	70	100
3	PCC	20APC0402	Switching Theory and Logic Design	3	0	0	3	30	70	100
4	PCC	20APC0403	Signals and Systems	3	0	0	3	30	70	100
5	HSMC	20AHSMB01	Managerial Economics and Financial Analysis	3	0	0	3	30	70	100
6	PCC	20APC0404	Electronic Devices and Circuits Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0405	Signals and Systems Laboratory	0	0	3	1.5	30	70	100
8	PCC	20APC0406	Switching Theory and Logic Design Laboratory	0	0	3	1.5	30	70	100
9	SOC	20ASC0401	Electronic Circuit Design	1	0	2	2	100	-	100
10	MC	20AMC9901	Biology for Engineers	3	0	0	0	30		30
TOTAL							**21.5**	**370**	**560**	**930**

AK 20 Regulations

Year: II **Semester**: I **Branch of Study:ECE, EEE**

Subject Code:20ABS9912	**Subject Name: Transform Techniques and Complex Variables**	**L T P** **3 0 0**	**Credits** **3**	**CLC** **2**

Course Outcomes (CO): After studying the course, Student will be able to:

1.Applythe Laplace transform techniques for solving differential equations.
2. Evaluate the Fourier series of periodic signals and half range series.
3. Apply the Fourier series and Fourier transforms for continuous functions.
4. Apply the Z -transform techniques for solving discrete functions.
5. Analyze the differentiation and integration of complex functions used in engineering fields.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	Laplace Transform techniques	for solving differential equations.		**L3**
2	Evaluate	Fourier series of periodic signals and half range series.			**L5**
3	Apply	theFourier series and Fourier transforms for continuous functions.			**L3**
4	Apply	theZ-Transform techniques for discrete time functions.			**L3**
5	Analyze	the concept of differentiation and integration	Complex functions		**L4**

Unit I : Laplace transforms **9 hrs**

Definition of Laplace transform, existence conditions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, transforms of integrals, multiplication by t^n, division by t, convolution theorem, periodic functions, unit step function, unit impulse function, applications to ordinary differential equations. (Without proofs)

Unit II: Fourier series **9 hrs**

Dirichlet's conditions, Fourier series, conditions for a Fourier expansion, functions of any period, odd and even functions - half range series.

Unit III: Fourier transforms **10 hrs**

Fourier integrals, Fourier cosine and sine integrals, Fourier transform, sine and cosine transform, properties, convolution theorem

Unit IV: Z-Transforms **8 hrs**

Definition of Z-transform, elementary properties, linearity property, damping rule, shifting u_n to the right and left, multiplication by n, initial value theorem, final value theorem, inverse Z-transform, convolution theorem, formation of difference equations, solution of difference equations using Z-transforms.

Unit V : Complex Variables **9 hrs**

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate. Complex integration, Cauchy theorem (without proof), Cauchy integral formula (without proof), Taylor's series, zeros of analytic functions, singularities, Laurent's series, residues, Cauchy residue theorem (without proof).

Textbooks:

1. B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 43/e, 2010.
2. Erwin kreyszig, Advanced Engineering Mathematics, 9/e, John Wiley & Sons, 2006.

References:

1. Dr.T.K.VIyengar, B.Krishna Gandhi, S. Ranganatham and M.V.S.S.N Prasad, Mathematics – II, S.Chand publications.
2. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9/e, Wiley India, 2009.
3. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India,1995.
4. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-Graw Hill, 2004.
5. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1	3											
2		3										
3	3											
4		2										
5		3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	**16**	21	3	**Apply**	**L3**	PO1	**Apply (L3)**	3
2	**17**	22	3	**Evaluate**	**L5**	PO2	**Analyze (L4)**	3
3	**16**	21	**3**	**Apply**	**L3**	PO1	**Apply(L3)**	3
4	**11**	14	**2**	**Apply**	**L3**	PO2	**Analyze (L4)**	2
5	**16**	21	**3**	**Analyze**	**L4**	PO2	**Analyze (L4)**	3

CO1: Applythe Laplace transform techniques for solving differential equations.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action Verb is equalto PO1 verb; Therefore correlation is high (3).

CO2: Evaluate the Fourier series of periodic signalsand half range series.
Action Verb:Evaluate (L5)
PO2 Verb: Analyze (L4)
CO2 Action Verb is high level to PO2 verb; Therefore correlation is high (3).

CO3: Apply the Fourier series and Fourier transforms for continuous functions.

Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO3 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO4: Apply the Z -transform techniques for solving discrete functions.

Action Verb: Apply (L3)
PO1 Verb: **Analyze (L4)**)
CO4 Action Verb is low level to PO1 verb by one level; Therefore correlation is moderate (2).

CO5: Analyze the differentiation and integration of complex functions used in engineering fields.
Action Verb: Analyze(L4)
PO2 Verb: Analyze (L4)
CO5 Action verb is same level to PO2 verb; therefore the correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	ELECTRONIC DEVICES AND CIRCUITS	L	T	P	C
20APC0401	II-I	**(COMMON TO ECE AND EEE)**	**3**	**0**	**0**	**3**

Course Outcomes: After studying the course, Student will be able to:

CO1 **Understand** the characteristics of PN junction diode and special electronic devices.

CO2 **Analyze** the construction and operation of three rectifiers using without and with filters.

CO3 **Evaluate** the transistor parameters from its characteristics in three configurations.

CO4 **Understand** transistor biasing methods and thermal stabilization concepts.

CO5 **Analyze** the transistor amplifier using h-parameter models for three configurations.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The characteristics of PN junction diode and special electronic devices			L2
CO2	Analyze	The construction and operation of three rectifiers	Using without and with filters		L4
CO3	Evaluate	The transistor parameters from it's characteristics	in three configurations		L5
CO4	Understand	The transistor biasing methods and thermal stabilization concepts.			L2
CO5	Analyze	The transistor amplifiers	Using h- parameter models	For three configurations	L4

UNIT - I		15Hrs
PN JUNCTION DIODE & SPECIAL DIODE CHARACTERISTICS **Review of semiconductor Physics:** Intrinsic & Extrinsic Semiconductors and their Fermi Levels, Open circuited p-n junction, Biased p-n junction, Current components in PN junction Diode, Diode Equation, V-I characteristics of p-n junction diode, Temperature dependence on V-I characteristics, Diode resistance,Diode capacitance. **Special Electronic Devices:** Construction, Operation, V-I Characteristics of Zener diode, Breakdown mechanisms, Zener diode applications, Varactor diode, Tunnel diode, SCR, UJT.		
UNIT - II		17Hrs
RECTIFIERS & FILTERS **Rectifiers:** Introduction to DC Power supply , Half Wave Rectifier, Full Wave Rectifier, Bridge Rectifier,derivations of rectifier parameters , Rectifier circuits-Operation, Input and Output waveforms. **Filters:** Capacitor filter, Inductor filter, L-section filter, π-section filter, Multiple L-section and Multiple π section filter, comparison of various filter circuits in terms of ripple factors.		
UNIT - III		15Hrs
TRANSISTOR CHARACTERISTICS **BJT:** Bi-polar Junction Transistor, Transistor current components, Transistor as an amplifier, Transistor equation, Transistor configurations, Input- Output Characteristics of Transistor in Common Base, Common Emitter and Common Collector configurations, Punch through-Reach through, Photo transistor, Typical transistor junction voltage values. **FET:** BJT Versus FET, Junction Field Effect Transistor JFET Types, Construction, Operation, parameters, Drain and Transfer characteristics, MOSFET Types -Enhancement and Depletion Types-Construction, Operation, Characteristics..		
UNIT - IV		14Hrs
TRANSISTOR BIASING & THERMAL STABILIZATION Need for biasing, operating point, Load line analysis, BJT biasing-Methods, Basic stability Fixed bias, Collector to base bias, Self-bias, Stabilization against variations in V_{BE}, I_C, and β, stability factors, (S', S'', S'''), Bias compensation, Thermal runaway, Thermal stability.		
UNIT - V		15Hrs
SMALL SIGNAL LOW FREQUENCY TRANSISTOR AMPLIFIER MODELS **BJT**: Two port network, Transistor hybrid model, determination of h-parameters, generalized analysis of transistor amplifier model using h-parameters, analysis of CB, CE and CC amplifiers using exact analysis, approximate hybrid model, analysis of CB, CE and CC amplifiers using approximate hybrid model, Comparison of transistor amplifiers. **FET**: Generalized analysis of small signal model, analysis of CG, CS and CD amplifiers, comparison ofFET amplifiers		

Textbooks:

1. David A. Bell, "Electronic Devices and Circuits", 5th Edition, Oxford University Press, 2015.
2. Thomas L. Floyd, "Electronic Devices", 9th Edition, Pearson Education, 2013

3. Robert L. Boylestad and Louis Nashelsky, "Electronic Devices & Circuit Theory", 11th Edition,Pearson Education, 2013.

Reference Books:

1.Donald Neamen, "Electronic Circuits: Analysis and Design", 3rd Edition, McGraw-Hill Education,2011.
2.Muhammad Rashid, "Microelectronic Circuits: Analysis & Design", 2nd Edition, Cengage Learning,2010.
3.S. Salivahanan, N. Suresh Kumar, "Electronic Devices and Circuits", 4th Edition, McGraw-HillEducation, 2017

Online Learning Resources:

nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	
CO2	3	3	3	3									3	
CO3	3	3	3										3	
CO4	2	2	2	1									2	
CO5	3	3	3	3									3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	20	2	Understand	L2	PO1, PO2	PO1: Apply (L3) PO2: Review(L2)	2 3
2	17	22	3	Analyze	L4	PO1, PO2, PO3, PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L3)	3 3 3 3
3	15	20	2	Evaluate	L5	PO1, PO2, PO3	PO1:Apply(L3) PO2:Identify(L3) PO3:Develop(L3)	3 3 3
4	14	18	2	Understand	L2	PO1, PO2, PO3, PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4)	2 2 2 1
5	15	20	2	Analyze	L4	PO1, PO2, PO3, PO4	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze(L4)	3 3 3 3
	73	100%						

Justification Statements :

CO 1: Understand the characteristics of PN junction diode and special electronic devices.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Review (L2)
CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
.**CO2: Analyze the construction, operations of three rectifiers without and with filters.**
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Identify (L3)
CO2 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verbs: Develop (L3)
CO2 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
CO3: Evaluate the transistor parameters from it's characteristics in three configurations
Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3)
CO3 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)
CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)
CO3 Action Verb is greater thanPO3verb; Therefore correlation is high (3).
CO4: Understand transistor biasing methods and thermal stabilization concepts.

Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb; Therefore correlation is moderate(2).
PO2 Verb: Identify (L3)
CO4 Action Verb is less than PO2 verb; Therefore correlation is moderate(2).
PO3 Verb: Develop (L3)
CO4 Action Verb is less than PO3 verb; Therefore correlation is moderate(2)
PO4 Verb: Analyze (L4)
CO4 Action Verb is less than PO4 verb; Therefore correlation is low (1).

CO5: Analyze the transistor amplifier using h-parameter models for three configurations.
Action Verb: (L4)
PO1 Verb: Apply (L3)
CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).
PO2 verb: Identify (L3)
CO5 Action verb is greater than PO2 verb therefore the correlation is high (3).
PO3 verb: Develop (L3)
CO5 Action verb is greater than PO3 verb therefore the correlation is high (3).
PO4 verb: Analyze (L4)
CO5 Action verb is equal to PO4 verb therefore the correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	SWITCHING THEORY AND LOGIC DESIGN	L	T	P	C
20APC0402	II-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1 **Understand** the fundamentals of number systems, Boolean algebra and Logic Gates

CO2 **Apply** the minimization techniques to boolean expressions using K-Map and Tabulation Methods

CO3 **Analyze** the design procedure of combinational logic circuits by using Logic gates

CO4 **Analyze** the design procedure of sequential logic circuits by using Flip-Flops

CO5 **Analyze** the semiconductor memories and realization of Programmable Logic Devices.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of number systems, Boolean algebra and Logic Gates			L2
CO2	Apply	the minimization techniques to boolean expressions		using K-Map and Tabulation Methods	L3
CO3	Analyze	The design procedure of combinational logic circuits	Using Logic gates		L4
CO4	Analyze	The design procedure of sequential logic circuits	Using Flipflops		L4
CO5	Analyze	The semiconductor memory concepts and realization of Programmable Logic Devices.			L4

UNIT - I		19Hrs

NUMBER SYSTEM AND BOOLEAN ALGEBRA

Number System: Digital Systems, Binary Numbers, Number base conversions, complements of numbers,Signed binary numbers, Binary codes.
Boolean Algebra: Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, other logic operations & Logic gates.

UNIT - II		11Hrs

GATE LEVEL MINIMIZATION

The map method, four variable & Five variable K-map, POS & SOP Simplification, don't care conditions, NAND & NOR Implementation, Other two-level Implementation, Ex-or Function.Tabular Method- Simplification of Boolean function using tabulation Method.

UNIT - III		9Hrs

COMBINATIONAL LOGIC CIRCUITS

Combinational circuits, Analysis & Design procedure, Binary Adder-Subtractor, Decimal Adder, BinaryMultiplier, Magnitude comparator, Decoder, Encoders, Multiplexers.

UNIT - IV		16Hrs

SEQUENTIAL LOGIC CIRCUITS

Sequential Circuits: Latches, Flips-Flops - RS, JK, Master-Slave JK, D & T flip flops, Analysis of Clocked sequential circuits, State Reduction & Assignment, Design procedure, Registers & Counters – Registers, Shift Registers, Ripple Counters, Synchronous counters, asynchronous counters.
Asynchronous sequential circuits: Introduction, Analysis Procedure, Design Procedure, Reduction of State flow tables, Race-free State Assignment, Hazards.

UNIT - V		12Hrs

PROGRAMMABLE DEVICES:

Memory organization, classification of semiconductor memories, ROM, PROM, DROM, EPROM, EEPROM, RAM, expansion of memory, CCD, Flash memories, content addressable memory, programmable logic devices, PROM at PLD, programmable logic array (PLA) programmable array logic (PAL), field programmable gate array (FPGA).

Textbooks:

1. M.Morris Mano & Michel D. Ciletti,"Digital Design", 5th Edition Pearson.
2. Zvi Kohavi and Nirah K.Jha, "Switching theory and Finite Automata Theory", 3rd EditionCambridge.

Reference Books:

1. Subratha Goshal, "Digital Electronics", Cambridge
2. Comer, "Digital & State Machine Design", Third Indian edition, OXFORD

Online Learning Resources:

nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											2	
CO2	3	3											3	
CO3	3	3	3	3								1	3	
CO4	3	3	3	3								1	3	
CO5	3	3	3									1	3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	19	29	3	Understand	L2	PO1, PO2,	PO1 : Apply (L3) PO2 : Identify (L3)	2 2
2	11	17	1	Apply	L3	PO1, PO2,	PO1 : Apply (L3) PO2 : Identify (L3)	3 3
3	09	13	2	Analyze	L4	PO1, PO2, PO3, PO4,PO12	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4) PO12: Thumb rule	3 3 3 3 1
4	16	23	3	Analyze	L4	PO1, PO2, PO3, PO4,PO12	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4) PO12: Thumb rule	3 3 3 3 1
5	12	18	2	Analyze	L4	PO1, PO2, PO3, PO12	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO12: Thumb rule	3 3 3 1
	67	100%						

Justification statements:

CO1: Understand the fundamentals of number systems, Boolean algebra and Logic Gates
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Identify (L3)
CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO2: Apply the minimization techniques to Boolean expressions using K-Map and Tabulation Methods
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Identify (L3)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO3: Analyze the combinational logic circuits design procedure by using Logic gates
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action Verb level is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)
CO3 Action Verb level is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)
CO3 Action Verb is equal to PO3 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4)
CO3 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
PO 12: CO3 Using Thumb rule, L4 correlates PO12 as low(1).

CO4: Analyze the sequential logic circuits design procedure by using Flip-Flops
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO4 Action Verb level is greater than PO2 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)
CO4 Action Verb level is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)
CO4 Action Verb is equal to PO3 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4)
CO4 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
PO 12: CO4 Using Thumb rule, L4 correlates PO12 as low(1).

CO5: Analyze the semiconductor memories and realization of Programmable Logic Devices.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO5 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)
CO5 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 verb: Develop (L3)
CO5 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO 12:CO5 Using Thumb rule, L4 correlates PO12 as low(1).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	SIGNALS AND SYSTEMS	L	T	P	C
20APC0403	II-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1 **Understand** the representation of continuous time and discrete time signals

CO2 **Analyze** the signals in frequency domain using Fourier series and Fourier Transforms

CO3 **Apply** the Sampling theorem to convert continuous time signals into discrete time signals

CO4 **Analyze** the properties of systems and characteristics of LTI systems

CO5 **Evaluate** Continuous Time and Discrete Time LTI systems by using Laplace and Z-Transforms.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the representation of continuous time and discrete time signals			L2
CO2	Analyze	the signals in frequency domain		Fourier series and Fourier Transforms	L4
CO3	Apply	To convert continuous time signals into discrete time signals	Sampling theorem		L3
CO4	Analyze	the properties of systems and characteristics of LTI systems			L4
CO5	Evaluate	Continuous Time and Discrete Time LTI systems by using		Laplace and Z-Transforms	L5

UNIT - I		21Hrs
SIGNALS Introduction: Definition of Signals, classification of signals: continuous time and discrete time signals, standard signals: impulse function, step function, ramp function complex exponential and sinusoidal signals, Signum, Sinc and Gaussian functions. Operations on signals and sequences. Analogy between vectors and signals, orthogonal signal space, Signal approximation using orthogonal functions, mean square error, Orthogonality of complex functions .		
UNIT - II		16Hrs
FOURIER SERIES AND FOURIER TRANSFORMS Fourier series: Representation of signals using Fourier Series, Trigonometric Fourier series (TFS) and complex exponential Fourier series (CEFS). Illustrative problems. Continuous Time Fourier Transform, definition, properties, Fourier Transforms of standard signals, complex Fourier spectrum, inverse Fourier Transform. Discrete Time Fourier Transform, definition, properties of Discrete Time Fourier Transform transforms of standard signals. Introduction to Hilbert Transform. Illustrative problems.		
UNIT - III		12Hrs
SAMPLING THEOREM Definition of sampling, types: impulse and pulse sampling. Sampling theorem for band limited signals-Graphical and analytical proof, Nyquist criterion, Reconstruction of signal from its samples, effect of under sampling – Aliasing. Sampling theorem for Band pass signals. Illustrative problems.		
UNIT - IV		12Hrs
SYSTEMS Definition of Systems, Classification of Systems, impulse response, response of a Linear Time Invariant system, Convolution and Correlation: time domain, frequency domain and Graphical representation. Transfer function of a LTI system. Filter characteristics of linear systems. Distortion less transmission through a system, signal bandwidth, system bandwidth, Ideal LPF, HPF and BPF characteristics, Causality and Poly-Wiener criterion for physical realization, relationship between bandwidth and rise time. Illustrative problems.		
UNIT - V		20Hrs

LAPLACE TRANSFORMS & Z TRANSFORMS

Laplace Transforms: Review of Laplace Transforms, concept of Region of Convergence (ROC) for Laplace Transforms, Inverse Laplace Transform, constraints on ROC for various classes of signals, properties of Laplace Transforms. Analysis of CT-LTI systems using Laplace Transforms: causality and stability.

Z-Transforms: Review of Z-Transforms, concept of Region of Convergence (ROC) for Z- Transforms, Inverse Z-Transform, constraints on ROC for various classes of signals, properties of Z-Transforms. Analysis of DT-LTI systems using Z- Transforms: causality and stability. Illustrative problems.

Textbooks:

1. B.P. Lathi, Signals, Systems & Communications, BS Publications, 2003.
2. A.V. Obppenheim, A.S. Willsky and S.H. Nawab, Signals and Systems PHI, 2nd Edition.2009

Reference Books:

1. Simon Haykin and Van Veen, Signals & Systems, Wiley, 2nd Edition.
2. John G.Proakis, Dimitris G. Manolakis, Digital Signal Processing,Principles,Algorithms, and Applications, 4 th Edition, PHI, 2007
3. BP Lathi, Principles of Linear Systems and Signals Oxford University Press, 2015.

Online Learning Resources:

nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	
CO2	3	3		3									1	
CO3	3	3											2	
CO4	3	3		3									2	
CO5	3	3		3									2	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	21	28%	3	Understand	L2	PO1, PO2,	PO1: Apply (L3) PO2: Review(L2)	2 3
2	16	21%	3	Analyze	L4	PO1,PO2,PO4	PO1: Apply (L3) PO2: Identify (L3) PO4:Analyze(L4)	3 3 3
3	12	16%	2	Apply	L3	PO1,PO2,PO12	PO1:Apply(L3) PO2:Identify(L4)	3 3
4	12	16%	2	Analyze	L4	PO1, PO2,PO4	PO1:Apply(L3) PO2:Identify(L3) PO4:Analyze(L4)	3 3 3
5	20	20%	2	Evaluate	L5	PO1,PO2,PO4	PO1:Apply(L3) PO2:Review(L2) PO4:Analyze(L4)	3 3 3
	75	100%						

Justification Statements :

CO1: Understand the representation of continuous time and discrete time signals
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Develop (L3)
CO1 Action Verb is less than PO3 verb by one level; therefore correlation is moderate (2).
CO2: 2.Analyze the signals in frequency domain using Fourier series and Fourier Transforms
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Review (L2)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO4 Verb: Analysis (L4)
CO2 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).
CO3 Apply the Sampling theorem to convert continuous time signals into discrete time signals
Action Verb: Apply(L3)
PO1 Verbs: Apply (L3)
CO3 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).
CO4: Analyze the properties of systems and characteristics of LTI systems
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO4 Action Verb is greater to PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Identify (L2)
CO4 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4)
CO4 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).
CO5: Evaluate Continuous Time and Discrete Time LTI systems by using Laplace and Z-Transforms.
Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater to PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Identify (L2)
CO5 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4)
CO5 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).

Course Code	MANAGERIAL ECONOMICS AND FINANCIAL ANALYSIS	L	T	P	C
20AHSMB01		3	0	0	3

B.Tech II-I sem **(Common to All branches of Engineering)**

Course Outcomes(CO): After studying the course, Student will be able to:

CO1: Understand the fundamentals of managerial economics and demand concept.
CO2: Understand theproduction and cost concepts to optimize the output
CO3: Analyze the price output relationship in different markets.
CO4: Evaluate the capital budgeting techniques to invest in various projects.
CO5: Analyze the accounting statements to evaluate the financial performance of business entity.

CO	Action Verb	Knowledge Statement	Condition	Criteria	BL
CO1	Understand	fundamentals of managerial economics			L2
CO2	Understand	production and cost concepts		To optimize the output	L2
CO3	Analyze	price output relationship in various markets			L4
CO4	Evaluate	capital budgeting techniques		To invest in various projects	L5
CO5	Analyze	accounting statements		to evaluate the financial performance of business entity	L4

UNIT - I **Managerial economics**

Introduction – meaning, nature, significance, functions, and advantages, ME and its role in other fields. Demand - Concept, Function,LawofDemand-DemandElasticity-Types–Measurement.DemandForecasting-Factorsgoverning forecasting,Methods.

UNIT-II **ProductionandCost Analysis**

Introduction – Nature, meaning, significance, functions and advantages. Production Function– Least-cost combination– Short run and Long run Production Function- Isoquants and Isocosts, MRTS - Cobb-DouglasProductionFunction-LawsofReturns-InternalandExternalEconomiesofscale.Cost&Break-EvenAnalysis-CostconceptsandCostbehavior-Break-EvenAnalysis(BEA)-Determination of Break-Even Point (Simple Problems)-Managerial significance and limitations ofBreak-EvenAnalysis.

UNIT-III **BusinessOrganizationsandMarkets**

Introduction–Nature,meaning,significance,functionsandadvantages.FormsofBusinessOrganizations-Sole Proprietary - Partnership - Joint Stock Companies - Public Sector Enterprises.Types of Markets - Perfect and Imperfect Competition - Features of Perfect Competition Monopoly-MonopolisticCompetition–Oligopoly-Price-OutputDetermination-PricingMethodsandStrategies.

UNIT-IV **Capital Budgeting**

Introduction to Capital, Sources of Capital. Short-termandLong-termCapital: Working capital, types, Estimating Workingcapitalrequirements. Capital Budgeting – Features, Proposals, Timevalueof money. Methods and Evaluation of Projects – Pay BackMethod, Accounting Rate of Return (ARR), Net Present Value (NPV), and Internal Rate Return (IRR)Method(simple problems).

UNIT-V **Financial AccountingandAnalysis**

Introduction – Nature, meaning, significance, functions and advantages. Concepts and Conventions-Double-EntryBookKeeping,Journal,Ledger,TrialBalance-FinalAccounts(TradingAccount,Profitand Loss Account and Balance Sheet with simple adjustments). ***Financial Analysis*** - Analysis andInterpretationofLiquidityRatios,ActivityRatios,andCapitalstructureRatiosandProfitability.

Textbooks:

1. Varshney&Maheswari:ManagerialEconomics,SultanChand,2013.
2. Aryasri:BusinessEconomicsandFinancialAnalysis,4/e,MGH,2019

ReferenceBooks:

1. Ahuja Hl Managerial economicsSchand,3/e,2013
2. S.A.SiddiquiandA.S.Siddiqui:ManagerialEconomicsandFinancialAnalysis,NewAgeInternation al,2013.
3. JosephG.NellisandDavidParker:PrinciplesofBusinessEconomics,Pearson,2/e,NewDelhi.
4. Domnick Salvatore: Managerial EconomicsinaGlobalEconomy,Cengage,2013.

OnlineLearningResources:
https://www.slideshare.net/123ps/managerial-economics-ppthttps://www.slideshare.net/rossanz/production-and-cost-45827016https://www.slideshare.net/darkyla/business-organizations-19917607https://www.slideshare.net/balarajbl/market-and-classification-of-markethttps://www.slideshare.net/ruchi101/capital-budgeting-ppt-59565396https://www.slideshare.net/ashu1983/financial-accounting.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
Managerial Economics and Financial	CO1	2													
	CO2		1												
	CO3	3													
	CO4		3												
	CO5		3												

Course Outcome (CO)	Percentage of contact hours over the total planned contact hours	CO: Action verb and BTL	Program Outcome(PO)	PO:Action verb and BTL	Level of correlation (0-3)
CO1	16%	understand	PO1	Apply	2
CO2	22%	understand	PO2	Analyse	1
CO3	22%	Analyse	PO1	Apply	3
CO4	16%	Evaluate	PO2	Analyse	3
CO5	22%	Analyse	PO2	Analyse	3

Justification Statements:

CO1: Understand the fundamentals of Managerial economics and demand concept.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)

CO2: Understand the Concept of Production and cost analysis.
Action Verb: Understand (L2)
PO2: Analyze (L4)
CO2 Action verb is less than PO1 verb by two levels. Therefore the correlation is low (1)

CO3: Analyze the price output in various markets.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 Action verb is more than PO1 verb by one level. Therefore the correlation is high (3)

CO4: Evaluate the capital budgeting techniques.
Action Verb : Evaluate (L5)
PO2: Analyze
CO3 Action verb is more than PO1 verb by one level. Therefore the correlation is high (3)

CO5: Analyze the Accounting statements and evaluate the financial performance of business entity.
Action Verb: Analyze (L4)
PO2: Analyze (L4)
CO5 Action verb is same as PO2 verb. Therefore the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	ELECTRONIC DEVICES AND CIRCUITS LAB	L	T	P	C
20APC0404	II-I	(COMMON TO ECE & EEE)	0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze V-I characteristics of PN Diode, Zener diodes, SCR and UJT.
CO2: Evaluate the parameters of Rectifiers with and without filters.
CO3: Evaluate the parameters from the characteristics of BJT and FET in different configurations.
CO4: Analyze the operation of DC biasing circuits of Transistors.
CO5: Analyze the frequency response of amplifiers using BJT and FET.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	V-I characteristics of		PN Diode, Zener diodes, SCR and UJT.	L4
CO2	Evaluate	the parameters of Rectifiers	with and without filters.		L5
CO3	Evaluate	the parameters from the characteristics of BJT and FET		in different configurations	L5
CO4	Analyze	the operation of DC biasing circuits of Transistors			L4
CO5	Analyze	the frequency response of amplifiers		using BJT and FET.	L4

LIST OF EXPERIMENTS:

1. PN Junction Diode Characteristics(**CO1)**
2. Zener Diode Characteristics and Zener Diode as Voltage Regulator. **(CO1)**
3. Rectifiers (With and Without Filter). **(CO2)**
4. BJT Characteristics (CB Configuration). **(CO3)**
5. BJT Characteristics (CE Configuration). **(CO3)**
6. FET Characteristics (CS Configuration). **(CO3)**
7. SCR Characteristics **(CO3)**
8. Transistor Biasing **(CO4)**
9. BJT-CE Amplifier **(CO5)**
10. Emitter Follower-CC Amplifier **(CO5)**
11. FET-CS Amplifier **(CO5)**
12. UJT Characteristics **(CO5)**

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3											3	
CO2	3	3	3	3									3	
CO3	3	3	2										3	
CO4	3	3	1	3									3	
CO5	3	3	1	3									3	

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Analyze	L4	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	3 3
2	Evaluate	L5	PO1, PO2,PO3,P04	PO1: Apply (L3) PO2: Review (L2) PO3:Develop(L3) P04: Analyze(L4)	3 3 3 3
3	Evaluate	L5	PO1, PO2, P03	PO1: Apply (L3) PO2: Review (L2) P03: design (L6)	3 3 2
4	Analyze	L4	PO1, PO2,PO3,P04	PO1: Apply (L3) PO2: Review (L2) PO3:Design(L6) P04: Analyze(L4)	3 3 1 3
5	Analyze	L4	PO1, PO2,PO3,P04	PO1: Apply (L3) PO2: Review (L2) PO3:Design(L6) P04: Analyze(L4)	3 3 1 3

Justification Statements :

CO 1: Analyze V-I characteristics of PN Diode, Zener diodes, SCR and UJT.

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)

CO1 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)

PO2 Verbs: Review (L2)

CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO 2: Evaluate the parameters of Rectifiers with and without filters.

Action Verb: evaluate (L5)

PO1 Verbs: Apply (L3)

CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO2 Action Verb is greater than PO2 verb by one level; Therefore correlation is high (3).

PO3 Verbs: Develop (L3)

CO2 Action Verb is equal to PO3 verb; Therefore correlation is high (3).

PO4 Verbs: Analyze (L4)

CO2 Action Verb is greater than to PO4 by one level verb; Therefore correlation is high (3).

CO 3: Evaluate the parameters from the characteristics of BJT and FET in different configurations.

Action Verb: evaluate (L5)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO3 Action Verb is greater than PO2 verb by two level; Therefore correlation is high (3).

PO3 Verbs: Analyze (L4)

CO3 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).

CO4: Analyze the operation of DC biasing circuits of Transistors.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO4 Action Verb is greater than PO1 verb by three levels; Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO4 Action Verb is greater than PO2 verb by four level; Therefore correlation is high (3).

PO3 Verbs: Design (L6)

CO4 Action Verb is less than to PO3 verb by two levels; Therefore correlation is low(1).

PO4 Verbs: Analyze (L4)

CO4 Action Verb is greater than to PO4 by two level verb; Therefore correlation is high (3).

CO5: Analyze the frequency response of amplifiers using BJT and FET.

Action Verb: Analyze (L4)

PO1 Verbs: Design (L6)

CO5 Action Verb is greater than PO1 verb by three levels; Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO5 Action Verb is greater than PO2 verb by four level; Therefore correlation is high (3).

PO3 Verbs: Design (L6)

CO5 Action Verb is less than to PO3 verb by two levels; Therefore correlation is low(1).

PO4 Verbs: Analyze (L4) CO5 Action Verb is greater than to PO4 by two level verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK20-REGULATIONS

B. Tech II Year I Semester

Course Code	Course Title	L	T	P	Credits
20APC0405	SIGNALS AND SYSTEMS LABORATORY	0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the generation of various standard signals and basic operations between them.
CO2: Analyze the spectrum of a periodic and aperiodic signals using FS and FT respectively.
CO3: Apply the Linearity and Time Invariant properties to test a continuous/discrete time system.
CO4: Analyze the process of sampling a Continuous Time signal to get a Discrete Time signal.
CO5: Evaluate the filters response for speech signal, removal of noise, and waveform synthesis**.**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
1.	Analyze	the generation of various standard signals and basic operations between them.			L4
2.	Analyze	the spectrum of a periodic and aperiodic signals	using FS and FT respectively		L4
3.	Apply	the Linearity and Time Invariant properties		to test a continuous/discrete time system.	L3
4.	Analyze	the process of sampling a Continuous Time signal		to get a Discrete Time signal	L4
5	Evaluate	the filters response for speech signal, removal of noise and waveform synthesis.			L5

LIST OF EXPERIMENTS

1. Write program to generate Standard Signals/Sequences: Periodic and Aperiodic, Unit Impulse, Unit Step, Square, Saw tooth, Triangular, Sinusoidal, Ramp, Sinc.(CO1)
2. Perform operations on Signals and Sequences: Addition, Multiplication, Scaling, Shifting, Folding, Computation of Energy and Average Power (CO1).
3. Write program to find the trigonometric & exponential Fourier series coefficients of a rectangular periodic signal. Reconstruct the signal by combining the Fourier series coefficients with appropriate weightings. Plot the discrete spectrum of the signal (CO2).
4. Write program to find Fourier transform of a given signal. Plot its amplitude and phase spectrum. (CO2)
5. Write program to convolve two discrete time sequences. Plot all the sequences.(CO1).
6. Write program to find autocorrelation and cross correlation of sequences.(CO1).
7. Write program to verify Linearity and Time Invariance properties of a given Continuous/Discrete System.(CO1).
8. Write program to generate discrete time sequence by sampling a continuous time signal. Show that with sampling rates less than Nyquist rate, aliasing occurs whilereconstructing the signal.(CO1).
9. Write program to find magnitude and phase response of first order low pass and high pass filter. Plot the responses in logarithmic scale.(CO1).
10. Write program to find response of a low pass filter and high pass filter, when a speech signal is passed through these filters.(CO1).
11. Write program for removal of noise by Autocorrelation / Cross correlation.(CO1)
12. Write a program for waveform Synthesis using Laplace Transform and to plot pole-zero diagram in S-plane / Z-plane of given signal/sequence.(CO1)

Note: All the experiments are to be simulated using MATLAB or equivalent software

Mapping of Course OutComes with Program Outcomes:

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O1	PSO 2
Signals and Systems Laboratory	CO1	3	1		3										2
	CO2	3	1		3										1
	CO3	3		3	2										1
	CO4	3		3	3										2
	CO5	3		3	3										1

	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
Expt. No.	Lesson Plan (Hrs)	%	Correlation	Action Verb	BTL			
A1,B1	6	14.3		Analyze	L4	PO1, PO2, PO4	PO1: Apply (L3) PO2: Formulate (L6) PO4: Analyze(L4)	3 1 3
A2,B2	6	14.3		Analyze	L4	PO1, PO2, PO4	PO1: Apply (L3) PO2: Formulate (L6) PO4: Analyze(L4)	3 1 3
A3,A4 B3,B4	12	28.5		Apply	L3	PO1, PO3, PO4	PO1: Apply (L3) PO3: Identify(L3) PO4: Analyze (L4)	3 3 2
A5,B5	6	14.4		Analyze	L4	PO1, PO3, PO4	PO1: Apply(L3) PO2: Develop(L3) PO4: Analyze (L4)	3 3 3
A6,A7, B6,B7	12	28.5		Analyze	L4	PO1, PO3, PO4	PO1: Apply(L3) PO2: Develop(L3) PO4: Analyze (L4)	3 3 3
	42	100						

Justification Statements:

CO1: Analyze the generation of various standard signals and basic operations between them.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO1 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verbs: Formulate(L6)

CO1 Action Verb is less than the PO2 verb by two levels. Therefore, the correlation is low (1).

PO4 Verbs: Analyze(L4)

CO1 Action Verb is same as the PO4 verb. Therefore, the correlation is high (3).

CO2: Analyze the spectrum of a periodic and aperiodic signals using FS and FT respectively.

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)

CO1 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verbs: Formulate(L6)

CO1 Action Verb is less than the PO2 verb by two level. Therefore, the correlation is low (1).

PO4 Verbs: Analyze(L4)

CO1 Action Verb is same as the PO4 verb. Therefore, the correlation is high (3).

CO3: Apply the Linearity and Time Invariant properties to test a continuous/discrete time system.

Action Verb: Apply(L3)

PO1 Verbs: Apply (L3)

CO3 Action Verb is same as the PO1 verb. Therefore, the correlation is high (3).

PO3 Verbs: Develop(L3)

CO3 Action Verb is in the same level of the PO2 verb by one level. Therefore, the correlation is high (3).

PO4 Verbs: Analyze(L4)

CO3 Action Verb is less than the PO3 verb by one level. Therefore, the correlation is medium (2).

CO4: Analyze the process of sampling a Continuous Time signal to get a Discrete Time signal.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO4 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3)

CO4 Action Verb level is more than the PO3 verb. Therefore, the correlation is high (3).

PO4 Verbs: Analyze (L4)

CO4 Action Verb is same as the PO4 verb. Therefore, correlation is high (3).

CO5: Evaluate the filters response for speech signal, removal of noise, and waveform synthesis**.**

Action Verb: Evaluate (L5)

PO1 Verbs: Apply (L3)

CO5 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).

PO3 Verb: Develop (L3)

CO5 Action Verb level is more than the PO3 verb. Therefore, the correlation is high (3).

PO4 Verbs: Analyze (L4)

CO5 Action Verb is more than the PO4 verb. Therefore, correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	SWITCHING THEORY AND LOGIC DESIGN LABORATORY	L	T	P	C
20APC0406	II-I		0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1 **Understand** the operation of different logic gates using relevant IC's.

CO2 **Analyze** the operation of different combinational logic circuits.

CO3 **Analyze** the operation of various flip flops

CO4 **Design** various shift registers using sequential logic circuits

CO5 **Design** Synchronous and Asynchronous counters using Flip-Flops.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	The operation of different logic gates	using relevant IC's.		L2
CO2	**Analyze**	The operation of different combinational logic circuits.			L4
CO3	**Analyze**	The operation of various flip flops			L4
CO4	**Design**	various shift registers	using sequential logic circuits		L6
CO5	**Design**	Synchronous and Asynchronous counters	using Flip-Flops.		L6

LIST OF EXPERIMENTS:

1. Verification of Basic Logic Gates **(CO1)**
2. Realization of basic gates using Universal Gates **(CO1)**
3. Half adder and Full Adder **(CO2)**
4. Half Subtractor and Full Subtractor **(CO2)**
5. Parallel Adder/Subtractor **(CO2)**
6. Code Converters **(CO2)**
7. Encoder/Decoder **(CO2)**
8. Flip-Flops **(CO3)**
9. Shift Registers**(CO4)**
10. Counters **(CO5)**
11. Johnson/Ring Counters **(CO5)**
12. Sequence Generator **(CO5)**

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**2**											**2**	
CO2	**3**	**3**	**3**	**3**									**3**	
CO3	**3**	**3**	**3**	**3**									**3**	
CO4	**3**	**3**	**3**	**3**	**3**								**3**	
CO5	**3**	**3**	**3**	**3**	**3**								**3**	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	**L2**	PO1,PO2,	PO1 : Apply (L3) PO2 : Identify (L3)	2 2
2				Apply	**L4**	PO1,PO2, PO3, PO4,	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4)	3 3 3 3
3				Analyze	**L4**	PO1,PO2, PO3, PO4,	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4)	3 3 3 3
4				Analyze	**L6**	PO1,PO2, PO3, PO4, PO5	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4) PO5 : Apply (L3)	3 3 3 3 3
5				Analyze	**L6**	PO1,PO2, PO3, PO4, PO5	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4) PO5 : Apply (L3)	3 3 3 3 3

Justification statements:

CO1: Understand the operation of different logic gates using relevant IC's.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2 Verbs: Identify (L3)

CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO2: Analyze the operation of different combinational logic circuits.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)

CO2 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO3 Verb: Develop (L3)

CO2 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO2 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO3: Analyze the operation of various SR, JK , T and D flip flops.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)

CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO3 Verb: Develop (L3)

CO3 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO3 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO4: Design various shift registers using sequential logic circuits

Action Verb: Design (L6)

PO1 Verbs: Apply (L3)

CO4 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)

CO4 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO3 Verb: Develop (L3)

CO4 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO4 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

PO5 Verb: Design(L6)

CO4 Action Verb is equal to PO5 verb; Therefore correlation is high (3).

CO5: Design Synchronous and Asynchronous counters using Flip-Flops.

Action Verb: Design (L6)

PO1 Verbs: Apply (L3)

CO5 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)

CO5 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

PO3 Verb: Develop (L3)

CO5 Action Verb is equal to PO3 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO5 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

PO5 Verb: Design (L6)

CO5 Action Verb is equal to PO5 verb; Therefore correlation is high (3).

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(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Course Title	L	T	P	C
Skill Oriented Course						
20ASC0401	**II-I**	**ELECTRONIC CIRCUIT DESIGN**	**1**	**0**	**2**	**2**

Course Outcomes: After studying the course, Student will be able to:

CO1:**Understand**the procedure for identifying different electronic components
CO2:**Analyze** the design of clipping ,clamping and rectifiers circuits using diodes.
CO3:**Analyze** the power supply requirements and power losses in electronic products.
CO4:**Understand** the fabrication process and design considerations of Printed Circuit Board.
CO5:**Evaluate** an electronic circuit over Printed Circuit Board under mini project

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the procedure for identifying different electronic components			L2
CO2	Analyze	the design of clipping ,clamping and rectifiers circuits	Using diodes.		L4
CO3	Analyze	the power supply requirements and power losses in electronic products			L4
CO4	Understand	the fabrication process and design considerations of Printed Circuit Board.			L2
CO5	Evaluate	an electronic circuit over Printed Circuit Board		under mini project	L5

UNIT - I		
IDENTIFICATION OF ELECTRONIC COMPONENTS: Samples of Wire, Coaxial Cable, Capacitors, Diodes, Fuses, Integrated Circuits, Light Emitting Diodes (LED), Transistors, Resistors, Rectifiers, Zener Diodes, Solder, Transformers, Potentiometer, Photo Resistors..		
UNIT - II		
FUNDAMENTALS OF CIRCUIT DESIGN: Diode applications, Clipping and Clamping Circuits with Diodes, Rectifier Circuits, Transistors, Selection and analysis of Components, sensing devices and display devices.		
UNIT - III		
POWER SUPPLY DESIGN: Introduction to various types of power supplies. Estimation of power supply requirements and power loss in electronic products. Selection of appropriate power supplies for the given primary power sources (230VAC/Battery).		
UNIT - IV		
EVOLUTION AND CLASSIFICATION OF PRINTED CIRCUIT BOARDS: Challenges in Modern PCB, Design and Manufacturing, PCB fabrication, PCB design considerations/ design rules for analog, digital and power applications		
UNIT - V		
MINI PROJECT: Students should complete their Mini Project based on the above concepts.		

Mapping of course outcomes with program outcomes

CO	PO 1	PO 2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO 1	2	2		1									2	
CO 2	3	3		3								1	2	
CO 3	3	3		3		1							2	
CO 4	2	2		1	2								2	
CO 5	3	3	2	3	2							2		2

Correlation matrix

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Understand	L2	PO1, PO2, PO4	PO1: Apply(L3) PO2: Identify(L3) PO4:Analyze(L4)	2 2 1
2	Analyze	L4	PO1, PO2,PO4, PO12	PO1: Apply (L3) PO2: Identify(L3) PO4:Analyze(L4) P012:Low(1)	3 3 3 1
3	Analyze	L4	PO1, PO2, P04, PO6	PO1: Apply (L3) PO2: Identify(L3) P04:Analyze(L4) P06: Low(1)	3 3 3 1
4	Understand	L2	PO1, PO2, P04, PO5	PO1: Apply (L3) PO2: Identify(L3) P04: Analyze(L4) PO5: Apply(L3)	2 2 1 2
5	Evaluate	L5	PO1, PO2,PO3,P04, PO5, PO12	PO1: Apply (L3) PO2: Identify(L3) PO3:Design(L6) P04: Analyze(L4) PO5: Create(L6) PO12: Medium(2)	3 3 2 3 2 2

Justification Statements :

CO1: **Understand the procedure for identifying different electronic components.**

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO2 Verbs: Identify (L3)

CO1 Action Verb is less than PO2 verb by one level; Therefore correlation is moderate (2).

PO4 Verbs: Analyze (L4)

CO1 Action Verb is less than PO4 verb by two level; Therefore correlation is low (1).

CO2: **Analyze the design of clipping ,clamping and rectifiers circuits using diodes.**

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO2 Action Verb is the greater than of PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)

CO2 Action Verb is the greater than of PO2 verb; Therefore correlation is high (3).

PO4 Verbs: Analyze (L4)

CO2 Action Verb is the same level of PO3 verb; Therefore correlation is high (3).

PO12 Verbs: CO2 Using Thumb rule, L4 correlates PO12 as low (1).

CO3: **Analyze the power supply requirements and power losses in electronic products.**

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

PO2 Verb: Identify (L3)

CO3 Action Verb level is greater than of PO2 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO3 Action Verb is same level of PO4 verb; Therefore correlation is high (3).

PO6: CO3 Using Thumb rule, L4 correlates PO6 as low (1).

CO4:**Understand the fabrication process and design considerations of Printed Circuit Board.**

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

CO4 Action verb is less than to PO1 verb by one level; therefore the correlation is moderate (2).

PO2 Verb: Identify (L3)

CO4 Action verb is less than to PO2 verb by one level;; therefore the correlation is moderate (2).

PO4 Verb: Analyze (L4)

CO4 Action Verb level is the less than of PO4 verb by two level; Therefore correlation is low (1).

PO5 Verbs: Apply (L3)

CO4 Action Verb is less than PO3 verb by one level;; Therefore correlation is moderate (2).

CO5:**Evaluate an electronic circuit over Printed Circuit Board under mini project.**

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)

CO5 Action verb is greater than PO1 verb by two level; therefore the correlation is high (3).

PO2 Verb: Identify (L3)

CO5 Action verb is greater than PO2 verb by two level;; therefore the correlation is high (3).

PO3 verb: Design (L6)

CO5 Action verb is less than PO3 verb by one level; therefore the correlation is moderate (2).

PO4 verb: Analyze (L4)

CO5 Action verb is the greater than of PO4 verb by one level; therefore the correlation is high (3).

PO5 Verbs: Create (L6)

CO5 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).

PO 12:CO5Using Thumb rule, L5 correlates PO12 as medium (2).

Year: II B.Tech Semester: I Branch: Common to All

Subject Code	Subject Name	L	T	P	Credits
20AMC9901	BIOLOGY FOR ENGINEERS	3	0	0	0

Course Outcomes (CO): After studying the course, Student will be able to:

1. Understand the structure of cells and basics in living organisms
2. Understand the importance of various biomolecules and enzymes in living organisms
3. Analyze the functioning of physiology in respiratory system and digestive system.
4. Understand the DNA technology and gen cloning in living organisms.
5. Apply the biological principles in different technologies for the production of medicines and pharmaceuticals.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the structure of cells and basics in living organisms			L2
2	**Understand**	the importance of various biomolecules and enzymes		in living organisms	L2
3	**Analyze**	the functioning of physiology		in respiratory system and digestive system	L4
4	**Understand**	the DNA technology and gen cloning		in living organisms	L2
5	**Apply**	the biological principles in different technologies	for the production of medicines and pharmaceuticals		L3

Unit I: Introduction to Basic Biology

Evolution: Different patterns of evolution, Darwin's theory of evolution, Cell as Basic unit of life, cell theory, Cell shapes, Cell structure, Cell cycle. Chromosomes. Prokaryotic and eukaryotic Cell. Plant Cell, Animal Cell, Plant tissues and Animal tissues, Brief introduction to five kingdoms of classification, Tissue Engineering.

Unit II: Introduction to Biomolecules

Carbohydrates, lipids, proteins, Vitamins and minerals, Nucleic acids (DNA and RNA) and their types. Enzymes, Enzyme application in Industry. Large scale production of enzymes by Fermentation.

Unit III: Human Physiology

Digestive system, Respiratory system, (aerobic and anaerobic Respiration).Respiratory organs, respiratory cycle, Central Nerves System and Excretory system.

Unit IV: Introduction to Molecular Biology and recombinant DNA Technology

Prokaryotic gene and Eukaryotic gene structure.DNA replication, Transcription and Translation.DNA technology. Introduction to gene cloning.

Unit V: Application of Biology

Brief introduction to industrial Production of Enzymes, Pharmaceutical and therapeutic Proteins, Vaccines and antibodies. Basics of biosensors, Properties and Classification of virus, Immune response to virus, Definitions-Pandemic, Epidemic and outbreak, pandemic alert system ranges, Prevention of pandemic disease and pandemic preparation.

Text books:

1. P.K.Gupta, Cell and Molecular Biology, 5th Edition, Rastogi Publications
2. U. Satyanarayana. Biotechnology, Books & Allied Ltd 2017

Reference Books:

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A Global Approach", Pearson Education Ltd, 2018.
2. T Johnson, Biology for Engineers, CRC press, 2011
3. J.M. Walker and E.B. Gingold, Molecular Biology and Biotechnology 2nd ed. Panima Publications. PP 434.

4. David Hames, Instant Notes in Biochemistry –2016
5. Phil Tunner, A. Mctennan, A. Bates & M. White, Instant Notes – Molecular Biology – 2014.
6. Richard Dawkins, River Out of Eden: A Darwinian View of Life.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2								
2						2								
3						2								
4						2								
5						2								

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**corr**	**Verb**	**BTL**			
1	**10**	20	2	**Understand**	**L2**	PO6	Thumb Rule	2
2	**10**	20	2	**Understand**	**L2**	PO6	Thumb Rule	2
3	**9**	18	1	**Analyze**	**L4**	PO6	Thumb Rule	2
4	**9**	18	1	**Understand**	**L2**	PO6	Thumb Rule	2
5	**10**	20	2	**Apply**	**L3**	PO6	Thumb Rule	2
	48							

CO1: Understand the structure of cells and basics in living organisms
Action Verb: Understand (L2)
Using Thumb rule, CO1 correlates PO6 as moderate (2).

CO2: Understand the importance of various biomolecules and enzymes in living organisms
Action Verb: Understand (L2)
Using Thumb rule, CO2 correlates PO6 as moderate (2).

CO3: Analyze the functioning of physiology in respiratory system and digestive system.
Action Verb: Analyze (L4)
Using Thumb rule, CO3 correlates PO6 as moderate (2).

CO4: Understand the DNA technology and gen cloning in living organisms.
Action Verb: Understand (L2)
Using Thumb rule, CO4 correlates PO6 as moderate (2).

CO5: Apply the biological principles in different technologies for the production of medicines and pharmaceuticals**.**
Action Verb: Apply (L3)
Using Thumb rule, CO4 correlates PO6 as moderate (2).

IV Semester (B.Tech –II year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	ESC	20AES0509	Basics of Python Programming	3	0	0	3	30	70	100
2	PCC	20APC0407	Probability Theory and Stochastic Process	3	0	0	3	30	70	100
3	PCC	20APC0408	Electromagnetic Theory and Transmission Lines	3	0	0	3	30	70	100
4	PCC	20APC0409	Analog Communication Systems	3	0	0	3	30	70	100
5	PCC	20APC0410	Electronic Circuit Analysis	3	0	0	3	30	70	100
6	ESC	20AES0510	Basics of Python Programming Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0411	Analog Communication Systems Laboratory	0	0	3	1.5	30	70	100
8	PCC	20APC0412	Electronic Circuit Analysis Laboratory	0	0	3	1.5	30	70	100
9	SOC	20ASC0402	Internet of Things	1	0	2	2	100	-	100
10	HSC	20AHS9905	Universal Human Values	2	1	0	3	30	70	100
TOTAL							**24.5**	**370**	**630**	**1000**

Community service Project with credits

(To visit the selected community to conduct survey (Socio-economic & domain survey) and conduct sensitization/awareness program/activities at the end of IV- semester before commencement of V-semester and complete immersion programme also during V-Semester and submit report in V - semester. Assessment will be done at the end of V-Semester)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Basics of Python Programming	L	T	P	C
20AES0509	II-II	(common to CSE,CIC)	3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: Understand the Basic concepts of python programming to build scripts in IDLE.

CO2: Apply the modularity techniques to invoke user defined functions.

CO3: Apply the concept of Strings and Lists to perform iterative operations on data.

CO4: Apply the Mutable and Immutable data types to perform python Programs.

CO5: Analyze the oops concepts to develop applications with reusability.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Basic concepts of python programming		to build scripts in IDLE	L2
CO2	Apply	the modularity techniques		to invoke user defined functions	L3
CO3	Apply	the concept of Strings and Lists		to perform iterative operations on data	L3
CO4	Apply	the Mutable and Immutable data types		to perform python Programs	L3
CO5	Analyze	the oops concepts		to develop applications with reusability .	L4

UNIT– I		9Hrs
Introduction: What is a program, Running python, Arithmetic operators, Value and Types. **Variables, Assignments and Statements**: Assignment statements, Script mode, Order of operations, string operations, comments. **Functions**: Function calls, Math functions, Composition, Adding new Functions, Definitions and Uses, Flow of Execution, Parameters and Arguments, Variables and Parameters are local, Stack diagrams, Fruitful Functions and Void Functions, Why Functions.		
UNIT–II		9Hrs
Case study: The turtle module, Simple Repetition, Encapsulation, Generalization, Interface design, Refactoring, docstring. **Conditionals and Recursion**: floor division and modulus, Boolean expressions, Logical operators, Conditional execution, Alternative execution, Chained conditionals, Nested conditionals, Recursion, Infinite Recursion, Keyboard input. **Fruitful Functions**: Return values, Incremental development, Composition, Boolean functions, more recursion, Leap of Faith, Checking types		
UNIT–III		9Hrs
Iteration: Reassignment, Updating variables, The while statement, Break, Square roots, Algorithms. **Strings**: A string is a sequence, len, Traversal with a for loop, String slices, Strings are immutable, Searching, Looping and Counting, String methods, The in operator, String comparison. **Case Study**: Reading word lists, Search, Looping with indices. **Lists**: List is a sequence, Lists are mutable, Traversing a list, List operations, List slices, List methods, Map filter and reduce, Deleting elements, Lists and Strings, Objects and values, Aliasing, List arguments.		
UNIT–IV		8Hrs
Dictionaries: A dictionary is a mapping, Dictionary as a collection of counters, Looping and dictionaries, Reverse Lookup, Dictionaries and lists, Memos, Global Variables. **Tuples:** Tuples are immutable, Tuple Assignment, Tuple as Return values, Variable-length argument tuples, Lists and tuples, Dictionaries and tuples, Sequences of sequences. **Files:** Persistence, Reading and writing, Format operator, Filename and paths, Catching exceptions, Databases, Pickling, Pipes, Writing modules. **Classes and Objects**: Programmer-defined types, Attributes, Instances as Return values, Objects are mutable, Copying.		
UNIT–V		10Hrs
Classes and Functions: Time, Pure functions, Modifiers, Prototyping versus Planning **Classes and Methods**: Object oriented features, Printing objects, The init method, The __str__method, Operator overloading, Type-based Dispatch, Polymorphism, Interface and Implementation **Inheritance**: Card objects, Class attributes, Comparing cards, decks, Printing the Deck, Add Remove shuffle and sort, Inheritance, Data encapsulation. **The Goodies:** Conditional expressions, List comprehensions, Generator expressions, any and all, Sets, Counters, default dict, Named tuples, Gathering keyword Args		
Textbooks:		
1. Allen B. Downey, “Think Python”, 2nd edition, SPD/O’Reilly, 2016.		
ReferenceBooks:		
1. Martin C.Brown, “The Complete Reference: Python”, McGraw-Hill, 2018. 2. Kenneth A. Lambert, B.L. Juneja, “Fundamentals of Python”, CENGAGE, 2015. 3. R. Nageswara Rao, “Core Python Programming”, 2nd edition, Dreamtech Press, 2019		

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3			2									
CO2	3	3	3		3							2		
CO3	3	3	3	2								2		
CO4	3	3	3	2								2		
CO5	3	3	3	3								2		

Correlation matrix

Unit No.	CO				TL	Program Outcome (PO)	PO(s): Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co'sActionverb				
1	10	19%	2	CO1 :Understand	L2	PO1 PO2 PO5	PO1: Apply(L3) PO2:Review(L2) PO5:Apply(L3)	2 3 2
2	13	24%	3	CO2: Apply	L3	PO1 PO2 PO3 PO5 PO12	PO1:Apply(L3) PO2:Review (L2) PO3:Develop(L3) PO5:Apply(L3) PO12:Thumb rule	3 3 3 3 2
3	10	19%	2	CO3: Apply	L3	PO1 PO2 PO3 PO4 PO12	PO1:Apply(L3) PO2:Review (L2) PO3:Develop(L3) PO4:Analyze(L4) PO12:Thumb rule	3 3 3 2 2
4	9	17%	2	CO4: Apply	L3	PO1 PO2 PO3 PO4 PO12	PO1:Apply(L3) PO2:Review(L2) PO3:Develop(L3) PO4:Analyze(L4) PO12:Thumb rule	3 3 3 2 2
5	11	20%	3	CO5:Analyze	L4	PO1 PO2 PO3 PO4 PO12	PO1:Apply(L3) PO2:Review (L2) PO3:Develop(L3) PO4:Analyze(L4) PO12:Thumb rule	3 3 3 3 2
	53	100 %						

Justification Statements :

CO1: Understand the Basic concepts of python programming to build scripts in IDLE..
Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Review(L2)
CO1 Action verb is same as PO2 verb..Therefore the correlation is high (3)
PO5: Apply(L3)
CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is medium (2)

CO2: Apply the modularity techniques to invoke user defined functions.
Action Verb :Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation high (3)
PO3: Develop (L3)
CO2 Action verb same as PO3 verb. Therefore the correlation high (3)
PO5: Apply(L3)
CO2 Action verb same as PO5 verb. Therefore the correlation high (3)
PO12: Thumb rule

For some modular applications user defined functions are created to meet societal needs. Therefore the correlation is medium (2)

CO3: Apply the concept of Strings and Lists to perform iterative operations on data.
Action Verb : Apply(L3)
PO1: Apply(L3)
CO3 Action verb is less than PO1 verb by two level. Therefore the correlation is medium (2)
PO2: Review (L2)
CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO3 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than one level as PO4 verb. Therefore the correlation is medium (2)
PO12: Thumb rule
For some of python Program Concepts are used to create programs. Therefore the correlation is medium (2)

CO4: Apply the Mutable and Immutable data types to perform python Programs.
Action Verb : Apply(L3)
PO1: Apply(L3)
CO4 Action verb is same as PO1 verb by one level. Therefore the correlation is high (3)
PO2: Review(L2)
CO4 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO4 Action verb is less than one level as PO4 verb. Therefore the correlation is medium (2)
PO12: Thumb rule
For some of python Program Concepts are used to create programs. Therefore the correlation is medium(2)

CO5: Analyze the oops concepts to develop applications with reusability.
Action Verb : Analyze(L4)
PO1: Apply(L3)
CO5 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO12: Thumb rule
For some of python Program Concepts are used to create programs. Therefore the correlation is medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Probability Theory and Stochastic Processes	L	T	P	C
20APC0407	II-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1:**Understand** the Basics of Probability and Random Variables.
CO2: **Analyze** the concepts of Multiple Random Variables and their operations.
CO3: **Analyze** the Temporal Characteristics of Random Process
CO4: **Analyze** the Spectral Characteristics of Random Process.
CO5: **Evaluate** the Response of Linear System with Random Inputs

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Basics of Probability and Random Variables.			L2
CO2	Analyze	the concepts of Multiple Random Variables and their operations.			L4
CO3	Analyze	the Temporal Characteristics of Random Process .			L4
CO4	Analyze	the Spectral Characteristics of Random Process			L4
CO5	Evaluate	the Response of Linear System	with Random Inputs	.	L5

UNIT - I		15Hrs
PROBABILITY: Probability introduced through Sets and Relative Frequency: Experiments and Sample Spaces, Discrete and Continuous Sample Spaces, Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Bays' Theorem, Independent Events: The Random Variable : Definition of a Random Variable, Conditions for a Function to be a Random Variable, Discrete and Continuous, Mixed Random Variable, Distribution and Density functions, Properties, Binomial, Poisson, Uniform, Gaussian, Exponential, Raleigh, Conditional Distribution, Methods of defining Conditioning Event, Conditional Density, Properties.		
UNIT - II		14Hrs
MULTIPLE RANDOM VARIABLES: Vector Random Variables, Joint Distribution Function, Properties of Joint Distribution, Marginal Distribution Functions, Conditional Distribution and Density – Point Conditioning, Conditional Distribution and Density – Interval conditioning, Statistical Independence, Sum of Two Random Variables, Sum of Several Random Variables, Central Limit Theorem, (Proof not expected). Unequal Distribution, Equal Distributions. **OPERATIONS ON MULTIPLE RANDOM VARIABLES:** Expected Value of a Function of Random Variables, Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables: Two Random Variables case, N Random Variable case, Properties, Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variable.		
UNIT - III		15Hrs
RANDOM PROCESSES - TEMPORAL CHARACTERISTICS: Temporal Characteristics: The Random Process Concept, Classification of Processes, Deterministic and Nondeterministic Processes, Distribution and Density Functions, concept of Stationarity and Statistical Independence. First-Order Stationary Processes, Second- Order and Wide-Sense Stationarity, (N-Order) and Strict- Sense Stationarity, Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation- Ergodic Processes, Autocorrelation Function and Its Properties, Cross-Correlation Function and its Properties, Covariance Functions, Gaussian Random Processes, Poisson Random Process.		
UNIT - IV		16Hrs
RANDOM PROCESSES – SPECTRAL CHARACTERISTICS: The Power Spectrum: Properties, Relationship between Power Spectrum and Autocorrelation Function, the Cross- Power Density Spectrum, Properties, Relationship between Cross-Power Spectrum and Cross- Correlation Function		
UNIT - V		17Hrs
LINEAR SYSTEMS WITH RANDOM INPUTS: Random Signal Response of Linear Systems: System Response – Convolution, Mean and Mean-squared Value of System Response, autocorrelation Function of Response, Cross-Correlation Functions of Input and Output, Spectral Characteristics of System Response: Power Density Spectrum of Response, Cross- Power Density Spectrums of Input and Output, Band pass, Band-Limited and Narrowband Processes, Properties.		

Textbooks:

1. Peyton Z. Peebles, "Probability, Random Variables & Random Signal Principles", TMH, 4th Edition, 2001.
2. Athanasios Papoulis and S. Unnikrishna Pillai, "Probability, Random Variablesand Stochastic Processes", PHI, 4th Edition, 2002.

Reference Books:

1. R.P. Singh and S.D. Sapre, "Communication Systems Analog & Digital", TMH, 1995.
2. Henry Stark and John W. Woods, "Probability and Random Processes withApplication to Signal Processing", Pearson Education, 3rd Edition.

3. George R. Cooper, Clave D. MC Gillem, "Probability Methods of Signal and System Analysis", Oxford, 3rd Edition, 1999.
4. S.P. Eugene Xavier, "Statistical Theory of Communication", New Age Publications, 2003.
5. B.P. Lathi, "Signals, Systems & Communications", B.S. Publications, 2003.

Online Learning Resources:

nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	-	3	-								1	
CO2	3	3	-	3	-								1	
CO3	3	3	3	3	3								2	
CO4	3	3	3	3	3								2	
CO5	3	2	-	3	3								2	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	19.4	2	Understand	L2	PO1, PO2, PO4	PO1: Apply (L3) PO2: Review (L2) PO4: Interpret (L2)	2 3 3
2	14	18.1	2	Analyze	L4	PO1, PO2,PO4	PO1: Apply (L3) PO2: Identify(L3) PO4: Interpret (L2)	3 3 3
3	15	19.4	2	Analyze	L4	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2:Identify (L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
4	16	20.7	3	Analyze	L4	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2:Identify (L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
5	17	22	3	Evaluate	L5	PO1, PO2, PO4, PO5	PO1: Apply (L3) PO2:Formulate(L6) PO4: Analyze (L4) PO5: Apply (L3)	3 2 3 3
	77							

Justification Statements :

CO1: Understand the Basics of Probability and Random Variables.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Review (L2) CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO4 Verbs: Interpret (L2) CO1 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO2: Analyze the concepts of Multiple Random Variables and their operations.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Identify (L3) CO2 Action Verb is greater than PO2 verb by one level; Therefore correlation is high (3).
PO4 Verbs: Interpret (L2) CO2 Action Verb is greater than PO4 verb by one level; Therefore correlation is high (3).

CO3: Analyze the Temporal Characteristics of Random Process.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO3 Action Verb is greater than PO1 verb ; Therefore correlation is high (3).
PO2 Verb: Identify (L3) CO3 Action Verb is greater than PO2 verb by one level; Therefore correlation is high (3).
PO3 Verb: Develop (L3) CO3 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze (L4) CO3 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3) CO3 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO4: Analyze the Spectral Characteristics of Random Process.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)CO4 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)CO4 Action Verb is greater than PO2; Therefore correlation is high (3).

PO3 Verb: Develop (L3)CO4 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze (L4) CO4 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3)CO4 Action Verb is greater than PO5 verb; Therefore correlation is high(3).

CO5: Evaluate the Response of Linear System with Random Inputs.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).
PO2 verb: Formulate(L6)CO5 Action verb is less than PO2 verb by one level ; therefore the correlation is moderate (2).
PO4 verb: Analyze (L4)
CO5 Action verb is greater than PO4 verb therefore the correlation is high (3).
PO5 Verb: Apply (L3)
CO5 Action verb is greater than PO5 verb therefore the correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Electromagnetic Theory and Transmission Lines	L	T	P	C
20APC0408	II-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: Understand the vector algebra and electrostatic fields using coulomb's law and Gauss law.
CO2: Understand the concept of magnetostatic fields using BIOT- Savart's law and Ampere's circuit law.
CO3: Apply the maxwell's equations for time varying fields in different boundary conditions.
CO4: Analyze the propagation of electromagnetic waves in conductors and dielectric media.
CO5: Understand the concepts of transmission line parameters and its applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the vector algebra and electrostatic fields	Using coulomb's law and Gauss law.		**L2**
CO2	**Understand**	the concept of magnetostatic fields	using BIOT-Savart's law and Ampere's circuit law.		**L2**
CO3	**Apply**	the maxwell's equations	for time varying fields	in different boundary conditions.	**L3**
CO4	**Analyze**	the propagation of electromagnetic waves in	conductors and dielectric media.		**L4**
CO5	**Understand**	the concepts of transmission line parameters and its applications.			**L2**

UNIT - I		10Hrs
Review of Vector Algebra, coordinate systems, Vector Calculus, Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions, Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations Between E and V, Maxwell's Two Equations for Electrostatic Fields, Energy Density, Dielectric Constant, Continuity Equation, Relaxation Time, Poisson's and Laplace's Equations, Illustrative Problems.		
UNIT - II		10Hrs
Biot-Savart Law, Ampere‟s Circuital Law and Applications, Magnetic Flux Density, Maxwell‟s Two Equations for Magneto static Fields, Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere‟s Force Law, Magnetic Energy, Illustrative Problems.		
UNIT - III		15Hrs
Faraday‟s Law and Transformer e.m.f, Inconsistency of Ampere‟s Law and Displacement CurrentDensity, Maxwell‟s equations for time varying fields, Maxwell‟s Equations in Different Final Forms and Word Statements. Boundary Conditions of Electromagnetic fields: Dielectric- Dielectric and Dielectric-Conductor Interfaces, Illustrative Problems.		
UNIT - IV		14Hrs
Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, All Relations between E & H, Wave Propagation in Lossless and Conducting Media, Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics, Polarization. Reflection and Refraction of Plane Waves – Normal and ObliqueIncidences, for both Perfect Conductor and Perfect Dielectrics, Brewster Angle, Critical Angle and Total Internal Reflection, Poynting Vector, and Poynting Theorem – Applications, Illustrative Problems.		
UNIT - V		14Hrs
Transmission Lines: Types, Transmission line parameters (Primary and Secondary), Transmission line equations, Input impedance, Standing wave ratio & power, Smith chart & its applications, Applications of transmission lines of various lengths, Micro-strip transmission lines – input impedance, Illustrative Problems.		

Textbooks:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", Oxford Univ. Press, 4th ed., 2008.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", TMH, 7th ed., 2006.
3. John D. Krauss, "Electromagnetics", McGraw- Hill publications.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3											2	
CO2	2	3											2	
CO3	3	3											3	
CO4	3	1		3									3	
CO5	2	3											2	

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	10	16	3	Understand	L2	PO1, PO2,	PO1: Identify (L2) PO2: Review (L2)	3 3
2	10	16	2	Understand	L2	PO1,PO2	PO1: Apply (L3) PO2: Identify (L2)	2 3
3	15	23	3	Apply	L3	PO1,PO2	PO1:Apply(L3) PO2:Identify(L2)	3 3
4	14	22	3	Analyze	L4	PO1, PO2 PO4	PO1:Apply(L3) PO2:Formulate(L6) PO4:Analyze(L4)	3 1 3
5	14	22	3	Understand	L2	PO1,PO2	PO1:Apply(L3) PO2: Identify(L2)	2 3
	63							

Justification Statements:

CO1: . Understand the vector algebra and electrostatic fields using coulomb's law and Gauss law.

Action Verb: Understand (L2)

PO1 Verbs: Identify (L2) CO1 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Review (L2) CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO2: Understand the concept of magnetostatic fields using BIOT- Savart's law and Ampere's circuit law.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO2 Action Verb is less than PO1 verb; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2) CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO3: Apply the maxwell's equations for time varying fields in different boundary conditions.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3) CO3 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

PO2 Verb: Identify (L3) CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Analyze the propagation of electromagnetic waves in conductors and dielectric media.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO4 Action Verb is greater to PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Formulate (L6) CO4 action verb is less than PO2 verb by two levels. Therefore correlation is low(1)

PO4 Verb: Analyze (L4) CO4 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).

CO5: understand the concepts of transmission line parameters and its applications.

Action Verb: Understand(L2)

PO1 Verb: Apply (L3) CO5 Action verb is lesser to PO1 verb by one level. Therefore correlation is moderate (2).

PO2 Verb: Identify (L2) CO5 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Analog Communication Systems	L	T	P	C
20APC0409	II-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1:**Understand** the elements of communication systems and amplitude modulation.

CO2:**Analyze** the angle modulation & demodulation methods in time and frequency domains.

CO3: **Evaluate** the performance of analog communication systems in the presence of different types of noise.

CO4:**Analyze** various pulse analog modulation schemes and parameters of radio receivers.

CO5: **Apply** the fundamental concepts of information theory to communication channel.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The elements of communication systems and amplitude modulation			L2
CO2	Analyze	The angle modulation & demodulation methods	In time and frequency domains		L4
CO3	Evaluate	performance of analog communication systems	In the presence of different types of noise.		L5
CO4	Analyze	various pulse analog modulation schemes and parameters of radio receivers.			L4
CO5	Apply	the fundamental concepts of information theory to communication channel			L3

UNIT - I		15Hrs

INTRODUCTION: Elements of communication systems, Information, Messages and Signals, Modulation, Modulation Methods, Modulation Benefits and Applications.

AMPLITUDE MODULATION & DEMODULATION: Baseband and carrier communication, Amplitude Modulation (AM), Rectifier detector, Envelope detector, Double sideband suppressed carrier (DSB- SC) modulation & its demodulation, Switching modulators, Ring modulator, Balanced modulator, Frequency mixer, sideband and carrier power of AM, Generation of AM signals, Quadrature amplitude modulation (QAM), Single sideband (SSB) transmission, Time domain representation of SSB signals & their demodulation schemes (with carrier, and suppressed carrier), Generation of SSB signals, Vestigial sideband (VSB) modulator & demodulator, Carrier Acquisition- phased locked loop (PLL), Costas loop, Frequency division multiplexing (FDM), and Super-heterodyne AM receiver, Illustrative Problems.

UNIT - II		14 Hrs

ANGLE MODULATION & DEMODULATION: Concept of instantaneous frequency, Generalized concept of angle modulation, Bandwidth of angle modulated waves – Narrow band frequency modulation (NBFM); and Wide band FM (WBFM), Phase modulation, Verification ofFrequency modulation bandwidth relationship, Features of angle modulation, Generation of FM waves –Indirect method, Direct generation; Demodulation of FM, Bandpass limiter, Practical frequency demodulators, Small error analysis, Pre-emphasis, & De-emphasis filters, FM receiver, FM Capture Effect, Illustrative Problems**.**

UNIT - III		15 Hrs

NOISE IN COMMUNICATION SYSTEMS: Thermal noise, Time domain representation of narrowband noise, Filtered white noise, Quadrature representation of narrowband noise, Envelope of narrowband noise plus sine wave, Signal to noise ratio & probability of error, Noise equivalent bandwidth, Effective noise temperature, and Noise figure, Baseband systems with channel noise, Performance analysis (i.e. finding SNR expression) of AM, DSB-SC, SSB-SC, FM, PM in the presence of noise, Illustrative Problems

UNIT - IV		16 Hrs

ANALOG PULSE MODULATION SCHEMES: Pulse amplitude modulation – Natural sampling, flat top sampling and Pulse amplitude modulation (PAM) & demodulation, Pulse- Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes, PPM spectral analysis, Illustrative Problems.

RADIO RECEIVER MEASUREMENTS: Sensitivity, Selectivity, and fidelity.

UNIT - V		17 Hrs

INFORMATION & CHANNEL CAPACITY: Introduction, Information content of message, Entropy, Entropy of symbols in long independent and dependent sequences, Entropy and information rate of Mark off sources, Shannon's encoding algorithm, Discrete communication channels, Rate of information over a discrete channel, Capacity of discrete memory less channels, Discrete channels with memory, Shannon– Hartley theorem and its implications, Illustrative problems.

Textbooks:

1. B. P. Lathi, "Modern Digital and Analog Communication Systems," Oxford Univ. press, 3rd Edition, 2006.
2. Sham Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2006.

Reference Books:

1. Bruce Carlson, & Paul B. Crilly, "Communication Systems – An Introduction to Signals & Noise in Electrical Communication", McGraw-Hill International Edition,5th Edition, 2010.
2. Herbert Taub & Donald L Schilling, "Principles of Communication Systems", Tata McGraw- Hill, 3rd Edition, 2009.
3. R.E. Ziemer & W.H. Tranter, "Principles of Communication-SystemsModulation & Noise", Jaico Publishing House, 2001

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	
CO2	2	3											3	
CO3	3	3		3									3	
CO4	3	3											3	
CO5	3	3	3										3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	19.4	2	Understand	L2	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	2 3
2	14	18.1	2	Analyze	L4	PO1, PO2	PO1: Apply (L3) PO2: Identify(L3)	3 3
3	15	19.4	2	Evaluate	L5	PO1, PO2, PO4,	PO1: Apply (L3) PO2:Identify (L3) PO4: Analyze (L4)	3 3 3
4	16	20.7	3	Analyze	L4	PO1, PO2	PO1: Apply (L3) PO2:Identify (L3)	3 3
5	17	22	3	Apply	L3	PO1, PO2, PO3	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3)	3 3 3
	77							

Justification Statements :

CO1: Understand the elements of communication systems and amplitude modulation.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verb : Review (L2)
CO1 Action Verb is equal to PO2 ;Therefore correlation is high (3).

CO2 :Analyze the angle modulation & demodulation methods in time and frequency domains

Action Verb: Analyze(L4)

PO1 Verb: Apply(L3)
CO2 Action Verb is more than PO1 verb; Therefore correlation is high (3).
PO2 Verb : Identify(L3)
CO2 Action Verb is more than PO2 verb ;Therefore correlation is high (3).

CO3:Evaluate the performance of analog communication systems in the presence of different types of noise

Action Verb: Evaluate(L5)
PO1 Verb: Apply(L3)
CO3 Action Verb is more than PO1 verb; Therefore correlation is high (3).
PO2 Verb : Identify (L3)
CO3 Action Verb is more than PO2 verb; Therefore correlation is high (3).
PO4 Verb : analyze (L4)
CO3 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO4:Analyze various pulse analog modulation schemes and parameters of radio receivers.

Action Verb: Analyze (L4)
PO1 Verb: Apply(L3)
CO4 Action Verb is more than PO1 verb; Therefore correlation is high (3).
PO2 Verb : Identify (L3)
CO4 Action Verb is more than PO2 ;Therefore correlation is high (3).

CO5:Apply the fundamental concepts of information theory to communication channel.

Action Verb: Apply(L3)
PO1 Verb: Apply(L3)
CO5 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verb : Identify (L3)
CO5 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO3 Verb : Develop (L3) CO5 Action Verb is equal to PO3 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Electronic Circuit Analysis	L	T	P	C
20APC0410	II-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand the** multi stage amplifiers and high input resistance amplifiers using BJT and FET.
CO2: **Apply** the hybrid Π model for transistor amplifiers at high frequencies
CO3: **Evaluate** the parameters of feedback amplifier and frequency of oscillators.
CO4: **Understand** the large signal amplifiers and thermal stabilization concepts
CO5: **Analyze** the tuned amplifiers and effect on bandwidth while cascading tuned amplifiers.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	The multi stage amplifiers and high input resistance amplifiers		using BJT and FET.	L2
CO2	**Apply**	the hybrid Π model for transistor amplifiers	at high frequencies		L3
CO3	**Evaluate**	the parameters of feedback amplifier and frequency of oscillators.			L5
CO4	**Understand**	the large signal amplifiers and thermal stabilization concepts			L2
CO5	**Analyze**	The tuned amplifiers and effect on bandwidth	while cascading tuned amplifiers		L4

UNIT - I — 15Hrs

MULTI STAGE AMPLIFIERS

Introduction, Classification of Amplifiers, Analysis of Cascaded amplifiers, Different Coupling Schemes used in Amplifiers, Analysis of two stage RC Coupled Amplifier, high input resistance transistor amplifiers- Darlington Pair Amplifier, Boot Strap Emitter Follower, Cascade Amplifier, Differential Amplifier, Analysis of multi stage amplifiers using FET.

UNIT - II — 14Hrs

HIGH FREQUENCY TRANSISTOR AMPLIFIERS- BJT

Transistor at High Frequencies, Hybrid- π Common Emitter transistor model, Validity of hybrid π model, determination of high-frequency parameters in terms of low-frequency parameters, Single Stage CE Amplifier frequency response with short circuit load and resistive load, gain cutoff frequencies, Gain- Bandwidth Product, Emitter follower at higher frequencies, Illustrative design problems.

FET: FET at High Frequencies, High Frequencies FET Model, Analysis of Common Source and Common Drain Amplifier circuits at High frequencies.

UNIT - III — 14Hrs

FEEDBACK AMPLIFIERS AND OSCILLATORS

FEEDBACK AMPLIFIERS: Concepts of Feedback, Classification of Feedback Amplifiers, General Characteristics of Negative Feedback Amplifiers, Effect of Feedback on Amplifier characteristics: Voltage Series, Voltage Shunt, Current Series and Current Shunt Feedback Configurations, Illustrative design Problems.

OSCILLATORS: Introduction, Classification of Oscillators, Conditions for Oscillations, RC and LC Oscillators, RC-Phase shift and Wien-Bridge Oscillators, Generalized Analysis of LC Oscillators, Hartley and Colpitt's Oscillators, Crystal Oscillators, Frequency and Amplitude Stability of Oscillators, Illustrative design problems.

UNIT - IV — 12Hrs

POWER AMPLIFIERS

Introduction, Classification of power amplifiers**,** Class A large signal Amplifiers-Series fed and Transformer coupled amplifier, Efficiency, Class B Amplifier -Push-pull amplifiers, Efficiency of Class B Amplifier, Complementary Symmetry push pull amplifier, Cross over Distortion, Phase Inverters, Class AB operation, Class D amplifier, Class S amplifier, MOSFET power amplifier, Thermal stability and Heat sink, Second harmonic Distortions, Higher order harmonic Distortion.

UNIT - V — 14Hrs

TUNED AMPLIFIERS

Introduction, series resonance, Transformation of resistor and inductor ,Parallel Resonance, Q- Factor, Impedance variation near resonance, Classification of tuned amplifiers, Small Signal Tuned Amplifier – Capacitance and transformed coupled single tuned amplifier, Double Tuned Amplifiers, Effect of Cascading Single tuned amplifiers on Band width, Effect of Cascading Double tuned amplifiers on Band width, Staggered tuned amplifiers, Stability of tuned amplifiers.

Textbooks:

1. Matthew N.O. Sadiku, "Elements of Electromagnetics", Oxford Univ. Press, 4th ed., 2008.
2. William H. Hayt Jr. and John A. Buck, "Engineering Electromagnetics", TMH, 7th ed., 2006.
3. John D. Krauss, "Electromagnetics", McGraw- Hill publications

Reference Books:

1. Electromagnetics, Schaum's outline series, Second Edition, Tata McGraw Hillpublications, 2006.
2. E.C.Jordan and K.G.Balmain, "Electromagnetic Waves and Radiating Systems", PHI, 2nd Edition, 2000.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		1	3								2	
CO2	3	3		2	3								3	
CO3	3	3		3	3								3	
CO4	2	3		1	2								2	
CO5	3	3		3	3								3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	22	3	Understand	L2	PO1,PO2,PO4, PO5	PO1: Apply (L3) PO2:Review (L2) PO3:Analyze(L4) PO5: Select(L1)	2 3 1 3
2	14	20	2	Apply	L3	PO1,PO2,PO4, PO5	PO1: Apply (L3) PO2:Review (L2) PO4: Analyze-L4 PO5: Apply (L3	3 3 2 3
3	14	20	2	Evaluate	L5	PO1,PO2,PO4, PO5	PO1: Apply (L3) PO2:Identify(L3) PO4: Analyze-L4 PO5: Apply (L3)	3 3 3 3
4	12	18	2	Understand	L2	PO1,PO2,PO4, PO5	PO1: Apply (L3) PO2:Review (L2) PO4: Analyze-L4 PO5: Apply (L3)	2 3 1 2
5	14	20	2	Analyze	L4	PO1,PO2,PO4, PO5	PO1: Apply (L3) PO2:Identify(L3) PO4: Analyze-L4 PO5: Apply (L3)	3 3 3 3
	69	100%						

Justification Statements :

CO1: Understand multi stage amplifiers and high input resistance amplifiers using BJT and FET.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3),CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Review (L2),CO1 Action Verb is equal to PO2 verb by same levels; therefore, correlation is High (3).
PO4 Verbs: Analyze-L4,CO1 Action Verb is less than PO4 verb by two levels; therefore, correlation is low (1).
PO5 Verbs: Select-L1,CO1 Action Verb is more than PO5 verb by one level; therefore, correlation is high (3).

CO2: Apply the hybrid Π model for transistor amplifiers at high frequencies

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3),CO2 Action Verb is equal to PO1 verb by same level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2),CO2 Action Verb is high than PO2 verb by one level ; Therefore, correlation is high (3).
PO4 Verbs: Analyze-L4,CO2 Action Verb is less than PO4 verb by one levels; therefore, correlation is moderate (2).
PO5 Verbs: Apply (L3),CO2 Action Verb is equal to PO5 verb by same level; Therefore, correlation is high (3).

CO3: Evaluate the parameters of feedback amplifier and frequency of oscillators.

Action Verb: Evaluate (L5)

PO1 Verbs: Apply (L3)CO3 Action Verb is high than PO1 verb by two levels ; Therefore, correlation is high (3).
PO2 Verb: Identify (L3)CO3 Action Verb is high than PO2 verb by two levels ; Therefore, correlation is high (3).
PO4 Verbs: Analyze-L4CO3 Action Verb is higher than PO4 verb by one levels; therefore, correlation is high (3).
PO5 Verbs: Apply (L3),CO3 Action Verb is higher than PO5 verb by two levels; Therefore, correlation is high (3).

CO4: Understand the large signal amplifiers and thermal stabilization concepts

Action Verb: Understand(L2)

PO1 Verbs: Apply (L3)CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2 Verbs: Review (L2),CO4 Action Verb is equal to PO2 verb by same levels; therefore, correlation is High (3).
PO4 Verb: Analysis (L4),CO4 Action Verb level is less than PO4 verb by two levels; Therefore, correlation is low (1).
PO5 Verbs: Apply (L3),CO4 Action Verb is less than PO5 verb by one level; Therefore, correlation is moderate (2).

CO5: Analyze tuned amplifiers and effect on bandwidth while cascading tuned amplifiers.

Action Verb: Analyse (L4)

PO1 Verb: Apply (L3),CO5 Action verb is greater to PO1 verb; therefore, the correlation is high (3).
PO2 Verb: Identify (L3),CO5 Action Verb is high than PO2 verb by one levels; Therefore, correlation is high (3).
PO4 verb: Analyze (L4),CO5 Action verb is equal to PO4 verb therefore the correlation is high (3).
PO5 Verbs: Apply (L3),CO5 Action Verb is more than PO5 verb by one level; Therefore, correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
Computer Science and Engineering

Course Code	Year & Sem	Basics of Python Programming Lab	L	T	P	C
20AES0510	II-II		0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the basic concepts of Python Programming

CO2: Apply the loops and conditional statements of python using IDLE and programs.

CO3: Analyzethe compound data using Lists, Tuples and dictionaries using functions.

CO4: Applythe development applications using python datatypes to read and write data from files.

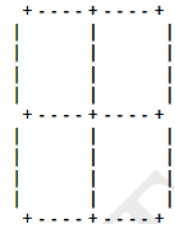
CO5:Designthe solutions using OOPs concepts for real world problems in python.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the basic concepts of Python Programming			L4
CO2	Apply	the loops and conditional statements of python	using IDLE and programs.		L3
CO3	Analyze	the compound data using Lists, Tuples and dictionaries	using functions.		L4
CO4	Apply	the development applications	using python datatypes	to read and write data from files	L3
CO5	Design	the solutions	using OOPs concepts.	for real world problems in python	L6

List of Experiments:

1. Install Python Interpreter and use it to perform different Mathematical Computations. Try to do all**(CO1)**
the operations present in a Scientific Calculator

2. Write a function that draws a grid like the following:**(CO1)**



3. Write a function that draws a Pyramid with # symbols**(CO1)**

```
    #
   # # #
  # # # # #
 # # # # # # #
```

4. Using turtles concept draw a wheel of your choice**(CO1)**

5. Write a program that draws Archimedean Spiral**(CO1)**

6. The letters of the alphabet can be constructed from a moderate number of basic elements, likevertical and horizontal lines and a few curves. Design an alphabet that can be drawn with a minimalnumber of basic elements and then write functions that draw the letters. The alphabet can belong toany Natural language excluding English. You should consider at least Ten letters of the alphabet.**(CO1)**

7. The time module provides a function, also named time that returns the current Greenwich MeanTime in “the epoch”, which is an arbitrary time used as a reference point. On UNIX systems, the
epoch is 1 January 1970.

```
>>> import time
>>>time.time()
1437746094.5735958
```

Write a script that reads the current time and converts it to a time of day in hours,minutes, andseconds, plus the number of days since the epoch.**(CO1)**

8. Given n+r+1 <= 2r . n is the input and r is to be determined. Write a program which computesminimum value of r that satisfies the above**(CO2)**

9. Write a program that evaluates Ackermann function**(CO2)**
10. The mathematician Srinivasa Ramanujan found an infinite series that can be used to generate anumerical approximation of 1/ π :
Write a function called estimate_pi that uses this formula to compute and return an estimate of π.

$$\frac{1}{\pi} = \frac{2\sqrt{2}}{9801} \sum_{k=0}^{\infty} \frac{(4k)!(1103 + 26390k)}{(k!)^4 396^{4k}}$$

It should use a while loop to compute terms of the summation until the last term is smaller than 1e-15 (which is Python notation for 10 -15). You can check the result by comparing it to math.pi.**(CO2)**
11. Choose any five built-in string functions of C language. Implement them on your own in Python. Youshould not use string related Python built-in functions.**(CO2)**
12. Given a text of characters, Write a program which counts number of vowels,consonants and specialcharacters.**(CO2)**
13. Given a word which is a string of characters. Given an integer say 'n', Rotate each character by 'n' positions and print it. Note that 'n' can be positive or negative.**(CO2)**
14. Given rows of text, write it in the form of columns.**(CO2)**
15. Given a page of text. Count the number of occurrences of each latter (Assume case insensitivity anddon't consider special characters). Draw a histogram to represent the same**(CO2)**
16. Write program which performs the following operations on list's. Don't use built-in functions**(CO3)**
a) Updating elements of a list
b) Concatenation of list's
c) Check for member in the list
d) Insert into the list
e) Sum the elements of the list
f) Push and pop element of list
g) Sorting of list
h) Finding biggest and smallest elements in the list
i) Finding common elements in the list
17. Write a program to count the number of vowels in a word.**(CO3)**
18. Write a program that reads a file, breaks each line into words, strips whitespace and punctuationfrom the words, and converts them to lowercase.**(CO4)**
19. Go to Project Gutenberg (http://gutenberg.org) and download your favorite out-of-copyright book inplain text format. Read the book you downloaded, skip over the header information at the beginningof the file, and process the rest of the words as before. Then modify the program to count the totalnumber of words in the book, and the number of times each word is used. Print the number ofdifferent words used in the book. Compare different books by different authors, written in differenteras.**(CO4)**
20. Go to Project Gutenberg (http://gutenberg.org) and download your favorite out-of-copyright book inplain text format. Write a program that allows you to replace words, insert words and delete wordsfrom the file.**(CO4)**
21. Consider all the files on your PC. Write a program which checks for duplicate files in your PC anddisplays their location. Hint: If two files have the same checksum, they probably have the samecontents.**(CO4)**
22. Consider turtle object. Write functions to draw triangle, rectangle, polygon, circle and sphere. Useobject oriented approach.**(CO5)**
23. Write a program illustrating the object oriented features supported by Python.**(CO5)**
24. Design a Python script using the Turtle graphics library to construct a turtle bar chart representingthe grades obtained by N students read from a file categorizing them into distinction, first class,second class, third class and failed.**(CO5)**
25. Design a Python script to determine the difference in date for given two dates in YYYY:MM:DDformat(0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.**(CO5)**
26. Design a Python Script to determine the time difference between two given times in HH:MM:SSformat.(0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)**(CO5)**

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3												
CO2	3	2	2											
CO3	3	3	2	2					1			1		
CO4	3	2												
CO5		1	3	3	3			2	1			2		

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
1	CO1 : Analyze	L4	PO1	PO1: Apply(L3)	2
			PO2	PO2: Analyze(L4)	3
2	CO2 : Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Analyze (L4)	2
			PO12	PO12: Thumb rule	2
3	CO3 :Analyze	L4	PO1	PO1: Apply(L3)	3
			PO2	PO2: Analyze (L4)	3
			PO3	PO3: Design (L6)	2
			PO4	PO4: Design (L6)	2
			PO9	PO9: Thumb rule	1
			PO12	PO12: Thumb rule	1
4	CO4 :Apply	L3	PO1	PO1: Apply(L3)	3
			PO2	PO2: Analyze (L4)	2
5	CO5 : Design	L6	PO2	PO2: Analyze (L4)	1
			PO3	PO3: Design (L6)	3
			PO4	PO4: Design (L6)	3
			PO5	PO5: Develop (L6)	3
			PO8	PO8: Thumb rule	2
			PO9	PO9: Thumb rule	1
			PO12	PO12: Thumb rule	2

Justification Statements :

CO1: Analyze the basic concepts of Python Programming
Action Verb :Analyze (L4)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Analyze(L4)
CO1 Action verb is same level as PO2 verb. Therefore the correlation is high (3)

CO2: Apply the loops and conditional statements of python using IDLE and programs.
Action Verb :Apply (L3)
PO1 Verb : Apply(L3)
CO1 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2 Verb : Analyze(L4)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)
PO12: Thumb rule
For usage of the loops and conditional statements of python using IDLE is medium. Therefore the correlation is medium (2)

CO3: Analyze the compound data using Lists, Tuples and dictionaries using functions.
Action Verb :Analyze(L4)
PO1: Apply(L3)
CO3 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2:Analyze (L4)
CO3 Action verb is higher level as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is less than PO3 verb by one level. Therefore the correlation is medium (2)
PO4: Design (L6)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is medium (2)

PO9 : Thumb rule
Team work is required to Analyze the compound data using. Hence the correlation is low (1)
PO12: Thumb rule
Construct real time applications using functions can be life long learning. Therefore the correlation is low (1)

CO4: Apply the development applications using python datatypes to read and write data from files.
Action Verb :Apply (L3)
PO1: Apply(L3)
CO4 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)

CO5: Design the solutions using OOPs concepts for real world problems in python.
Action Verb :Design(L6)
PO2: Analyze (L4)
CO5 Action verb is less than PO2 verb by two levels. Therefore the correlation is low (1)
PO3: Design (L6)
CO5 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Design (L6)
CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Develop(L6)
CO5 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO8 : Thumb rule
IOT Applications can be used to make society better place. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required to Create BPP applications. Hence the correlation is low (1)
PO12: Thumb rule
In real time oops concepts are used to solve the societal problems. Therefore the correlation is medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	ANALOG COMMUNICATION SYSTEMS LAB	L	T	P	C
20APC0411	II-II		0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the Analog modulation and demodulation methods in time domain.
CO2: Evaluate the characteristics of mixer, pre emphasis and de emphasis.
CO3: Evaluate the performance of various analog pulse modulation schemes.
CO4: Analyze the selectivity, sensitivity and fidelity parameters of radio receiver
CO5: Analyze the parameters of Half wave dipole and loop antenna using radiation pattern.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze(L4)	Analog modulation and demodulation methods	in time domain.		L4
CO2	Evaluate(L5)	the characteristics of mixer, pre emphasis and de emphasis.			L5
CO3	Evaluate(L5)	perfomance of Delta modulation and demodulation systems.			L5
CO4	Analyze(L4)	the selectivity, sensitivity and fidelity parameters of radio receiver			L4
CO5	Analyze(L4)	the parameters of Half wave dipole and loop antenna	using radiation pattern.		L4

LIST OF EXPERIMENTS: (All Experiments are to be conducted)

1. Amplitude modulation and demodulation.(CO1)
2. Frequency modulation and demodulation. (CO1)
3. Characteristics of Mixer. (CO2)
4. Pre-emphasis & de-emphasis. (CO2)
5. Pulse amplitude modulation & demodulation. (CO3)
6. Pulse width modulation & demodulation. (CO3)
7. Pulse position modulation & demodulation. (CO3)
8. Radio receiver measurements – sensitivity selectivity and fidelity. (CO4)
9. Measurement of half power beam width (HPBW) and gain of a half wave dipole antenna.(CO5)
10. Measurement of radiation pattern of a loop antenna in principal planes. (CO5)

EQUIPMENT REQUIRED FOR THE LABORATORY

1. Regulated Power Supply equipment 0 – 30 V
2. CROs 0 – 20 M Hz.
3. Function Generators 0 – 3 M Hz
4. RF Signal Generators 0 – 1000 M Hz
5. Multimeter

REQUIRED ELECTRONIC COMPONENTS (ACTIVE AND PASSIVE) FOR THE DESIGN OF EXPERIMENTS FROM 1 - 7

1. Radio Receiver Demo kits or Trainers.
2. RF power meter frequency range 0 – 1000 MHz
3. Spectrum Analyzer
4. Dipole antennas (2 Nos.) 850 MHz – 1GHz
5. Loop antenna (1 no.) 850 MHz – 1GHz
6. Bread Boards

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**3**	**3**		**3**										**3**
CO2	**3**	**2**		**3**										**3**
CO3	**3**	**3**		**3**										**3**
CO4	**3**	**1**	**1**	**3**	**3**									**3**
CO5	**3**	**1**	**1**	**3**	**3**									**3**

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Analyze(L)	**L4**	PO1, PO2 ,P04	PO1: Apply (L3) PO2: Identify(L3) P04: Analyze(L4)	3 3 3
2	Evaluate(L5)	**L5**	PO1, PO2,P04	PO1: Apply (L3) PO2: Formulate(L6) P04: Analyze(L4)	3 2 3
3	Evaluate(L5)	**L5**	PO1, PO2, P04	PO1: Apply (L3) PO2: Identify(L3) P04: Analyze(L4)	3 3 3
4	Analyze(L4)	**L4**	PO1, PO2,PO3,P04, P05	PO1: Apply (L3) PO2: Formulate(L6) PO3:Design(L6) P04: Analyze(L4) PO5: Apply (L3)	3 1 1 3 3
5	Analyze(L4)	**L4**	PO1, PO2,PO3,P04, P05	PO1: Apply (L3) PO2: Formulate(L6) PO3:Design(L6) P04: Analyze(L4) PO5: Apply (L3)	3 1 1 3 3

Justification Statements :

CO 1: **Analyze the Analog modulation and demodulation methods in time domain.**

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO1 Action Verb is greater than PO1 verb; Therefore correlation is high(3).

PO2 Verbs: Identify (L3)

CO1 Action Verb is greater than PO2 verb; Therefore correlation is high(3) .

PO4 Verbs: Analyze (L4)

CO1 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO 2: Evaluate the characteristics of mixer, pre emphasis and de emphasis.

Action Verb: Evaluate(L5)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater than PO1; Therefore correlation is high (3).

PO2 Verbs: Formulate(L6)

CO2 Action Verb is less than PO2 verb by one level; Therefore correlation is moderate (2).

PO4 Verbs: Analyze(L4)

CO2 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

CO 3: Evaluate the performance of various analog pulse modulation schemes.

Action Verb: Evaluate(L5)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO2 Verb: Identify (L3)

CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO4 Verbs: Analyze(L4)

CO3 Action Verb is greater than PO4 verb; Therefore correlation is high (3).

CO4: Analyze the selectivity, sensitivity and fidelity parameters of radio receiver

PO1 Verbs: Apply (L3)

CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

PO2 Verbs: Formulate(L6)

CO5 Action Verb is less than PO2 verb by two levels; Therefore correlation is low (1).

PO3 Verbs: Design (L6)

CO5 Action Verb is less than PO2 verb by two levels; Therefore correlation is low (1).

PO4 Verbs: Analyze (L4)

CO5 Action Verb is greater than to PO4 by one level ; Therefore correlation is high (3).

PO5 Verb: Apply (L3)

CO5 Action Verb is greater than to PO5 by one level; Therefore correlation is high (3).

CO5: Apply Phase shift keying method for modulation and demodulation of digital signals.
Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO5 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Formulate(L6)

CO5 Action Verb is less than PO2 verb; Therefore correlation is low (1).

PO3 Verbs: Design (L6)

CO5 Action Verb is less than PO2 verb; Therefore correlation is low (1).

PO4 Verbs: Analyze (L4)

CO5 Action Verb is greater than to PO4; Therefore correlation is high (3).

PO5 Verb: Apply (L3)

CO5 Action Verb is greater than to PO5; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & sem		L	T	P	C
20APC0412	II-II	ELECTRONIC CIRCUIT ANALYSIS LABORATORY	0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1:Analyze the frequency response of multistage amplifier and high input resistance amplifier.
CO2**:**Evaluate the Parameters of feedback amplifiers with and without feedback
CO3: Analyze the steps in the design of LC &RC oscillators.
CO4:Evaluate the conversion efficiency of class A and class B power amplifiers.
CO5:Evaluate the performance of single and double tuned amplifiers.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	The frequency response of multistage amplifier and high input resistance amplifier			L4
CO2	Evaluate	the Parameters of feedback amplifiers	with and without feedback		L5
CO3	Analyze	the steps in the design of	LC &RC oscillators.		L4
CO4	Evaluate	the conversion efficiency of	class A and class B power amplifiers		L5
CO5	Evaluate	the performance of	single and double tuned amplifiers		L5

(Minimum of Ten experiments to be performed both in hardware and software)

1. Determination of ft of a given transistor. **CO1**
2. Voltage-Series Feedback Amplifier **CO2**
3. Current-Shunt Feedback Amplifier **CO2**
4. RC Phase Shift/Wien Bridge Oscillator **CO3**
5. Hartley/Colpitt's Oscillator **CO3**
6. Two Stage RC Coupled Amplifier **CO1**
7. Darlington Pair Amplifier **CO1**
8. Bootstrapped Emitter Follower **CO1**
9. Class A Series-fed Power Amplifier **CO4**
10. Transformer-coupled Class A Power Amplifier **CO4**
11. Class B Push-Pull Power Amplifier **CO4**
12. Complementary Symmetry Class B Push-Pull Power Amplifier **CO4**
13. Single Tuned Voltage Amplifier **CO5**
14. Double Tuned Voltage Amplifier **CO5**

SOFTWARE REQUIRED FOR LABORATORY

i. Multisim/ P-Spice /Equivalent Licensed simulation software tool
ii. Computer Systems with required specifications

EQUIPMENT REQUIRED FOR LABORATORY

1. Regulated Power supplies
2. Analog/Digital Storage Oscilloscopes
3. Analog/Digital Function Generators
4. Digital Multimeters
5. Decade Résistance Boxes/Rheostats
6. Decade Capacitance Boxes
7. Ammeters (Analog or Digital)
8. Voltmeters (Analog or Digital)
9. Active & Passive Electronic Components
10. Bread Boards
11. Connecting Wires

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	1	3										3
CO2	3	3	2	3										3
CO3	3	3	1	3										3
CO4	3	3	2	3										3
CO5	3	3	2	3										3

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Analyze	L4	PO1, PO2, PO3, PO4	PO1: Apply PO2: Review PO3: Design PO4: Analyze	3 3 1 3
2	Evaluate	L5	PO1, PO2, PO3, PO4	PO1: Apply PO2: Review PO3: Design PO4: Analyze	3 3 2 3
3	Analyze	L4	PO1, PO2, PO3, PO4	PO1: Apply PO2: Review PO3: Design PO4: Analyze	3 3 1 3
4	Evaluate	L5	PO1, PO2, PO3, PO4	PO1: Apply PO2: Review PO3: Design PO4: Analyze	3 3 2 3
5	Evaluate	L5	PO1, PO2, PO3, PO4	PO1: Apply PO2: Review PO3: Design PO4: Analyze	3 3 2 3

Justification Statements :

CO1: Analyze the frequency response of multistage amplifier and high input resistance amplifier.

Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO1 Action Verb is greater than PO1 action verb by 1 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO1 Action Verb is greater than PO2 action verb by 2 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO1 Action Verb is less than PO3 action verb by 2 level therefore correlation is low (1).
PO4 Verb: Analyze (L4)
CO1 Action Verb is equal to PO4 action verb therefore correlation is high (3).

CO2: Evaluate the Parameters of feedback amplifiers with and without feedback

Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO2 Action Verb is greater than PO1 action verb by 1 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO2 Action Verb is greater than PO2 action verb by 2 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO2 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2).
PO4 Verb: Analyze (L4)
CO2 Action Verb is equal to PO4 action verb therefore correlation is high (3).

CO3: **Analyze the steps in the design of LC &RC oscillators**

Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action Verb is greater than PO1 action verb by 1 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO3 Action Verb is greater than PO2 action verb by 2 level therefore correlation is high (3).
PO3 Verb: Design (L6)

CO3 Action Verb is less than PO3 action verb by 2 level therefore correlation is low (1).
PO4 Verb: Analyze (L4)
CO3 Action Verb is equal to PO4 action verb therefore correlation is high (3).
CO4 Evaluate the conversion efficiency of class A and class B power amplifiers.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO4 Action Verb is greater than PO1 action verb by 1 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO4 Action Verb is greater than PO2 action verb by 2 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO4 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2).
PO4 Verb: Analyze (L4)
CO4 Action Verb is equal to PO4 action verb therefore correlation is high (3).
CO5: Evaluate the performance of single and double tuned amplifiers.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO5 Action Verb is greater than PO1 action verb by 2 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO5 Action Verb is greater than PO2 action verb by 3 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO5 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2).
PO4 Verb: Analyze (L4)
CO5 Action Verb is greater than PO4 action verb by 1 level therefore correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	INTERNET OF THINGS	L	T	P	C
20ASC0402	II-II		1	0	2	2

Course Outcomes: After studying the course, Student will be able to:

CO1: Understand the characteristics and functionality of IoT.
CO2: Analyze the characteristics and applications of various sensors
CO3: Apply different enabling technologies for Arduino IDE.
CO4: Analyze the different electronic components in Development Boards.
CO5: Create an IOT application as a mini project.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The characteristics and functionality of IoT.			L2
CO2	Understand	The types of Sensors			L2
CO3	Apply	Different enabling technologies for Arduino IDE			L3
CO4	Analyze	The different electronic components in Development Boards.			L4
CO5	Create	An IOT application as a mini project.			L6

List of Contents

1. INTRODUCTION TO IOT

- Characteristics of IoT
- Design Principles of IoT
- IoT Architecture

2. SENSORS

- Sensors Classification
- Working Principle of Sensors
- Criteria to choose a Sensor
- Generation of Sensors

3. BASICS OF ARDUINO

- Introduction to Arduino
- Study of Arduino Board with Specifications
- Basic Commands for Arduino
- Advantages of Arduino

4. EXAMPLES USING ARDUINO

- Digital Sensor using Arduino consists of Development Board, Digital Sensor (Pull-up switch), LED, Connecting wires.
- Development Board, Actuators, Bluetooth Module (HC-05), Connecting wires.

5. MINI PROJECT:

- Students should complete their Mini Project based on the above concepts.

• Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**3**			**3**								**2**	
CO2	**3**	**3**			**3**								**1**	
CO3	**3**	**3**			**3**									**2**
CO4	**3**	**3**		**3**	**3**									**2**
CO5		**3**	**3**	**3**	**3**									**3**

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Understand	L2	PO1, PO2,PO5	PO1: Apply (L3) PO2: Review (L2) PO5: Select (L1)	2 3 3
2	Analyze	L4	PO1, PO2,PO5	PO1: Apply (L3) PO2: Identify (L3) PO5: Select (L1)	3 3 3
3	Apply	L3	PO1, PO2, PO5	PO1: Apply (L3) PO2: Review (L2) PO5: Select (L1)	3 3 3
4	Analyze	L4	PO1,PO2, PO4, PO5	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze (L4)	3 3 3 3
5	create	L6	PO2, PO3,PO4,PO5	PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 3 3

Justification Statements :

CO 1: Understand the characteristics and functionality of IoT.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2)

PO2 Verbs: Review (L2)

CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

PO5 Verbs: Select (L1)

CO1 Action Verb is greater than PO5 verb by one level; Therefore correlation is high (3)

CO 2: Analyze the characteristics and applications of various sensors

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high(3)

PO2 Verbs: Identify (L3)

CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high(3)

PO5 Verbs: Select (L1)

CO2 Action Verb is greater than PO5 verb by one level; Therefore correlation is high(3)

CO 3: Apply different enabling technologies for Arduino IDE.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO3 Action Verb is equal to PO1 verb ,Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO3 Action Verb is greater than PO2 verb by one level; Therefore correlation is high (3).

PO5 Verbs: PO5: Select (L1)

CO3 Action Verb is greater than PO5 verb by two level Therefore correlation is high (3).

CO4: Analyze the different electronic components in Development Boards.

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)

CO4 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)

PO2 Verbs: Review (L2)

CO4 Action Verb is greater than PO2 verb by two level; Therefore correlation is high (3).

PO4: Analyze (L4)

CO4 Action Verb is equal to PO4 verb, Therefore correlation is high (3).

PO5 Verbs: PO5: Select (L1)

CO4 Action Verb is greater than PO5 verb ,Therefore correlation is high (3).

CO5: Create an IOT application as a mini project.

Action Verb: Create (L6)

PO2 Verbs: Review (L2)

CO5 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO3 Verbs: Design (L6)

CO5 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO4 Verbs: Analyze (L4)

CO5 Action Verb is greater than PO4 verb, Therefore correlation is high (3).

PO5 Verbs: Apply (L3)

CO5 Action Verb is greater than PO5 verb ; Therefore correlation is high (3)

Year: **II** Semester: **II** Branch of Study : ECE

SubjectCode	SubjectName	L	T	P	Credits
20AHS9905	Universal Human Values	2	1	0	3

Course Outcomes: After studying this course, Student will be able to:

CO1. Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.

CO2. Analyze the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.

CO3. Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.

CO4. Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.

CO5. Apply the holistic understanding of harmony on professional ethics through augmenting universal human order.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the essentials of human values, self-exploration, happiness and prosperity for value added education			**L2**
CO2	**Analyze**	the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.			**L4**
CO3	**Apply**	the nine universal human values in relationships for harmony in the family and orderliness in the society			**L3**
CO4	**Evaluate**	the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence			**L5**
CO5	**Apply**	the holistic understanding of harmony on professional ethics through augmenting universal human order.			**L3**

UNIT – 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

- Purpose and motivation for the course, recapitulation from Universal Human Values-I
- Self-Exploration–what is it? - Its content and process; 'Natural Acceptance' and Experiential Validation- as the process for self-exploration
- Continuous Happiness and Prosperity- A look at basic Human Aspirations
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority
- Understanding Happiness and Prosperity correctly- A critical appraisal of the current. scenario
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT II: Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physical facility
- Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'

- Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.

UNIT III: **Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship**.

• Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
• Understanding the meaning of Trust; Difference between intention and competence
• Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship
• Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
• Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family
Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives

UNIT IV:**Understanding Harmony in the Nature and Existence - Whole existence as Coexistence**

• Understanding the harmony in the Nature
• Interconnectedness and mutual fulfillment among the four orders of nature recyclability and self-regulation in nature
• Understanding Existence as Co-existence of mutually interacting units in all- pervasive space
• Holistic perception of harmony at all levels of existence. Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT- V: Implications of the above Holistic Understanding of Harmony on Professional Ethics.

• Natural acceptance of human values
• Definitiveness of Ethical Human Conduct
• Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
• Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
• Case studies of typical holistic technologies, management models and production systems
• Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers, technologists and managers b. At the level of society: as mutually enriching institutions and organizations
• Sum up.
Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions Eg. To discuss the conduct as an engineer or scientist etc.

TEXT BOOKS

1. R R Gaur, R Asthana, G P Bagaria, "A Foundation Course in Human Values and Professional

Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93- 87034-47-1
2. R R Gaur, R Asthana, G P Bagaria, "Teachers' Manual for A Foundation Course in Human Values and Professional Ethics", 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

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1. Jeevan Vidya: EkParichaya, A Nagaraj, Jeevan VidyaPrakashan, Amar kantak, 1999.
2. A. N. Tripathi, "Human Values", New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi "The Story of My Experiments with Truth"
5. E. FSchumacher. "Small is Beautiful"
6. Slow is Beautiful –Cecile Andrews
7. J C Kumarappa "Economy of Permanence"
8. PanditSunderlal "Bharat Mein Angreji Raj"
9. Dharampal, "Rediscovering India"
10. Mohandas K. Gandhi, "Hind Swaraj or Indian Home Rule"
11. India Wins Freedom - Maulana Abdul Kalam Azad
12. Vivekananda - RomainRolland(English)
13. Gandhi - Romain Rolland (English)

Articulation matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
Universal Human Values	CO1								2				12		
	CO2							3	3						
	CO3						2	2	2						
	CO4						3	3	3				3		
	CO5						2	2	2				2		

Correlation matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	**7**	19.4	2	**Understand**	**2**	PO8,PO12	Thumb Rule	2,2
2	**8**	22.2	3	**Analyze**	**4**	PO7,PO8	Thumb Rule	3,3
3	**7**	19.4	**2**	**Apply**	**3**	PO6,PO7,PO8	Thumb Rule	2,2,2
4	**8**	22.2	**3**	**Evaluate**	**5**	PO6,PO7,PO8,PO12	Thumb Rule	3,3,3,3
5	**7**	19.4	**2**	**Apply**	**3**	PO6,PO7,PO8,PO12	Thumb Rule	2,2,2,2

Justification Statements:

CO1: Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.
Action Verb: Understand (L2)
CO1 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).
CO2: Analyze the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.

Action Verb: Analyze (L4)

CO2 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3).

CO3: Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.

Action Verb: Apply (L3)

CO3 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2)

CO4: Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.

Action Verb:Evaluate (L5)

CO4 Action Verb is Evaluate of BTL5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3).

CO5: Apply the holistic understanding of harmony on professional ethics through augmenting universal human order.

Action Verb: Apply (L3)

CO5 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2).

V Semester (B.Tech –III year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	PCC	20APC0413	Antennas and Wave Propagation	3	0	0	3	30	70	100
2	PCC	20APC0414	Digital Communication Systems	3	0	0	3	30	70	100
3	PCC	20APC0415	Integrated Circuits and Applications	3	0	0	3	30	70	100
4	OEC	20APC0515	Operating Systems	3	0	0	3	30	70	100
		20AOE0202	Programmable Logic Controllers							
		20APC0213	Control Systems							
5	PEC	20APE0401	VLSI Design	3	0	0	3	30	70	100
		20APE0402	Computer Organization							
		20APE0403	Digital System Design							
6	PCC	20APC0416	Digital Communication Systems Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0417	Integrated Circuits and Applications Laboratory	0	0	3	1.5	30	70	100
8	SOC	20AHE9902	Principles of Effective Public Speaking	1	0	2	2	100	-	100
9	MC	20AMC9904	Professional Ethics and Human Values	3	0	0	0	30	-	30
10	CSP	20CSP0401	Community Service Project	0	0	0	1.5	100	-	100
TOTAL							**21.5**	**440**	**490**	**930**

S. No.	Open Elective*(OE/JOE come for NPTEL)
1	The Joy of Computing Using Python
2	Computer Architecture
3	An Introduction to Artificial Intelligence
4	Environment and Development
5	Soft Skills
6	Public Speaking
7	Ethical Hacking
8	Cloud Computing
9	Electronic Systems for Cancer Diagnosis
10	Remote Sensing Essentials
11	Sustainable Transportation Systems

Student shall register any number of MOOC courses listed above (Open) by the department as approved by the BOS from III year. But student is required to submit the pass certificate on NPTEL platform for at least one course with in the Programme duration (Before IV-II examination notification released).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	ANTENNAS AND WAVE PROPAGATION	L	T	P	C
20APC0413	III-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the fundamentals of Antenna Parameters.
CO2: **Analyze** the working principles of Loop, Yagiuda, Helical and Horn antenna
CO3: **Analyze** the working principles of Micro-strip antenna, Reflector, Lens antennas and its parameters.
CO4: **Analyze** the Principles of Antenna Arrays and Measurements using pattern multiplication.
CO5: **Understand** Different Modes of Wave propagation in Atmospheric Layers.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of Antenna Parameters.			L2
CO2	Analyze	the working principles of		Loop, Yagiuda, Helical and Horn antenna	L4
CO3	Analyze	the working principles of		Micro-strip antenna, Reflector, Lens antennas and its parameters.	L3
CO4	Analyze	The Principle Antenna Arrays and Measurements.	Using Pattern Multiplication		L3
CO5	Understand	The Different Modes of Wave propagation in Atmospheric Layers.			L2

UNIT - I		16Hrs

ANTENNA BASICS
Introduction, Basic antenna parameters - patterns, Beam Area, Radiation Intensity, BeamEfficiency, Directivity, Gain, Antenna Apertures, Effective height, Polarization - Linear,Elliptical, & Circular polarizations, Antenna impedance, Front–to-back ratio, Antenna theorems.

DIPOLE ANTENNAS
Basic Maxwell's equations, Retarded potential-Helmholtz Theorem, Radiation from Small Electric Dipole, Current Distributions, Field Components, Radiated power, Radiation Resistance, Beam width, Natural current distributions, Fields from oscillating dipole, Illustrative problems.

UNIT - II		16Hrs

VHF, UHF AND MICROWAVE ANTENNAS-I
Loop Antennas: Introduction, Small Loop, Comparison of far fields of small loop and short dipole. **Arrays with Parasitic Elements:** Yagi - Uda Arrays, Folded Dipoles & their characteristics. **Helical Antennas:** Helical Geometry, Helix modes, Practical Design considerations for Monofilar Helical Antenna in Axial and Normal Modes. **Horn Antennas:** Types, Fermat's Principle, Optimum Horns, Design considerations of Pyramidal Horns, Illustrative Problems.

UNIT - III		15Hrs

VHF, UHF AND MICROWAVE ANTENNAS-II
Micro strip Antennas: Introduction, features, advantages and limitations, rectangular patch antennas- Geometry and parameters, characteristics of Micro strip antennas, Impact of different parameters on characteristics. **Reflector antennas:** Introduction, Flat sheet and corner reflectors, parabola reflectors- geometry, pattern characteristics, Feed Methods, Reflector Types - Related Features. **Lens Antennas:** Geometry of Non-metallic Dielectric Lenses, Zoning, Tolerances, Applications, Illustrative Problems.

UNIT - IV		15Hrs

ANTENNA ARRAYS
Definition, Patterns, arrays of 2 Isotropic sources different cases, Principle of Pattern Multiplication, Uniform Linear Arrays – Broadside Arrays, End fire Arrays.

ANTENNA MEASUREMENTS
Introduction, Near and Far Fields, Pattern Measurement, Directivity Measurement, Gain Measurements (by comparison, Absolute and 3-Antenna Methods).

UNIT - V		15Hrs

WAVE PROPAGATION
Introduction, Definitions, Characterizations and general classifications, different modes of wave propagation, Ray/Mode concepts.
Ground wave propagation: Introduction, Plane earth reflections, Space and surface waves, wave tilt, curved earth reflections.
Space wave propagation: Introduction, Super refraction, duct propagation, fading and path loss calculations.
Sky wave propagation: Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Relation between MUF and Skip distance, Multi - HOP propagation, Illustrative problems.

Textbooks:
1. John D. Kraus and Ronald J. Marhefka and Ahmad S. Khan, "Antennas and wave propagation," TMH, New Delhi, 4th Ed., (special Indian Edition), 2010. 2. E.C. Jordan and K.G. Balmain, "Electromagnetic Waves and Radiating Systems," PHI, 2ndEdn, 2000.
Reference Books:
1. C.A. Balanis, "Antenna Theory- Analysis and Design," John Wiley & Sons, 2nd Edn., 2001. 2. K.D. Prasad, Satya Prakashan, "Antennas and Wave Propagation," Tech. India Publications, New Delhi, 2001.
Online Learning Resources:
nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2									2	2	
CO2	3	3	3	3								2	3	
CO3	3	3	3	2								2	3	
CO4	3	3	3	3								2	3	
CO5	2	2	2	1								2	2	

Correlation Matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	16	21	3	Understand	L2	PO1,PO2 PO3, PO12	PO1: Apply (L3) PO2:Review(L2) PO3: Develop (L3) PO12:Thumb rule	2 3 2 2
2	16	21	1	Analyze	L4	PO1,PO2,PO 3,PO4,PO12	PO1: Apply (L3) PO2:Review(L2) PO3:Develop(L3) PO4:Interpret(L2). PO12: Thumb rule	3 3 3 3 2
3	15	19	1	Analyze	L4	PO1,PO2,PO 3,PO4,PO12	PO1:Apply(L3) PO2:Identify(L3) PO3:Develop(L3) PO4: Analyze (L4) PO12: Thumb rule	3 3 3 3 2
4	15	19	1	Analyze	L4	PO1,PO2,PO 3,PO4,PO12	PO1:Apply(L3) PO2:Identify(L3) PO3:Develop(L3) PO4: Analyze (L4) PO12: Thumb rule	3 3 3 3 2
5	15	19	1	Understand	L2	PO1,PO2,PO 3,PO4,PO12	PO1:Apply(L3) PO2:Identify(L3) PO3:Develop(L3) PO4: Analyze (L4) PO12: Thumb rule	2 2 2 1 2
	77							

Justification Statements:

CO1: Understand the fundamentals of Antenna Parameters.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO 2 Verbs: Review (L2)CO1 Action Verb is equal to PO1 verb; Therefore correlation is High (3).
PO3 Verbs: Develop (L3)CO1 Action Verb is less than PO3 verb by one levels; therefore correlation is moderate (2).
PO 12 Verbs: Based on the Thumb rule CO1correlates PO12correlation is moderate (2).

CO2: Analyze the working principles of Loop, Yagiuda, Helical and Horn antenna

PO1 Verbs: Apply (L3)CO2 Action Verb is higher than PO1 verb by one level; Therefore correlation is High (3).
PO 2 Verbs: Review (L2)CO2 Action Verb is higher than PO2 verb by two level; Therefore correlation is High (3).
PO3 Verbs: Develop (L3)CO2 Action Verb is higher than PO3 verb by one level; Therefore correlation is High (3).

PO4 Verbs: Interpret (L2)CO2 Action Verb is higher than PO4 verb by two level; Therefore correlation is High (3).
PO 12 Verbs: Based on the Thumb rule CO2correlates PO12correlation is moderate (2).

CO3: Analyze the working principles of Micro-strip antenna, Reflector, Lens antennas and its parameters.

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)CO3 Action Verb is equal to PO1 verb; Therefore correlation is High (3).
PO2 Verb: Identify (L3)CO3 Action Verb level is equal to PO2 verb; Therefore correlation is High (3).
PO3 Verb: Develop (L3)CO3 Action Verb is equal to PO3 verb; Therefore correlation is High (3).
PO4 Verb: Analysis (L4)CO3 Action Verb is less than PO4 verb by one levels; Therefore correlation is moderate (2).
PO 12 Verbs: Based on the Thumb rule CO3correlates PO12correlation is moderate (2).

CO4: Analyze the Principle of Pattern Multiplication for Antenna Arrays and Measurements.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)CO4 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)CO4 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)CO4 Action Verb is equal PO3 verb; Therefore correlation is high(3).
PO4 Verb: Analysis (L4)CO4 Action Verb is less than PO4 verb by one levels; Therefore correlation is moderate (2).
PO 12 Verbs: Based on the Thumb rule CO4correlates PO12correlation is moderate (2).

CO5: Understand Different Modes of Wave propagation in Atmospheric Layers.

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)CO5 Action verb is less than to PO1 verb by one level; therefore the correlation is moderate (2).
PO2 Verb: Identify (L3)CO5 Action Verb level is less than to PO2 verb by one level; therefore the correlation is moderate (2).
PO3 verb: Develop (L3)CO5 Action verb is less than to PO3 verb by one level; therefore the correlation is moderate (2).
PO4 verb: Analysis (L4)CO5 Action verb is less than to PO3 verb by two level; therefore the correlation is low (1).
PO 12 Verbs: Based on the Thumb rule CO5 correlates PO12,correlation is moderate (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Digital communication systems	L	T	P	C
20APC0414	III-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

Co1:Understand the concepts of various digital pulse modulation methods.

Co2:Analyze the performance of base band pulse transmission using signalling schemes.

Co3:Apply the signal representation and error probabilities in receivers.

Co4:Apply the digital modulation techniques for pass band data transmission.

Co5:Evaluate the error detection and error correction using Block code and Convolutional code.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The concepts of various digital pulse modulation methods.			L2
CO2	Analyze	The performance of base band pulse transmission	Using signaling schemes.		L4
CO3	Apply	The signal representation and error probabilities in receivers.			L3
CO4	Apply	The digital modulation techniques for pass band data transmission.			L3
CO5	Evaluate	The error detection and error correction	Using Block code and Convolutional code.		L5

UNIT - I		10Hrs

SOURCE CODING SYSTEMS

Introduction, sampling process, quantization, quantization noise, Pulse-Code Modulation (PCM), Line codes-Types, Noise considerations in PCM systems, Time-Division Multiplexing (TDM), Synchronization, Delta modulation (DM), Differential PCM (DPCM), Processing gain, AdaptiveDPCM (ADPCM), Comparison of the above systems.

UNIT - II		10Hrs

BASEBAND PULSE TRANSMISSION

Introduction, optimum filter, Matched filter, Properties of Matched filter, Error rate due to noise, Inter-symbol Interference (ISI), Nyquist's criterion for distortion less baseband binary transmission, ideal Nyquist channel, Raised cosine filter & its spectrum, Correlative coding – Duo binary & Modified duo binary signaling schemes, Eye diagrams.

UNIT - III		15Hrs

SIGNAL SPACE ANALYSIS

Introduction, Geometric representation of signals, Gram Schmidt orthogonalization procedure, Conversion of the Continuous AWGN channel into a vector channel, Coherent detection of signals in noise, Correlation receiver, Equivalence of correlation and Matched filter receivers, Probability of error, Signal constellation diagram.

UNIT - IV		14Hrs

PASS BAND DATA TRANSMISSION

Introduction, Pass band transmission model, Coherent phase-shift keying – binary phase shift keying (BPSK), Quadrature shift keying (QPSK), Binary Frequency shift keying (BFSK), Error probabilities of BPSK, QPSK, BFSK, Generation and detection of Coherent BPSK, QPSK, & BFSK, Power spectra of above mentioned modulated signals

UNIT - V		14Hrs

CHANNEL CODING

Error Detection & Correction - Repetition & Parity Check Codes, Interleaving, Code Vectors and Hamming Distance, Forward Error Correction (FEC) Systems, Automatic Retransmission Query (ARQ) Systems, Linear Block Codes – Matrix Representation of Block Codes, Convolutional Codes – Code tree, state diagram, code trellis, Decoding Methods-Viterbi algorithm.

Textbooks:

1.D. Roy Chowdhury, "Linear Integrated Circuits", New Age Int. (P) Ltd, 2nd Edition, 2003.

K. LalKishore,"OperationalAmplifiers&Linear Integrated circuits", Pearson Education, 2007.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2		2								2	
CO2	3	3	3	3	3								3	
CO3	3	3	3	3	3								3	
CO4	3	3	3	2	3								3	
CO5	3	3	2	3	2								3	

Correlation Matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	18	24	3	Understand	L2	PO1, PO2, PO3,PO5	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO5: Apply (L3)	2 2 2 2
2	14	19	2	Analyze	L4	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
3	10	14	2	Apply	L3	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2:I Identify (L3) PO3: Develop (L3) PO4: Interpret(L2) PO5: Apply (L3)	3 3 3 3 3
4	16	22	3	Apply	L3	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2: Identify(L3) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 2 3
5	16	22	3	Evaluate	L5	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2: Identify (L3) PO3: Design(L6) PO4: Analyze (L4) PO5: Create (L6)	3 3 2 3 2
	74							

Justification Statements:

CO 1: Understand the concepts of various digital pulse modulation methods.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Identify (L3)CO1 Action Verb is less than PO2 verb by one level ; Therefore correlation is moderate (2).
PO3 Verbs: Develop (L3)CO1 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).
PO5 Verbs: Apply (L3)CO1 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).

CO2: Analyze the performance of base band pulse transmission using signaling schemes

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Identify (L3)CO2 Action Verb is greater than PO2 verb ; Therefore correlation is high (3).
PO3 Verbs: Develop (L3CO2 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze (L4)CO2 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3)CO2 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO3: Apply the signal representation and error probabilities in receivers.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)CO3 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)CO3 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO4 Verbs: Interpret(L2 CO3 Action Verb is greater than PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3CO3 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO4: Apply the digital modulation techniques for pass band data transmission.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)CO4 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verb: Identify (L3)CO4 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)
CO4 Action Verb is equal to PO3 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4)
CO4 Action Verb is less than PO4 verb by one level; Therefore correlation is moderate (2).
PO5 Verb: Apply (L3)
CO4 Action Verb is equal to PO5 verb; Therefore correlation is high (3).

CO5: Evaluate the error detection and error correction using Block code and Convolutional code.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)
CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).
PO2 verb: Identify (L3)
CO5 Action verb is greater than PO2 verb ; therefore the correlation is high (3).
PO3 verb: Design(L6)
CO5 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).
PO4 verb: Analyze (L4)
CO5 Action verb is greater than PO4 verb therefore the correlation is high (3).
PO5 Verb: Create (L6)
CO5 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	INTEGRATED CIRCUITS AND APPLICATIONS	L	T	P	C
20APC0415	III-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the basic building blocks of operational amplifiers and its characteristics

CO2. **Analyze** the frequency response of different feedback amplifiers using Operational amplifiers.

CO3. **Analyze** the linear and nonlinear applications and filter design using operational amplifiers

CO4. **Understand** the oscillators and specialized applications using opamps and 555 IC Timer respectively

CO5. **Analyze** the Analog to Digital Converters and Digital to Analog Converters using Opamp.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic building blocks of operational amplifiers its characteristics			L2
CO2	Analyze	the frequency response of different feedback amplifiers	using Operational amplifiers		L4
CO3	Analyze	the linear and nonlinear applications and filter design	using operational amplifiers		L4
CO4	Understand	the oscillators and specialized applications	using opamps and 555 IC Timer respectively		L2
CO5	Analyze	the Analog to Digital Converters and Digital to Analog Converters	using Opamp		L4

UNIT - I		15Hrs
DIFFERENTIAL AMPLIFIERS: Differential amplifier configurations, Balanced and unbalanced output differential amplifiers, current mirror, level Translator. **OPERATIONAL AMPLIFIERS**: Introduction, Block diagram, Ideal op-amp, Equivalent Circuit, VoltageTransfer curve, open loop op-amp configurations. Introduction to dual OP-AMP TL082 as a general purpose JFET-input Operational Amplifier.		
UNIT - II		14Hrs
FEED BACK AMPLIFIERS: Introduction, feedback configurations, voltage series feedback, voltage shunt feedback and differential amplifiers, properties of Practical op-amp. **FREQUENCY RESPONSE**: Introduction, compensating networks, frequency response of internally compensated op-amps and non-compensated op-amps, High frequency op-amp equivalent circuit, open loop gainVs frequency, closed loop frequency response, circuit stability, slew rate.		
UNIT - III		15Hrs
OP-AMP APPLICATIONS-1: DC and AC amplifiers, peaking amplifier, summing, scaling and averaging amplifiers, instrumentation amplifier, voltage to current converter, current to voltage converter, integrator, differentiator, active filters, First and Second order Butterworth filter and itsfrequency response.		
UNIT - IV		16Hrs
OP-AMP APPLICATIONS -2: Oscillators, Phase shift and Wein bridge oscillators, Square, triangular and saw tooth wave generators, Comparators, zero crossing detector, Schmitt trigger, characteristics and limitations. **SPECIALIZED APPLICATIONS**: 555 timer IC (monostable & astable operation) & its applications, PLL, operating principles, Monolithic PLL, applications, analog multiplier and phase detection		
UNIT - V		15Hrs
A/D AND D/A CONVERTERS: Analog and Digital Data Conversions, D/A converter – specifications – weighted resistor type, R-2R Ladder type, Voltage Mode and Current-Mode R - 2R Ladder types - switches for D/A converters, high speed sample-and-hold circuits, A/D Converters – specifications – Flash type – Successive Approximation type –Counter type ADC– Dual Slope type ADC.		
Textbooks:		
1.D. Roy Chowdhury, "Linear Integrated Circuits", New Age Int. (P) Ltd, 2nd Edition, 2003. **K. LalKishore,"OperationalAmplifiers&Linear Integrated circ**uits", Pearson Education, 2007.		
Online Learning Resources:		
nptel videos		

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2		1									2	
CO2	3	3	1										3	
CO3	3	1		3								3	3	
CO4	2	3	2									2	2	
CO5	3	3		2								3	3	

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	20%	2	Understand	L2	PO1, PO2, PO4	PO1: Apply (L3) PO2: Identify(L3) PO4: Analyze(L4)	2 2 1
2	14	19%	2	Analyze	L4	PO1, PO2, PO3,	PO1: Apply (L3) PO2: Identify (L3) PO3:Design(L6)	3 3 1
3	15	20%	2	Analyze	L4	PO1, PO2, PO4 PO12	PO1: Apply(L3) PO2:Formulate(L6) PO4: Analyze(L4) PO12:Thumb rule	3 1 3 3
4	16	21%	3	Understand	L2	PO1, PO2, PO3, PO12	PO1: Apply (L3) PO2: Review(L2) PO3: Develop (L3) PO12:Thumb rule	2 3 2 2
5	15	20%	2	Analyze	L4	PO1, PO2, PO4 PO12	PO1: Apply(L3) PO2: Identify (L3) PO4: Interpret(L5) PO12:Thumb rule	3 3 2 3
	75	100%						

Justification Statements:

CO1: Understand the basic building blocks of operational amplifiers and its characteristics

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)CO1 Action Verb is less than PO1 verb by one level.Therefore,the correlation is medium (2).
PO2 Verbs:Identify (L3)CO1 Action Verb isless than PO2 verb by one level. Therefore, the correlation is medium (2).
PO4 Verb: Analyze (L4)CO1 Action Verb is less than PO4 verb by two level. Therefore, the correlation is low (1).

CO2: Analyze the frequency response of different feedback amplifiers using Operational amplifiers Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)CO2 Action Verb is greaterthan the PO1 verb. Therefore,the correlation is high (3).
PO2 Verbs: Identify (L3)CO2 Action Verb is greater than the PO2 verb. Therefore, the correlation is high (3).
PO3 Verb: Design (L6)CO2 Action Verb is less than PO3 verb by two level. Therefore, the correlation is low (1).

CO3: Analyze the linear and nonlinear applications and filter design using operational amplifiers.
Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)CO3 Action Verb is greater than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Formulate (L6)CO3 Action Verb is less than PO3 verb by two level. Therefore, the correlation is low (1).
PO4 Verb: Analyze (L4)CO3 Action Verb is same as the PO4 verb. Therefore, the correlation is high (3).
PO12: CO3 using Thumb rule, correlates PO12 as high (3).

CO4: Understand the oscillators and specialized applications using opamps and 555 IC Timer respectively
Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)CO4 Action Verb is less than the PO1 verbby one level.Therefore,the correlation is medium (2).
PO4 Verb: Review (L2)CO4 Action Verb level is equal to PO4 verb. Therefore, he correlation is high (3).
PO3 Verbs: Develop (L3)CO4 Action Verb is less than the PO5 verbby one level.Therefore, correlation is medium (2).
PO12: CO4 using Thumb rule, correlates PO12 as medium (2).

CO5: Analyze the Analog to Digital Converters and Digital to Analog Converters using Opamp.
Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)CO5 Action verb is greater than the PO1 verb. Therefore, the correlation is high (3).

PO2 verb: Identify (L3)
CO5 Action verb is greater than the PO2 verb. Therefore, the correlation is high (3).
PO4 verb: Interpret (L5)CO5 Action verb is less than the PO4 verb by one level. Therefore, the correlation is medium (2)
PO12: CO5 using Thumb rule, correlates PO12 as high(3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI

(AUTONOMOUS)

COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Operating Systems	L	T	P	C
20APC0515	III-I	**(common to CSE,CIC,AIDS,AIML,CSE(DS),ECE)**	**3**	**0**	**0**	**3**

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the basic concepts of Operating Systems and its services.
CO2: **Apply** the concepts of process synchronization and CPU scheduling by drawing Gantt chart
CO3: **Analyze**the methods to handle deadlock and memory management
CO4: **Evaluate**the various disk scheduling algorithms and file system interfaces
CO5: **Understand** the issues and goals of protection various security

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloomslevel
CO1	Understand	the basic concepts of Operating Systems and its services			L2
CO2	Apply	the concepts of process synchronization & CPU scheduling	by drawing Gantt chart		L3
CO3	Analyze	the methods to handle deadlock and memory management			L4
CO4	Evaluate	the various disk scheduling algorithms and file system interfaces			L5
CO5	Understand	the various security issues and goals of protection			L2

UNIT - I		9Hrs
Operating Systems Overview: Operating system functions, Operating system structure, operating systems Operations, protection and security, Computing Environments, Open- Source Operating Systems **System Structures**: Operating System Services, User and Operating-System Interface, systems calls, Types of System Calls, system programs, operating system structure, operating system debugging, System Boot. **Processes:** Process concept, process Scheduling, Operations on processes, Inter process Communication, Examples of IPC systems.		
UNIT - II		10Hrs
Threads: overview, Multi-core Programming, Multithreading Models, Thread Libraries, Implicit Threading, Threading Issues. **Process Synchronization:** The critical-section problem, Peterson's Solution, Synchronization Hardware, Mutex Locks, Semaphores, Classic problems of synchronization, Monitors, Synchronization examples, Alternative approaches. **CPU Scheduling:** Scheduling-Criteria, Scheduling Algorithms, Thread Scheduling, Multiple-Processor Scheduling, Real-Time CPU Scheduling, Algorithm Evaluation.		
UNIT - III		8Hrs
Memory Management: Swapping, contiguous memory allocation, segmentation, paging, structure of the page table. **Virtual memory:** demand paging, page-replacement, Allocation of frames, Thrashing, Memory-Mapped Files, Allocating Kernel Memory **Deadlocks:** System Model, deadlock characterization, Methods of handling Deadlocks, Deadlock prevention, Detection and Avoidance, Recovery from deadlock.		
UNIT - IV		9Hrs
Mass-storage structure: Overview of Mass-storage structure, Disk structure, Disk attachment, Disk scheduling, Swap-space management, RAID structure, Stable-storage implementation. **File system Interface:** The concept of a file, Access Methods, Directory and Disk structure, File system mounting, File sharing, Protection. **File system Implementation:** File-system structure, File-system Implementation, Directory Implementation, Allocation Methods, Free-Space management.		
UNIT - V		8Hrs
I/O systems: I/O Hardware, Application I/O interface, Kernel I/O subsystem, Transforming I/O requests to Hardware operations. **Protection:** Goals of Protection, Principles of Protection, Domain of protection, Access Matrix, Implementation of Access Matrix, Access control, Revocation of Access Rights, Capability- Based systems, Language – Based Protection		

Security: The Security problem, Program threats, System and Network threats, Cryptography as a security tool, User authentication, Implementing security defenses, Firewalling to protect systems and networks, Computer–security classifications.
Textbooks:
1. Operating System Concepts, Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Wiley, Eight Edition, 2018
Reference Books:
1. Operating systems by A K Sharma, Universities Press, 2. Operating Systems, S.Haldar, A.A.Aravind, Pearson Education. 3. Operating Systems, A.S.Godbole, Second Edition, TMH. 4. Operating Systems, G.Nutt, N.Chaki and S.Neogy, Third Edition, Pearson Education. 5. Operating Systems, R.Elmasri, A,G.Carrick and D.Levine, Mc Graw Hill. 6. Principles of Operating Systems, B.L.Stuart, Cengage learning, India Edition.
Online Learning Resources:
https://nptel.ac.in/courses/106/106/106106144/http://peterindia.net/OperatingSystems.html

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										2	1	1
CO2	3	3				2						3	1	1
CO3	3	3	3	3	3								2	2
CO4	3	3	3	3	3	2		3				2	2	2
CO5	2	3						3				2	2	2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	16	19%	2	CO1 : Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	2 3 2
2	19	22%	3	CO2 :Apply	L3	PO1 PO2 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO6: Thumb rule PO12: Thumb rule	3 3 2 3
3	16	19%	2	CO3 : Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3)	3 3 3 3 3
4	18	21%	3	CO4 :Evaluate	L5	PO1 PO2 PO3 PO4 PO5 PO6 PO8 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO6: Thumb rule PO8: Thumb rule PO12: Thumb rule	3 3 3 3 3 2 3 2
5	17	19%	2	CO5 : Understand	L2	PO1 PO2 PO8 PO12	PO1: Apply(L3) PO2: Review(L2) PO8: Thumb rule PO12: Thumb rule	2 3 3 2
	86	100 %						

Justification Statements :

CO1: Understand the basic concepts of Operating Systems and its services.
Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb :Review(L2)
CO1 Action verb is same as PO2 verb. Therefore the correlation is high(3)
PO12: Thumb rule

In today's world operating system services are updating, those services needs to understand. Therefore the correlation is medium (2)

CO2: Apply the concepts of process synchronization & CPU scheduling by drawing gantt chart
Action Verb :Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2 Verb :Review(L2)
CO1 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)
PO6: Thumb rule
Most of the scheduling algorithm were used to solve some of the societal problems like forming Queue line. Therefore the correlation is Moderate (2)
PO12: Thumb rule
Scheduling is the one of the daily activity done in many sectors. Therefore the correlation is High(3)

CO3: Analyzethe methods to handle deadlock and memory management
Action Verb :Analyze (L4)
PO1: Apply(L3)
CO3 Action verb is greater level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO3 Action verb is greater than PO3 verb by one level. Therefore the correlation is high(3)
PO4: Analyze (L4)
CO3 Action verb is sameas PO4 verb. Therefore the correlation is high(3)
PO5: Apply(L3)
CO3 Action verb is greater than PO5 verb by one level. Therefore the correlation is high(3)

CO4: Evaluatethe various disk scheduling algorithms and file system interfaces.
Action Verb :Evaluate (L5)
PO1: Apply(L3)
CO4 Action verb is greater level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore the correlation is high(3)
PO4: Analyze (L4)
CO4 Action verb is greater than PO4 verb by one level. Therefore the correlation is high(3)
PO5: Apply(L3)
CO4 Action verb is greater than PO5 verb. Therefore the correlation is high(3)
PO6: Thumb rule
Disk scheduling and file system interfaces are applied to provide solutions for E-Commerce database access . Therefore the correlation is medium (2)
PO8: Thumb rule
Since ethical principles shall be followed in file manipulations and data storage. Therefore the correlation is high(3)
PO12: Thumb rule
File manipulation of data and storage of data is playing major role in current scenario. Therefore, the correlation is medium (2)

CO5:Understand the various security issues and goals of protection
Action Verb :Understand (L2)
PO1: Apply(L3)
CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO2: Review (L2)
CO5 Action verb is same asPO2 verb. Therefore, the correlation is high(3)
PO8 : Thumb rule
Ethical principles should be followed for various security issues. Therefore the correlation is high(3)
PO12: Thumb rule
Security services and principles are keep on updating in the today's world. Therefore, the correlation is medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year-Semester: III-V
Branch of Study:EEE&ECE

Course Name: PROGRAMMABLE LOGIC CONTROLLERS
Subject Code: 20AOE0202

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES: After studying the course, Student will be able to:

CO1: Understand the purpose, functions, and operations of a PLC and identify the basic components of the PLC and how they function.
CO2: Analyze the directory of processor files using PLC software.
CO3: Understand the different types of devices to which PLC input and output modules are connected and various types of PLC registers.
CO4: Create the ladder diagrams from process control descriptions.
CO5: Apply the PLC timers and counters for the control of industrial processes.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
1	Understand	The purpose, functions, and operations of a PLC and identify the basic components of the PLC and how they function.			L2
2	Analyze	The directory of processor files.	Using PLC software.		L4
3	Understand	The different types of devices to which PLC input and output modules are connected and various types of PLC registers.			L2
4	Create	The ladder diagrams from process control descriptions.			L6
5	Apply	The PLC timers and counters for the control of industrial processes.			L3

SYLLABUS:

UNIT - I
PLC Basics PLC system, I/O modules and interfacing CPU processor programming equipment programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT - II
PLC Programming input instructions, outputs, operational procedures, programming examples using contacts and coils. Drill-press operation. Digital logic gates programming in the Boolean algebra system, conversion examples Ladder diagrams for process control Ladder diagrams and sequence listings, ladder diagram construction and flow chart for spray process system.

UNIT - III
PLC Registers: Characteristics of Registers module addressing holding registers input registers, output registers. PLC Functions Timer functions and industrial applications counters counter function industrial applications, Architecture functions, Number comparison functions, number conversion functions.

UNIT - IV

Data handling functions: SKIP, Master control Relay Jump Move FIFO, FAL, ONS, CLR and Sweep functions and their applications. Bit Pattern and changing a bit shift register, sequence functions and applications, controlling of two axes and three axis Robots with PLC, Matrix functions.

UNIT - V

Analog PLC operation: Analog modules and systems Analog signal processing multi bit data processing , analog output application examples, PID principles position indicator with PID control, PID modules, PID tuning, PID functions

TEXTBOOKS:

1. "John W Webb and Ronald A Reiss", Programmable Logic Controllers – Principle and Applications, PHI, 5th Edition 2003.
2. "JR Hackworth and F. D Hackworth Jr", Programmable Logic Controllers –
3. Programming Method and Applications by - Pearson, 2004.

REFERENCE BOOKS:

1. "W. Bolton", Programmable Logic Controllers, Newnes, 4th Edition 2000.

Mappingofcourseoutcomeswithpogramoutcomes

CourseTitle	COs	ProgrammeOutcomes(POs)&ProgrammeSpecificOutcomes(PSOs)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
PROGRAMMABLE LOGIC CONTROLLERS	CO1	2	2			2							1		1
	CO2	3	3			3							1		1
	CO3	2	2			2							1		1
	CO4	3	3			3							1		1
	CO5	3	3			3							1		1

Justification Table:

CO			Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1, PO2, PO5, PO12	PO1: Apply (L3) PO2: Identify (L3) PO5: Select (L3) PO12: Thumb Rule	2 2 2 1
2	Analyze	L4	PO1, PO2, PO5, PO12	PO1: Apply (L3) PO2: Analyze (L4) PO5: Apply (L3) PO12: Thumb Rule	3 3 3 1

3	Understand	L2	PO1, PO2, PO5, PO12	PO1: Apply (L3) PO2: Select (L3) PO5: Apply (L3) PO12: Thumb Rule	2 2 2 1
4	Create	L6	PO1, PO2, PO5, PO12	PO1: Apply (L3) PO2: Analyze (L4) PO5: Create (L6) PO12: Thumb Rule	3 3 3 1
5	Apply	L3	PO1, PO2, PO5, PO12	PO1: Apply (L3) PO2: Identify (L3) PO5: Apply (L3) PO12: Thumb Rule	3 3 3 1

CO1: Understand the purpose, functions, and operations of a PLC and identify the basic components of the PLC and how they function.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Identify (L3)
CO1 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO5: Select (L3)
CO1 Action Verb is Less than PO5 verb by one level; Therefore, correlation is moderate (2).
PO12: Using thumb rule, CO1 correlates to PO12 as low (1).
CO2: Analyze the directory of processor files using PLC software.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).
PO5: Apply (L3)
CO2 Action Verb is greater than PO5 verb by one level; Therefore, correlation is high (3).
PO12: Using thumb rule, CO2 correlates to PO12 as low (1).
CO3: Understand the different types of devices to which PLC input and output modules are connected and various types of PLC registers.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO3 Action Verb is less than PO1 verb by two level; Therefore, correlation is moderate (2).
PO2: Select (L3)
CO3 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO5: Apply (L3)
CO2 Action Verb is less than PO5 verb by one level; Therefore, correlation is moderate (2).
PO12: Using thumb rule, CO3 correlates to PO12 as Low (1).
CO4: Create the ladder diagrams from process control descriptions.
Action Verb: Create (L6)
PO1: Apply (L3)
CO4 Action Verb is Greater than PO1 verb by three levels; Therefore, correlation is high (3).
PO2: Analyze (L4)

CO4 Action Verb is greater than PO2 verb by two levels; Therefore, correlation is high (3).
PO5: Cretae (L6)
CO4 Action Verb is equal to PO5 verb; Therefore, correlation is high (3)
PO12: Using thumb rule, CO4 correlates to PO12 as Low (1).

CO5: Apply the PLC timers and counters for the control of industrial processes.

Action Verb: Apply (L3)
PO1: Apply (L3)
CO5 Action Verb is equal to PO1 verb; Therefore, correlation is high (3).
PO2: Identify (L3)
CO5 Action Verb is equal to PO2 verb level; Therefore, correlation is high (3).
PO5: Apply (L3)
CO5 Action Verb is equal to PO5 verb level; Therefore, correlation is high (3)
PO12: Using thumb rule, CO5correlates to PO12 as Low (1).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year/Semester: III / V
Branch of Study: EEE, ECE & CIC

Course Name: CONTROLSYSTEMS
Course code: 20APC0213

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES: After studying the course, Student will be able to:

CO1:- Understand the mathematical modelling and transfer function of physical systems.
CO2:- Apply time response analysis to first order systems &controllers and their stability.
CO3:- Analyze the stability of a system using Routh-Hurwitz criteria and root locus.
CO4:- Evaluate the stability of a system using Bode and Nyquist plot methods.
CO5:- Apply state space analysis to study response of continuous system.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	MathematicalModelAndTransferFunctionOfthePhysicalSystems.			L2
CO2	Apply	Time response analysis to first order systems & controllers and study their stability.			L3
CO3	Analyze	The stability of a system using Routh-Hurwitz criteria and root locus.			L4
CO4	Evaluate	The stability of a system using Bode and Nyquist plot methods.			L5
CO5	Apply	State Space Analysis to Study Continuous System.			L3

SYLLABUS:

UNIT –I CONTROLSYSTEMSCONCEPTS
Basic elements of control systems- open and close loop systems - Transfer function – Modelling of Electrical systems and mechanical systems – Block diagram reduction techniques – Signal flow graphs.

UNIT-II TIMERESPONSEANALYSIS
Step Response - Impulse Response - Time response of first order systems – Characteristic Equation of Feedback control systems, Transient response of second order systems Time domainspecifications-Steadystateresponse-Steadystateerrorsanderrorconstants,P,PI, PIDControllers.

UNIT-III STABILITYANALYSISINTIMEDOMAIN
Stability - concept and definition, Characteristic equation – Location of poles – Routh Hurwitzcriterion-LimitationsofRouth'sstability-TheRootlocusconcept-constructionof root loci-

UNIT-IV FREQUENCYRESPONSEANALYSIS
Bodeplot-Correlationbetweenfrequencydomainandtimedomainspecifications-Bode Diagrams-Determination of Frequency domain specifications and transfer function from the Bode Diagram-Stability Analysis from Bode Plots -Nyquist

Plots- Phase margin and Gain Margin–Stability Analysis.

UNIT-V STATESPACEANALYSISOFCONTINUOUSSYSTEMS

Concepts of state, state variables and state models - differential equations & Transfer functionmodels - Transfer function from state model-State Transition Matrix and it's Properties-System response through State Space models-The concepts of controllability and observability, Duality between controllability and observability.

TEXTBOOKS:

1. KatsuhikoOgata,"ModernControlEngineering",5th edition,PrenticeHallofIndiaPvt. Ltd., 2010.
2. I. J. Nagrath and M. Gopal,"ControlSystemsEngineering"5th edition,NewAge International(P)LimitedPublishers,2007.

REFERENCEBOOKS:

1. M. Gopal, "Control Systems Principles & Design" 4th Edition, Mc Graw Hill Education, 2012.
2. B. C. Kuo and FaridGolnaraghi, "Automatic Control Systems" 8th edition, John Wiley and sons, 2003.
3. JosephJDistefanoIII,"FeedbackandControlSystems",AllenR Stubberud&Ivan Williams,2nd Edition,Schaum'soutlines,McGrawHillEducation,2013.
4. GrahamC.Goodwin,"ControlSystemDesign"StefanF.GraebeandMarioE.Salgado, Pearson,2000.
5. Gene F.Franklin,"FeedbackControlof DynamicSystems",J.D. PowellandAbbas Emami-Naeini,6th Edition,Pearson,2010.

Mappingofcourseoutcomeswithpramoutcomes

CourseTitle	COs	ProgrammeOutcomes(POs)&ProgrammeSpecificOutcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
CONTROL SYSTEMS	CO1	2	1				1							3	
	CO2	3	2	1			1							3	
	CO3	3	3	1			1							3	
	CO4	3	3	2			1							3	
	CO5	3	2				1							3	

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year/Semester: III / V
Branch of Study: EEE, ECE & CIC

Justification Table:

CO	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	17	22.6	3	Understand	L2	PO1, PO2 PO6	PO1:Apply(L3) PO2:Analyze(L4) PO6: Thumb Rule	2 1 1
2	15	20	2	Apply	L3	PO1, PO2 PO6	PO1:Apply(L3) PO2:Analyze(L4) PO6: Thumb Rule	3 2 1
3	14	18.6	2	Analyze	L4	PO1, PO2 PO3 PO6	PO1:Apply(L3) PO2:Analyze(L4) PO3:Design(L6) PO6: Thumb Rule	3 3 1 1
4	16	21.3	3	Evaluate	L5	PO1, PO2 PO3 PO6	PO1:Apply(L3) PO2:Analyze(L4) PO3:Design(L6) PO6:Thumb Rule	3 3 2 1
5	13	17.3	2	Apply	L3	PO1, PO2 PO6	PO1:Apply(L3) PO2:Analyze(L4) PO6:Thumb Rule	3 2 1
	75							

CO1:- Understand the mathematicalmodellingandtransferfunctionofphysicalsystems.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; therefore correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is less than PO2 verb by two level; therefore correlation is low (1).
PO6: using thumb rule, CO1 correlation with PO6 is low (1)

CO2:- Applytimeresponseanalysis to first order systems &controllers and study their stability.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action Verb is equal to PO1 verb; therefore correlation is High (3).
PO2: Analyze (L4)
CO2 Action Verb is less than PO2 verb by one level; therefore correlation is moderate (2).
PO6: using thumb rule, CO2 correlation with PO6 is low (1)

CO3:- Analyze the stability of a system using Routh-Hurwitz criteria and root locus.
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO3 Action Verb is greater than PO1 verb by one level; therefore correlation is High (3).
PO2: Analyze (L4)
CO3 Action Verb is same as PO2 verb; therefore correlation is High (3).
PO3: Design (L6)
CO3 Action Verb is less than as PO3 verb by two level; therefore correlation is Low (1).
PO6: using thumb rule, CO3 correlation with PO6 is low (1)

CO4:- Evaluate the stability of a system usingBodeandNyquistplot methods.
Action Verb: Evaluate (L5)
PO1: Apply (L3)

CO4 Action Verb is greater than PO1 verb by two level; therefore correlation is High (3).
PO2: Analyze (L4)
CO4 Action Verb is greater than PO2 verb by one level; therefore correlation is High (3).
PO3: Design (L6)
CO1 Action Verb is less than as PO3 verb by one level; therefore correlation is Moderate (2).
PO6: using thumb rule, CO4 correlation with PO6 is low (1)

CO5:- Apply state space analysis to study response of continuous system.

Action Verb: Apply (L3)

PO1: Apply (L3)
CO5 Action Verb is same PO1 verb; therefore correlation is High (3).
PO2: Analyze (L4)
CO5 Action Verb is less than PO2 verb by one level; therefore correlation is Moderate (2).
PO6: using thumb rule, CO5 correlation with PO6 is low

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	VLSI DESIGN	L	T	P	C
20APE0401	III-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1 Understand the IC fabrication Process and electrical properties of MOS Circuits.

CO2 Analyze the scaling parameters of Metal Oxide Semiconductor (MOS) circuits.

CO3 Analyze a Gate-level VLSI circuits using stick diagrams and layouts with design rules.

CO4 Analyze a VLSI circuits at Physical-level through various VLSI design styles and methods.

CO5 Evaluate the VLSI circuits using VHDL synthesis and Design Tools.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The IC fabrication Process and electrical properties of MOS Circuits			L2
CO2	Analyze	The scaling parameters of	Metal Oxide Semiconductor (MOS) circuits		L4
CO3	Analyze	A Gate-level VLSI circuits design using	Stick diagrams and layouts	Design rules	L6
CO4	Analyze	A VLSI circuits at Physical-level through	Various VLSI Design Styles and Methods		L6
CO5	Evaluate	The VLSI circuits using	VHDL synthesis and Design Tools		L5

UNIT - I		20Hrs
IC Fabrication: MOS transistors – working, MOS switches, Basic steps of IC fabrication: PMOS, NMOS, CMOS &BiCMOS, and SOI process technologies. Basic Electrical Properties of MOS and BiCMOS Circuits: MOS design equations: Ids–Vds relationship, Threshold Voltage, Body effect, Channel length modulation ,gm, gds, figure of merit ω0; Pass transistor, NMOS Inverter, CMOS Inverter analysis and design, Various pull-ups loads, BiCMOS Inverters.		
UNIT - II		10Hrs
Basic Circuit Concepts: Capacitance, resistance estimations- Sheet Resistance Rs, MOS Device Capacitances, routing Capacitance, Analytic Inverter Delays, Driving large Capacitive Loads, Fan-in and fan-out.		
UNIT - III		21Hrs
VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2µm CMOS Design rules for wires, Contacts and Transistors Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling. Gate-level Design: Logic gates and other complex gates, Switch logic, Alternate gate circuits: Pseudo NMOS Logic, Dynamic CMOS Logic.		
UNIT - IV		10Hrs
Physical Design: Floor Planning Methods, Global Interconnect, Floor Plan Design. VLSI Design styles: Full-custom, Standard Cells, Gate-arrays, FPGAs, CPLDs and Design Approach for Full-custom and Semi-custom devices.		
UNIT - V		11Hrs
VHDL Synthesis: VHDL Synthesis, Circuit Design Flow, Circuit Synthesis, Simulation, Layout, Design capture tools, Design Verification Tools. Test and Testability: Fault-modeling and simulation, test generation, design for testability: Built-in-self-test.		
Textbooks:		
1Kamran Eshraghian, Eshraghian Douglas and A. Pucknell, —Essentials of VLSI circuits and systems‖,		

PHI, 2013 Edition. **2. K. Lal Kishore and V.S.V. Prabhakar,—VLSI Design‖, IK Publishers**
Online Learning Resources:
nptel videos

Mapping of course outcomes with program outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										1	**2**	
CO2		3		1								1	**3**	
CO3			1	2								1	**3**	
CO4			1	2								1	**3**	
CO5				3	2							1	**3**	**3**

Correlation Matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	**20**	**27.78**	3	Understand	L2	PO1, PO2,PO12	PO1: Apply (L3) PO2: Review (L2) PO12: Thumb rule	2 3 1
2	**10**	**13.88**	2	Analyze	L4	PO2,PO4, PO12	PO2: Analyze (L4) PO4: Interpret(L2) PO12: Thumb rule	3 3 1
3	**21**	**29.16**	**3**	Analyze	L4	PO3,PO4, PO12	PO3: Design (L6) PO4: Interpret (L5) PO12: Thumb rule	1 2 1
4	**10**	**13.88**	**2**	Analyze	L4	PO3, PO4,PO12	PO3: Design (L6) PO4: Interpret (L5) PO12: Thumb rule	1 2 1
5	**11**	**15.3**	**2**	Evaluate	L5	PO4, PO5,PO12	PO4: Interpret (L5) PO5: Create (L6) PO12: Thumb rule	3 2 1
	72	**100**						

Justification Statements:

CO1: Understand the IC fabrication Process and electrical properties of MOS Circuits. Action Verb- Understand (L2)

PO1: Action Verb- Apply (L3), CO1 action verb is less than PO1 action verb by one level, therefore correlation is moderate (2)

PO2: Action verb- Review (L2), CO1 action verb is equal to PO2 action verb, therefore correlation is high (3)

PO12: CO1 correlates PO12 as per thumb rule with correlation is Low (1)

CO2: Analyze the scaling parameters of Metal Oxide Semiconductor (MOS) circuits. Action Verb- Analyze(L4)

PO2: Action verb- Analyze (L4), CO2 action verb is equal to PO2 action verb; therefore correlation is high (3)

PO4: Action verb- Interpret(L2), CO2 action verb is greater than PO4 action verb; therefore correlation is high (3)

PO12: CO2 correlates PO12 as per thumb rule with correlation is Low (1)

CO3: Analyze a Gate-level VLSI circuits design using stick diagrams and layouts with design rules. Action Verb- Analyze(L4)

PO3: Action verb- Design (L6), CO3 action verb is less than to PO3 action verb by two levels; therefore correlation is Low (1)
PO4: Action verb- Interpret(L5), CO3 action verb is less than PO4 action verb by one level; therefore correlation is moderate (2)
PO12: CO3 correlates PO12 as per thumb rule with correlation is Low (1)

CO4: Analyze a VLSI circuits at Physical-level through various VLSI design styles and methods. Action Verb- Analyze(L4)
PO3: Action verb- CO4 action verb is less than to PO3 action verb by two levels; therefore correlation is Low (1)
PO4: Action verb- Interpret(L5), CO4 action verb is less than to PO3 action verb by two levels; therefore correlation is Low (1)
PO12: CO4 correlates PO12 as per thumb rule with correlation is Low (1)

CO5: Evaluate the VLSI circuits using VHDL synthesis and Design Tools. Action Verb- Evaluate (L5)
PO4: Action verb- Interpret(L5), CO5 action verb is equal to PO4 action verb; therefore correlation is high (3)
PO5: Action verb- Create(L6), CO5 action verb is less than PO5 action verb by one; therefore correlation is moderate (2)
PO12: CO5 correlates PO12 as per thumb rule with correlation is Low (1)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Computer Organization	L	T	P	C
20APE0402	III-I	(common to CSE,CIC,CSE(DS),ECE)	3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: Understand the operational concepts and instruction set related to modern processors.

CO2: Evaluate the Arithmetic operations for understanding execution process.

CO3: Understand the hardware requirements of primary and secondary memories to store the data.

CO4: Analyze the Input / Output interfaces to connect multiple devices.

CO5: Apply the pipeline concepts to execute parallel tasks.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the Operational concepts and instruction set related		to modern processors.	L2
CO2	Evaluate	the Arithmetic operations		for understanding execution process.	L5
CO3	Understand	The hardware requirements of primary and secondary memories		to store the data.	L2
CO4	Analyze	the Input/Output interfaces		to connect multiple devices.	L4
CO5	Apply	the pipeline concepts		to execute parallel tasks.	L3

UNIT - I	**Basic Structure of Computer, Machine Instructions and Programs**	9Hrs
Basic Structure of Computer: Computer Types, Functional Units, Basic operational Concepts, Bus Structure, Software, Performance, Multiprocessors and Multicomputer. Machine Instructions and Programs: Numbers, Arithmetic Operations and Programs, Instructions and Instruction Sequencing, Addressing Modes, Basic Input/output Operations, Stacks and Queues, Subroutines, Additional Instructions.		
UNIT - II	**Arithmetic, Basic Processing Unit**	9Hrs
Arithmetic: Addition and Subtraction of Signed Numbers, Design of Fast Adders, Multiplication of Positive Numbers, Signed-operand Multiplication, Fast Multiplication, Integer Division, Floating-Point Numbers and Operations. Basic Processing Unit: Fundamental Concepts, Execution of a Complete Instruction, Multiple-Bus Organization, Hardwired Control, and Multi programmed Control.		
UNIT - III	**The Memory System**	9Hrs
The Memory System: Basic Concepts, Semiconductor RAM Memories, Read-Only Memories, Speed, Size and Cost, Cache Memories, Performance Considerations, Virtual Memories, Memory Management Requirements, Secondary Storage.		
UNIT - IV	**Input/Output Organization**	9Hrs
Input/Output Organization: Accessing I/O Devices, Interrupts, Processor Examples, Direct Memory Access, Buses, Interface Circuits, Standard I/O Interfaces.		
UNIT - V	**Pipelining, Large Computer Systems**	9 Hrs
Pipelining: Basic Concepts, Data Hazards, Instruction Hazards, Influence on Instruction Sets. Large Computer Systems: Forms of Parallel Processing, Array Processors, The Structure of General-Purpose multiprocessors, Interconnection Networks.		
Textbooks:		
1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, “Computer Organization”, 5th Edition, McGraw Hill Education, 2013.		
Reference Books:		
1. M.Morris Mano, “Computer System Architecture”, 3rd Edition, Pearson Education. 2. Themes and Variations, Alan Clements, “Computer Organization and Architecture”, CENGAGE Learning. 3. SmrutiRanjanSarangi, “Computer Organization and Architecture”, McGraw Hill Education. John P.Hayes, “Computer Architecture and Organization”, McGraw Hill Education		
Online Learning Resources:		
https://nptel.ac.in/courses/106/103/106103068/		

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3										2		
CO2	3	3	3			2						2	2	
CO3	2	3						2	2					
CO4	3	3	3	3	3			2				2		1
CO5	3	3						2	2				2	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	09	20%	2	CO1 :Understand	L2	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	2 3 2
2	09	20%	2	CO2 : Evaluate	L5	PO1 PO2 PO3 PO6 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO6: Thumb rule PO12: Thumb rule	3 3 3 2 2
3	09	20%	2	CO3 : Understand	L2	PO1 PO2 PO8 PO9	PO1: Apply(L3) PO2: Review(L2) PO8: Thumb rule PO9: Thumb rule	2 3 2 2
4	09	20%	2	CO4 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO8 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO12: Thumb rule	3 3 3 3 3 2 2
5	09	20%	2	CO5 : Apply	L3	PO1 PO2 PO8 PO9	PO1: Apply(L3) PO2: Review (L2) PO8: Thumb rule PO9: Thumb rule	3 3 2 2
	45	100 %						

Justification Statements :

CO1: Understand the operational concepts and instruction set related to modern processors.
Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb :Review(L2)
CO1 Action verb is same as PO2 verb. Therefore the correlation is high (3)
PO12: Thumb rule
Identify the deficiencies and demonstrate the need of updating the computer components to meet desired requirements. Therefore the correlation is medium (2)

CO2: Evaluate the Arithmetic operations for understanding execution process
Action Verb : Evaluate (L5)
PO1: Apply(L3)
CO2 Action verb is greater than level PO1 verb by two level. Therefore the correlation is high (3)
PO2: Review (L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation is high(3)
PO3: Develop (L3)
CO2 Action verb is greaterthan PO3 verb. Therefore the correlation is high(3)
PO6: Thumb rule
For some of computer applications, Various arithmetic operations are evaluated for understanding execution process of computer systems. Therefore, the correlation is Medium (2)
PO12: Thumb rule
Identify the deficiencies and demonstrate the need of updating the computer instruction set to meet desired requirements. Therefore the correlation is medium(2)

CO3: Understand the hardware requirements of primary and secondary memories to store the data.
Action Verb :Understand (L2)
PO1: Apply(L3)
CO3 Action verb is less than PO1 verb level by one level. Therefore the correlation is moderate (2)
PO2: Review (L2)
CO3 Action verb is same as PO2 verb. Therefore the correlation is high (3)
PO8 : Thumb rule
Since ethical principles should be followed to while creating the primary and secondary memories. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required to understand and demonstrate the secondary memories in computer system. Hence the correlation is medium (2)

CO4: Analyze the Input/Output interfaces to connect multiple devices.ActionVerb :Analyze(L4)
Action Verb :Analyze (L4)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 by one level. Therefore the correlation is high (3)
PO2: Analyze (L4)
CO4 Action verb is same as PO2 verb. Therefore the correlation is High(3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO8: Thumb rule
Since ethical principles shall be followed in creating quality input and output interfaces. Therefore the correlation is medium(2)
PO12: Thumb rule
Identify the deficiencies and demonstrate the need of updating the input and output interfaces to meet desired requirements. Therefore the correlation is medium(2)

CO5:Apply the pipeline concepts to execute parallel tasks.
Action Verb :Apply (L3)
PO1: Apply(L3)
CO5 Action verb is same as PO1. Therefore the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than PO2 verb. Therefore the correlation is high(3)
PO8 : Thumb rule
Since ethical principles should be followed in solving problems caused in pipeline hazards. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required to provide the solutions caused due to pipeline hazards. Hence the correlation is medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Digital System Design	L	T	P	C
20APE0403	III-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1:**Understand** the different Logic families and its interfacing

CO2: **Analyze** different applications by understanding VHDL Programming

CO3: **Analyze** different combinational circuits and its logic

CO4: **Analyze** different sequential circuits by using logical concepts.

CO5: **Apply** Various VHDL programming models on digital circuit designs

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the different Logic families and its interfacing			**L2**
CO2	**Analyze**	different applications by understanding	Using VHDL programming		**L4**
CO3	**Analyze**	different combinational circuits and its logic			**L4**
CO4	**Analyze**	different sequential circuits by using logical concepts.			**L4**
CO5	**Apply**	Various VHDL programming models on digital circuit designs			**L3**

UNIT - I	**CMOS LOGIC**	**9 Hrs**
Introduction to logic families, CMOS logic, CMOS logic families; BIPOLAR LOGIC ANDINTERFACING: Bipolar logic, Transistor logic, TTL families, CMOS/TTL interfacing, low voltage CMOS logic and interfacing, Emitter coupled logic, Comparison of logic families.		
UNIT - II	**HARDWARE DESCRIPTION LANGUAGES**	**9Hrs**
HDL Based Digital Design, The VHDL Hardware Description Language–Program Structure, Types, Constants and Arrays, Functions and procedures, Libraries and Packages, Structural design elements, Dataflow design elements, Behavioral design elements, The Time Dimension, Simulation, Test Benches, VHDL Features for Sequential Logic Design, Synthesis.		
UNIT - III	**COMBINATIONAL LOGIC DESIGN PRACTICES**	**9 Hrs**
Description of basic structures like Decoders, Encoders, Comparators, Multiplexers (74 –series MSI); Design of complex Combinational circuits using the basic structures; Designing Using combinational PLDs like PLAs, PALs ,PROMs CMOS PLDs; Adders & subtractors, ALUs, Combinational multipliers; VHDL models for the above standard building block ICs.		
UNIT - IV	**SEQUENTIAL MACHINE DESIGN PRACTICES:**	**9 Hrs**
Review of design of State machines; Standard building block ICs for Shift registers, parallel / serial conversion , shift register counters, Ring counters; Johnson counters, LFSR counter ; VHDL models for the above standard building block ICs. Synchronous Design example using standard ICs		
UNIT - V	**DESIGN EXAMPLES (USING VHDL)**	**9 Hrs**
Barrel shifter, comparators, floating-point encoder, and dual parity encoder. Sequential logicDesign: Latches & flip flops, PLDs and their VHDL models.		

Textbooks:

1.John F.Wakerly ,"Digital Design Principles and Practices" 4th edition, Pearson Education.,2009
2.Charles H.Roth,Jr., "Fundamentals of Logic Design" 5th edition , CENGAGE Learning 2012.

Reference Books:

1.M.Morris Mano and Michael D. Cilleti., "Digital Logic Design" 4th edition Pearson Education., 2013
2.Stephen Brown and ZvonkoVranesic, "Fundamentals of digital logic with VHDL design" 2ndedition McGraw Hill Higher Education.
J. Bhasker, "A VHDL PRIMER" 3rd edition Eastern Economy Edition, PHI Learning,2010

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**3**	**2**	**1**									**2**	
CO2	**3**	**3**	**3**	**3**	**3**								**3**	
CO3	**3**	**3**	**3**		**3**								**1**	**3**
CO4	**3**	**3**	**3**		**3**									**3**
CO5	**3**	**3**	**3**	**3**	**3**							**2**		**3**

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review(L2) PO3:Apply(L3) PO4:Analyze(L4)	2 3 2 1
2				Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3:Apply(L3) PO4:Interpret(L2) PO5:Apply(L3)	3 3 3 3 3
3				Analyze	L4	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3:Apply(L3) PO5: Apply(L3)	3 3 3 3
4				Analyze	L4	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3:Apply(L3) PO5: Apply(L3)	3 3 3 3
5				Apply	L3	PO1 PO2 PO3 PO4 PO5 PO12	PO1: Apply (L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L3) PO5:Apply(L3) PO12:Thumb Rule	3 3 3 3 3 2

Justification Statements :

CO1: Understand the different Logic families and its interfacing

Action Verb: Understand(L2)

PO1 Verb: Apply(L3) CO1 Action verb is lesser than PO1 verb by one level. Therefore the correlation is medium (2)

PO2 Verb : Review(L2) CO1 Action verb is same level as PO2 verb . Therefore the correlation is high(3)

PO3: Apply (L3) CO1 Action verb is lesser than PO1 verb by one level. Therefore the correlation is medium (2)

PO4: Analyze(L2)

CO1 Action verb is lesser than PO1 verb by two level. Therefore the correlation is low (1)

CO2: Analyze different applications by understanding VHDL Programming

Action Verb : Analyze (L4)

PO1 Verb: Apply(L3)

CO2 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Review(L2)

CO2 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)

PO3: Apply (L3)

CO2 Action verb is greater than as PO3 verb. Therefore the correlation is high (3)

PO4: Interpret(L2)

CO2 Action verb is greater than as PO4 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO2 Action verb is greater than as PO5 verb. Therefore the correlation is high (3)

CO3: Analyze different combinational circuits and its logic

Action Verb :Analyze(L4)

PO1 Verb: Apply(L3)

CO3 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Identify(L3)

CO3 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)

PO3: Apply (L3)

CO3 Action verb is greater than as PO3 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is greater than as PO5 verb. Therefore the correlation is high (3)

CO4: Analyze different sequential circuits by using logical concepts

Action Verb :Analyze (L3)

PO1 Verb: Apply(L3)

CO4 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Identify(L3)

CO4 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)

PO3: Apply (L3)
CO4 Action verb is greater than as PO3 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO5: Apply Various VHDL programming models on digital circuit designs
Action Verb : Apply (L3)
PO1 Verb: Apply(L3)
CO5 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)
PO2 Verb : Identify(L3)
CO5 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO2 Action verb is greater than as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO2 Action verb is greater than as PO5 verb. Therefore the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	DIGITAL COMMUNICATION SYSTEMS LAB	L	T	P	C
20APC0416	III-I		0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the process of transmission and receiving of signals using Time division multiplexing.
CO2: Evaluate the performance of pulse code modulation and demodulation schemes.
CO3: Analyze performance of Delta modulation and demodulation systems.
CO4: Apply Frequency shift keying method for modulation and demodulation of digital signals.
CO5: Apply Phase shift keying method for modulation and demodulation of digital signals.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze(L4)	the process of transmission and receiving of signals			L4
CO2	Evaluate(L5)	the perfomance of pulse code modulation and demodulation schemes.		.	L5
CO3	Analyze(L4)	Analyze perfomance of Delta modulation and demodulation systems.			L4
CO4	Apply(L3)	Apply Frequency shift keying method for modulation and demodulation of digital signals.			L3
CO5	Apply(L3)	Phase shift keying method for modulation and demodulation of digital signals.			L3

LIST OF EXPERIMENTS:

Minimum of Ten experiments to be conducted (Five from each Part-A&B)

HARDWARE EXPERIMENTS (PART – A)

1. Time division multiplexing.(CO1)
2. Pulse code modulation.(CO2)
3. Differential pulse code modulation.(CO2)
4. Delta modulation.(CO3)
5. Frequency shift keying.(CO4)
6. Differential phase shift keying.(CO5)
7. QPSK modulation and demodulation.(CO5)

SOFTWARE EXPERIMENTS (PART-B)

Modeling of Digital Communications using MATLABORATORY

1.Pulse code modulation.

2.Differential pulse code modulation.

3.Frequency shift keying.

4.Phase shift keying.

5.Differential phase shift keying.

6.QPSK modulation and demodulation

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3	3									3
CO2	3	3		3	3									3
CO3	3	3		3	3									3
CO4		3		2	3									3
CO5		3		2	3									3

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Analyze(L4)	L4	PO1, PO2 ,P04,PO5	PO1: Apply (L3) PO2: Review (L2) P04:Analyze(L4), PO5:select(L1)	3 3 3 3
2	Evaluate(L5)	L5	PO1, PO2 ,P04,PO5	PO1: Apply (L3) PO2: Review (L2) PO4:Interpret(L2) P05: Apply (L3)	3 3 3 3
3	Analyze(L4)	L4	PO1, PO2 ,P04,PO5	PO1: Apply (L3) PO2: Review (L2) PO4:Interpret(L2) P05: Apply (L3)	3 3 3 3
4	Apply(L3)	L3	PO2,PO4,P05	PO2: Identify(L3) P04: Analyze(L4) P05: Apply (L3)	3 2 3
5	Apply(L3)	L3	PO2,PO4,P05	PO2: Identify(L3) P04: Analyze(L4) P05: Apply (L3)	3 2 3

Justification Statements :

CO 1: Analyze the process of transmission and receiving of signals using Time division multiplexing.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO1 Action Verb is greater than PO1; Therefore correlation is high(3).

PO2 Verbs: Review (L2)

CO1 Action Verb is greater than PO2; Therefore correlation is high(3) .

PO4 Verbs: Analyze (L4)

CO1 Action Verb is equal to PO4; Therefore correlation is high (3).

PO5 verbs: select(L1)

CO1 Action Verb is greater than PO5; Therefore correlation is high(3) .

CO 2: Evaluate the performance of pulse code modulation and demodulation schemes

Action Verb: Evaluate(L5)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater than PO1; Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO2 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO4 Verbs: Interpret(L2)

CO2 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO5 Verbs: Apply (L3)

CO2 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO 3: Analyze performance of Delta modulation and demodulation systems.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1; Therefore correlation is high (3).

PO2 Verbs: Review (L2)

CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO4 Verbs: Interpret(L2)

CO3 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO5 Verbs: Apply (L3)

CO3 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO4: Apply Frequency shift keying method for modulation and demodulation of digital signals. Action Verb: Apply (L3)

PO2 Verb: Identify (L3)

CO4 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO4 Action Verb is less than PO4 verb by one level; Therefore correlation is moderate (2).

PO5 Verb: Apply (L3)

CO4 Action Verb is equal to PO5 verb; Therefore correlation is high (3)

CO5: Apply Phase shift keying method for modulation and demodulation of digital signals.Action Verb: Apply (L3)

PO2 Verb: Identify (L3)

CO4 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO4 Action Verb is less than PO4 verb by one level; Therefore correlation is moderate (2).

PO5 Verb: Apply (L3)

CO4 Action Verb is equal to PO5 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI(AUTONOMOUS)
AK20-REGULATIONS

B. Tech III Year V Semester

Course Code	Course Title	L	T	P	Credits
20APC0417	INTEGRATED CIRCUITS AND APPLICATIONS LABORATORY	0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:
Upon completion of the course students will be able to
CO1: Analyze the characteristics of negative feedback, regenerative feedback and ICs.
CO2: Evaluate the performance of summing, subtracting and instrumentation amplifiers using op-amps.
CO3: Evaluate the steps in the design of Analog filters for the given specifications.
CO4: Analyze the performance of DC-DC Converter and Function Generator.
CO5: Analyze the performance of Voltage Controlled Oscillator, Phase Locked Loop and Regulator.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
1.	Analyze	the characteristics of negative feedback, regenerative feedback and ICs.			L4
2.	Evaluate	the performance of summing, subtracting and instrumentation amplifiers	using op-amps		L5
3.	Evaluate	Evaluate the steps in the design of Analog filters	for the given specifications.		L5
4.	Analyze	the performance of DC-DC Converter and Function Generator			L4
5	Analyze	performance of Voltage Controlled Oscillator, Phase Locked Loop and Regulator			L4

Minimum of Ten experiments to be conducted
All experiments are based upon 741 / TL 082/ASLK Kits.

1. Study the characteristics of negative feedback amplifier (CO1)
2. Summing and Subtractor Amplifier (CO2)
3. Design of an instrumentation amplifier (CO2)
4. Study the characteristics of regenerative feedback system with extension to design anAstable multi vibrator (CO1)
5. Study the characteristics of integrator circuit (CO1)
6. Design of Analog filters – I(CO3)
7. Design of Analog filters – II(CO3)
8. DC-DC Converter (CO4)
9. Design of a function generator (CO4)
10. Design of a Voltage Controlled Oscillator (CO5)
11. Design of a Phase Locked Loop (PLL) (CO5)
12. Design of a low drop out regulator (CO5)

Mapping of Course OutComes with Program Outcomes:

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
Integrated Circuits and Applications Laboratory	CO1	3	1	3											3
	CO2	3	2	3											3
	CO3	3	2	3											3
	CO4	3	3		3										3
	CO5	3	3		3										3

	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
Expt. No.	**Lesson Plan (Hrs)**	**%**	**Correlation**	**Action Verb**	**BTL**			
1,4,5	**9**	25%		Analyze	**L4**	PO1, PO2, PO3	PO1: Apply (L3) PO2: Formulate (L6) PO3: Develop(L3)	3 1 3
2,3	**6**	16.7 %		Evaluate	**L5**	PO1, PO2, PO3	PO1: Apply (L3) PO2: Formulate (L6) PO3:Develop(L3)	3 2 3
6,7	**6**	**16.6 %**		Evaluate	**L5**	PO1, PO2, PO3	PO1: Apply (L3) PO2: Formulate (L6) PO3:Develop(L3)	3 2 3
8,9	**6**	**16.7 %**		Analyze	**L4**	PO1, PO2, PO4	PO1: Apply(L3) PO2: Analyze(L4) PO4: Identify(L3)	3 3 3
10,11 ,12	**9**	**25%**		Analyze	**L4**	PO1, PO3, PO4	PO1: Apply(L3) PO2: Analyze(L4) PO4: Identify(L3)	3 3 3
	36	**100 %**						

Justification Statements:

CO1: Analyze the characteristics of negative feedback, regenerative feedback and ICs
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO1 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Formulate(L6)
CO1 Action Verb is less than the PO2 verb by two levels. Therefore, the correlation is low (1).
PO3 Verbs: Develop(L3)
CO1 Action Verb is more than than the PO3 verb. Therefore, the correlation is high (3).

CO2: Evaluate the performance of summing, subtracting and instrumentation amplifiers using op-amps.
Action Verb: Evaluate(L5)
PO1 Verbs: Apply (L3)
CO2 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Formulate(L6)
CO2 Action Verb is less than the PO2 verb by one level. Therefore, the correlation is medium(2).
PO3 Verbs: Develop(L3)

CO3: Evaluate the steps in the design of Analog filters for the given specifications
Action Verb: Evaluate(L5)
PO1 Verbs: Apply (L3)
CO3 Action Verb is more than than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Formulate(L6)
CO3 Action Verb is less than the PO2 verb by one level. Therefore, the correlation is medium(2).
PO3 Verbs: Develop(L3)
CO3 Action Verb is more than than the PO3 verb. Therefore, the correlation is high (3).

CO4: Analyze the performance of DC-DC Converter and Function Generator
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO4 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Analyze(L4)
CO4 Action Verb level is same as PO2 verb. Therefore, the correlation is high (3).
PO4 Verbs: Identify (L3)
CO4 Action Verb is more than the PO4 verb. Therefore, correlation is high (3).

CO5: Analyze the performance of Voltage Controlled Oscillator, Phase Locked Loop and Regulator.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Analyze(L4)
CO5 Action Verb level is same as PO2 verb. Therefore, the correlation is high (3).
PO4 Verbs: Identify (L3)
CO5 Action Verb is more than the PO4 verb. Therefore, correlation is high (3).

Year: III Semester:I Branch of Study: ECE

Subject Code	Subject Name	L	T	P	Credits
20AHE9902	**Principles of Effective Public Speaking**	1	0	2	2

Course Outcomes (CO): After studying the course, Student will be able to:

1. Apply the knowledge of principles, concepts and skills learned in speech preparation.
2. Analyze the techniques of knowing audiences and in refining the speech
3. Understand the listening skills and styles in effective listening.
4. Analyze the diverse methods of speech in speech composition
5. Apply the supporting materials and presentation aids in speech preparation.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Apply**	the knowledge of principles, concepts and skills learned	in speech preparation		**L3**
2	**Analyze**	the techniques of knowing audiencs and	in refining the speech		**L4**
3	**Understand**	the listening skills and styles	in effective listening		**L2**
4	**Analyze**	the diverse methods of speech	in speech composition		**L4**
5	**Apply**	the supporting materials and presentation aids	in speech preparation		**L3**

Syllabus

Unit -1

Introduction to Public Speaking:

Basic communication concepts, processes – Models of Communication, concepts and principles of public speaking - Steps and methods of speech preparation.

Unit -2

Selecting Topic and Knowing your Audience:

Identifying sources; Tools and techniques for selecting and refining speech topics - Identifying speech purposes - Central idea statement - Audience analysis techniques.

Unit – 3

Listening with a purpose:

Effective listening, the listening process, and types of listening; Listening barriers; Identifying and improving listening styles.

Unit - 4

Speaking with a purpose:

Methods of speech preparation - Informative, persuasive, and ceremonial speeches.

Unit -5

Delivering your speech and using Visual Aids:

The mechanics of verbal and nonverbal communication in speech delivery - Effective delivery techniques - Incorporating presentation aids in presentation.

References:

1. DeVito, J.A. (2009). The Essential Elements of Public Speaking. (3rd ed.) Boston: Pearson Education, Inc.
2. Lucas, S.E. (2009). The Art of Public Speaking. (10th ed.) New York: McGraw - Hill Co.

3. Zarefsky, D. (2011). Public Speaking: Strategies for Success. (6th ed. Boston: Pearson Education, Inc).

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1										2		
2										3		
3										2		
4										3		
5										2		

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**corr**	**Verb**	**BTL**			
1				**Apply**	**L3**	10	Thumb Rule	2
2				**Analyze**	**L4**	10	Thumb Rule	3
3				**Understand**	**L2**	10	Thumb Rule	2
4				**Analyze**	**L4**	10	Thumb Rule	3
5				**Apply**	**L3**	10	Thumb Rule	2

CO1: Apply the knowledge of principles, concepts and skills learned in speech preparation**.**
Action Verb: Apply (L3)
CO1 Action Verb is Apply of BTL3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2).
CO2: Analyze the techniques of knowing audiencs and in refining the speech
Action Verb: Analyze (L4)
CO2 Action Verb is Analyze of BTL4. Using Thumb rule, L4 correlates PO6 to PO12 as high (3).
CO3: Understand the listening skills and styles in effective listening**.**
Action Verb: Apply (L3)
CO3 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2)
CO4: Analyze the diverse methods of speech in speech composition**.**
CO4 Action Verb is Evaluate of BTL5. Using Thumb rule, L5 correlates PO6 to PO12 as high (3)
CO5: **Apply** the supporting materials and presentation aids in speech preparation**.**
CO5 Action Verb is Apply of BTL3. Using Thumb rule, L3 correlates PO6 to PO12 as moderate (2)

Year:III **Semester:**I **Branch of Study: ECE**

SubjectCode	SubjectName	L	T	P	Credits
20AMC9904	**PROFESSIONAL ETHICS AND HUMAN VALUES**	3	0	0	0

Course Outcomes (CO): After studying the course, Student will be able to:

CO1. Understand the sustained happiness through identifying the essentials of human values and skills.

CO2. Understand the importance of Values and Ethics in their personal lives and professional careers.

CO3. Understand the rights and responsibilities as an employee, team member and a global citizen.

CO4. Understand the importance of trust, mutually satisfying human behavior and enriching interaction with nature.

CO5. Understand appropriate technologies and management patterns to create harmony in professional and personal life.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the sustained happiness	through identifying the essentials of human values and skills		**L2**
2	**Understand**	the importance of Values and Ethics		in their personal lives and professional careers.	**L2**
3	**Understand**	the rights and responsibilities	as an employee, team member and a global citizen.		**L2**
4	**Understand**	the importance of trust, mutually satisfying human behavior and enriching interaction with nature.			**L2**
5	**Understand**	appropriate technologies and management patterns		to create harmony in professional and personal life.	**L2**

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
1												2
2								2	2			
3						2			2			
4						2		2				
5					1		2					2

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**			**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**corr**	**Verb**	**BTL**			
1	**8**	27	2	**Understand**	**L2**	PO12	Thumb Rule	2
2	**8**	26	2	**Understand**	**L2**	PO8,	Thumb Rule	2

						PO9	Thumb Rule	2
3	**4**	13	**2**	**Understand**	**L2**	PO6, PO9	Thumb Rule Thumb Rule	2 2
4	**5**	17	**2**	**Understand**	**L2**	PO6, PO8	Thumb Rule Thumb Rule	2 2
5	**5**	17	**2**	**Understand**	**L2**	PO5, PO7, PO12	PO5 : APPLY Thumb Rule Thumb Rule	1 2 2

CO1: Understand sustained happiness through identifying the essentials of human values and skills.
Action Verb: Understand (L2)
CO1 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO2: Understand the importance of Values and Ethics in their personal lives and professional careers.
Action Verb: Understand (L2)
CO2 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO3: Understand the rights and responsibilities as an employee, team member and a global citizen.
Action Verb: Understand (L2)
CO3 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO4: Understand the importance of trust, mutually satisfying human behavior and enriching interaction with nature.
Action Verb: Understand (L2)
CO4 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).

CO5: Understand appropriate technologies and management patterns to create harmony in professional and personal life.
Action Verb: Understand (L2)
CO5 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO12 as moderate (2).
CO5 Action Verb is understand of BTL 2. Using action verb apply, L2 correlates PO5 as low (1).

VI Semester (B.Tech –III year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	PCC	20APC0418	Microprocessors and Microcontrollers	3	0	0	3	30	70	100
2	PCC	20APC0419	Digital Signal Processing	3	0	0	3	30	70	100
3	PCC	20APC0420	Microwave and Optical Communications	3	0	0	3	30	70	100
4	PEC	20APE0404	Low Power VLSI Circuits and Systems	3	0	0	3	30	70	100
		20APE0405	MEMS and Microsystems							
		20APE0406	Industrial Electronics							
5	PCC	20APC0421	Microprocessors and Microcontrollers Laboratory	0	0	3	1.5	30	70	100
6	PCC	20APC0422	Digital Signal Processing Laboratory	0	0	3	1.5	30	70	100
7	PCC	20APC0423	Microwave and Optical Communications Laboratory	0	0	3	1.5	30	70	100
8	SOC	20ASA0501	Basics of Cloud Computing	1	0	2	2	100	-	100
9	MC	20AMC9903	Environmental Studies	3	0	0	0	30	-	30
TOTAL							**18.5**	**340**	**490**	**830**
Internship 2 Months (Mandatory) during summer vacation										

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Microprocessors and Microcontrollers	L	T	P	C
20APC0418	III-II	**(common to ECE and EEE)**	**3**	**0**	**0**	**3**

Course Outcomes: After studying the course, Student will be able to:

CO1:**Understand** the basic concepts of 8085 architecture and Instruction set
CO2:**Understand** the architecture details of 8086 processor.
CO3:**Apply** various Instructions in assembly language programs by using 8086 Instruction set .
CO4:**Analyze** the architectural features of different MSP 430 family processors.
CO5:**Evaluate** the operational behavior of peripheral devices by using low power modes

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The basic concepts of 8085 architecture and Instruction set			L2
CO2	Understand	the architecture details of 8086 processor			L2
CO3	Apply	various Instructions in	Assembly language programs	By using 8086 instruction set	L3
CO4	Analyze	The architectural features of different MSP 430 family processors			L4
CO5	Evaluate	the operational behaviour of peripheral devices	By using Low power modes of MSP 430		L5

UNIT - I		10Hrs
OVERVIEW OF 8085 MICROPROCESSOR : Overview of microcomputer systems and their building blocks, Introduction to 8-bit microprocessor (8085) Architecture, Addressing modes, Instruction set, Machine cycles, instruction cycle and timing states.		
UNIT - II		10Hrs
INTRODUCTION TO 8086: Introduction-8086 Architecture-Block Diagram, Register Organization, Flag Register, Pin Diagram, Timing and Control Signals, System Timing Diagrams, Memory Segmentation, Interrupt structure of 8086 and Interrupt Vector Table. Memory organization and memory banks accessing.		
UNIT - III		15Hrs
PROGRAMMING OF 8086: Instruction Formats -Addressing Modes-Instruction Set of 8086, Assembler Directives- Macros and Procedures.- Sorting, Multiplication, Division and multi byte arithmetic code conversion. String Manipulation instructions-Simple ALPs.		
UNIT - IV		14Hrs
INTRODUCTION TO LOW POWER RISC MSP 430: Low power RISC MSP430 – block diagram, features and architecture, Variants of the MSP430 family viz. MSP430x2x, MSP430x4x, MSP430x5x and their targeted applications, MSP430x5x series block diagram, Addressing modes, Instruction set Memory address space, on-chip peripherals (analog and digital), and Register sets. Sample embedded system on MSP430 microcontroller.		
UNIT - V		14Hrs
PERIPHERAL DEVICES OF MSP 430: I/O ports pull up/down resistors concepts, Interrupts, Watchdog timer. System clocks. Low Power aspects of MSP430: low power modes, Active Vs Standby current consumption. Timer & Real Time Clock (RTC), timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.		
Textbooks:		
1. R. S. Gaonkar, Microprocessor Architecture: Programming and Applications with the 8085/8080A, Penram International Publishing, 1996.		
2. Douglas V. Hall, "Microprocessors and interfacing: Programming and hardware", 2nd Edition. Tata McGraw Hill, 1991.		
3. "Microprocessor and Microcontrollers", N. Senthil Kumar, M. Saravanan, S. Jeevanath Oxford Publishers. 1st Edition, 2010		
Reference Books:		
1.Carl Hamacher, ZvonksVranesic, SafwatZaky, "Computer Organization" 5th Edition, McGraw Hill, 2002. 2.Andrew S.Tanenbaum, "Structured Computer Organization",4th Edition PHI/Pearson 3.John L.Hennessy and David A.Patterson, "Computer Architecture a quantitative approach", Fourth Edition Elsevier		
Online Learning Resources:		
nptel videos		

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2										2	
CO2	2	3	2										2	
CO3	3	3	3										3	
CO4	3			3									3	
CO5	3		3	3								1	3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	B TL			
1	10	16%	2	Understand	L2	PO1, PO3,	PO1: Apply (L3) PO3: Develop (L3)	2 2
2	10	16%	2	Understand	L2	PO1,PO2	PO1: Apply (L3) PO2:Review(L2) PO3: Apply(L3)	2 3 2
3	15	23%	3	Apply	L3	PO1,PO2,PO3	PO1:Apply PO2:Identify(L3) PO3:Develop (L3)	3 3 3
4	14	22%	3	Analyze	L4	PO1, PO4	PO1:Apply PO4:Analyze(L4)	3 3
5	14	22%	3	Evaluate	L5	PO1,PO3,PO4,PO12	PO1:Apply(L3) PO3:Develop(L3) PO4:Analyze(L4) PO12: Thumb's rule	3 3 3 2
	63	100%						

Justification Statements :

CO1: Understand the basic concepts of 8085 architecture and Instruction set

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO3 Verbs: Develop (L3)

CO1 Action Verb is less than PO3 verb by one levels; therefore correlation is moderate (2).

CO2: Understand the characteristics and features of 8086 processor.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO2 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2)

CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

PO3 Verb: Apply (L3)

CO3 Action Verb is less than PO3 verb; Therefore correlation is moderate (2).

CO3: Apply various techniques in assembly language programs by using 8086 Instruction set .

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO3 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

PO2 Verb: Identify (L3)

CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

PO3 Verb: Develop (L3)

CO3 Action Verb is equal to PO3 verb; Therefore correlation is high (3).

CO4: Analyze different MSP 430 family processors using low power design implementation.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater to PO1 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO4 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).

CO5: Evaluate the operational behavior of peripheral devices by using low power modes.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)

CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).

PO3 verb: Develop (L3)

CO5 Action verb is greater than PO3 verb therefore the correlation is high (3).

PO4 verb: Analyze (L4)

CO5 Action verb is greater than PO3 verb therefore the correlation is high (3).

PO 12: CO5 Using Thumb rule, L5 correlates PO12 as moderate (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Digital Signal processing	L	T	P	C
20APC0419	III-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: Analyze the discrete time signals and systems in time and frequency domains.
CO2. Apply the Fast Fourier Transform algorithms for efficient computation of DFT.
CO3. Analyze the steps in the design of analog and digital filters for the given specifications
CO4.Evaluate the realizations of digital IIR and FIR filters by using various structures.
CO5. Analyze the interpolation and decimation in multirate digital signal processing and applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the discrete time signals and systems	in time and frequency domains		L4
CO2	Apply	the Fast Fourier Transform algorithms	for efficient computation of DFT		L3
CO3	Analyze	the steps in the design of analog and digital filters		for the given specifications	L4
CO4	Evaluate	the realizations of digital IIR and FIR filters	by using various structures		L5
CO5	Analyze	the interpolation and decimation		in multirate digital signal processing	L4

UNIT - I		21Hrs

Introduction to DSP

Review of discrete-time signals and systems – Time domain analysis of discrete-time signals & systems, Frequency domain analysis of discrete-time signals and systems.

Discrete Fourier Transform: Frequency-domain sampling and reconstruction of discrete- time signals, Discrete Fourier Transform (DFT), The DFT as a linear transformation, Relationship of the DFT to other transforms, Properties of DFT, Frequency analysis of signals using the DFT.

UNIT - II		12Hrs

Fast Fourier Transform

Efficient computation of the DFT – Direct computation of DFT, Divide and conquer approach to computation of DFT, Radix-2, Radix-4, and Split radix FFT algorithms, Implementation of FFT algorithms, Applications of FFT algorithms – Efficient computation of the DFT of two real sequences, 2N point real sequences, Use of the FFT algorithm in linear filtering and correlation, Quantization errors in the computation of DFT.

UNIT - III		19Hrs

Analog & Digital Filters

General considerations – Causality and its implications, Characteristics of practical Frequency Selective Filters, Design of Finite Impulse Response (FIR) filters – Symmetric and asymmetric FIR filters, Design of linear phase FIR filters using windows, Design of linear phase FIR filters by the frequency sampling method, Comparison of design methods for linear phase FIR filters, Design of Impulse Invariance Response (IIR) filters from analog filters – IIR filter design by approximation of derivatives, by Impulse invariance, and by bilinear transformation methods, Characteristics of commonly used analog filters, Design examples of both FIR and IIR filters, Frequency transformation in the analog and digital domains, Illustrative problems..

UNIT - IV		12Hrs

Realization of Filters

Structures for the realization of discrete-time systems, Structures for FIR systems - Direct form, Cascade form, Linear Phase Realization and Lattice structures, Structures for IIR systems – Direct form, Signal flow graphs & Transposed, Cascade form, Parallel form and Lattice structures, lattice – Ladder structure.

UNIT - V		11Hrs

Multirate DSP

Introduction, Decimation, and interpolation, Sampling rate conversion by a rational factor, Implementation of sampling rate onversion, Multistage implementation of sampling rate conversion, Sampling rate conversion of band pass signals, Sampling rate conversion by arbitrary factor, Applications of multirate signal processing.

Textbooks:

1. John G. Proakis, Dimitris G. Manolakis, "Digital signal processing, principles,Algorithms and applications," Pearson Education/PHI, 4th ed., 2007.
2. Sanjit K Mitra, "Digital signal processing, A computer base approach," Tata McGraw Hill, 3rd edition, 2009.

Reference Books:

1.Carl Hamacher, ZvonksVranesic, SafwatZaky, "Computer Organization" 5th Edition, McGraw Hill, 2002.
2.Andrew S.Tanenbaum, "Structured Computer Organization",4th Edition PHI/Pearson
3.John L.Hennessy and David A.Patterson, "Computer Architecture a quantitative approach", Fourth Edition Elsevier

Online Learning Resources:

nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		2		2							3	
CO2	3	3	3									2	3	
CO3	3		3	1		2							3	
CO4	3	2	3			2							3	
CO5	3	3			1	2						2	3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	21	28%	2	Analyze	L4	PO1, PO2, PO4 PO6	PO1: Apply (L3) PO2: Review(L2) PO4:Identitify (L5) PO6:Thumb rule	3 3 2 2
2	12	16%	2	Apply	L3	PO1, PO2, PO3 PO12	PO1: Apply (L3) PO2:Identify(L3) PO3:Develop(L3) PO12:Thumb rule	3 3 3 2
3	19	25%	2	Analyze	L4	PO1, PO3, PO4, PO6	PO1: Apply(L3) PO3:Develop(L3) PO4: Design(L6) PO6:Thumb rule	3 3 1 2
4	12	16%	3	Evaluate	L5	PO1, PO2, PO3 PO6	PO1: Apply(L3) PO2:Formulate(L6) PO3:Develop(L3) PO6: Thumb rule	3 2 3 2
5	11	15%	2	Analyze	L4	PO1, PO2, PO5, PO6, PO12	PO1: Apply(L3) PO2:Identify(L3) PO5: Create (L6) PO6:Thumb rule PO12:Thumb rule	3 3 1 2 2
	75	100%						

Justification Statements:

CO1: Analyze the discrete time signals and systems in time and frequency domains.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO1 Action Verb is greater than PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Review (L2) CO1 Action Verb is in the same level of less than PO2 verb. Therefore, the correlation is high (3).
PO4 Verbs: Identify(L5) CO1 Action Verb is less than PO4 verb by one levels. Therefore, the correlation is moderate (2).
PO6: CO1 using Thumb rule, correlates PO6 as medium (2).

CO2: Apply the Fast Fourier Transform algorithms for efficient computation of DFT

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3) CO2 Action Verb is equal to the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Identify(L3) CO2 Action Verb is in the same level of PO2 verb. Therefore, the correlation is high (3).
PO3 Verbs: Develop (L3) CO2 Action Verb is same level PO3 verb. Therefore, the correlation is high (3).
PO12: CO2 using Thumb rule, correlates PO12 as medium (2).

CO3: Analyze the steps in the design of analog and digital filters for the given specifications.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3) CO3 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop(L3)CO3 Action Verb level is in the same level of PO3 verb. Therefore, the correlation is high (3).
PO4 Verb: Design(L6)CO3 Action Verb is less than PO4 verb by two levels. Therefore, the correlation is high (1).
PO6: CO3 using Thumb rule, correlates PO6 as medium (2).

CO4: Evaluate the realizations of digital IIR and FIR filters by using various structures.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3) CO4 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Formulate (L6) CO4 Action Verb level is less than the PO2 verb by one level. Therefore, the correlation is moderate (2).
PO3 Verb: Develop (L3) CO4 Action Verb is greater than the PO3 verb. Therefore, correlation is high (3).
PO6: CO4 using Thumb rule, correlates PO6 as medium (2).
CO5: Analyze the interpolation and decimation in multirate digital signal processing and applications.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)CO5 Action verb is less than the PO1 verb by one level. Therefore, the correlation is medium (3).
PO4 verb: Identify (L3)CO5 Action verb is greater than the PO4 verb . Therefore, the correlation is high (3).
PO5 verb: create (L6)CO5 Action verb is less than PO5 verb by one level. Therefore, the correlation is low (1)
PO6: CO5 using Thumb rule, L3 correlates PO6 as medium (2).
PO12: CO5 using Thumb rule, correlates PO12 as medium (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Microwave and Optical communications	L	T	P	C
20APC0420	III-II	**(Common to ECE and EEE)**	**3**	**0**	**0**	**3**

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the different fields in rectangular waveguides and principles of Gunn diode.
CO2: **Evaluate** S parameters of different waveguide components.
CO3: **Analyze** the operation of O type tubes and measure different parameters of microwave test bench setup.
CO4: **Understand** the fundamental concepts of Optical fibre modes in various configurations
CO5: **Analyze** the types of Optical sources, detectors, Fiber joining techniques and fiber components.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The different fields in rectangular waveguides and principles of Gunn diode			L2
CO2	Evaluate	S parameters of different wave guide components.			L5
CO3	Analyze	the operation of O type tubes and measure different parameters of microwave test bench setup.			L4
CO4	Understand	the fundamental concepts of Optical fibre modes		in various configurations	L2
CO5	Analyze	the types of Optical sources, detectors, Fiber joining techniques and fiber components.			L4

UNIT - I		12Hrs
Introduction: Microwave spectrum and bands, applications of Microwaves. Rectangular Waveguides-Solution of Wave Equation in Rectangular Coordinates, TE/TM mode analysis, Expressions for fields, dominant and degenerate modes, Mode characteristics- Phase and Group velocities, wavelengths and impedance relations, Gunn diode-principles, RWH theory. .		
UNIT - II		20Hrs
WAVEGUIDE COMPONENTS AND APPLICATIONS: Coupling mechanisms- probe, loop. Wave guide discontinuities-waveguide Windows, tuning screws and posts, matched loads. Waveguide attenuators-resistive card, rotary vane Attenuators; waveguide phase shifters-dielectric, rotary vane phase shifters. Wave guide multiport junctions and scattering parameters-E plane and H plane Tees, Magic Tee, Directional couplers-2-hole, Bothe hole types.		
UNIT - III		14Hrs
MICROWAVE TUBE: Limitations and losses of conventional tubes at microwave frequencies. O type tubes: 2 cavity klystrons-structure, Applegate diagram, velocity modulation process, bunching process. Reflex Klystrons-structure, Applegate diagram, Velocity Modulation, mathematical theory of bunching. **MICROWAVE MEASUREMENTS:** Description of Microwave bench-different blocks and their features, errors and precautions, Measurement of attenuation, Power, low and high VSWR, impedance.		
UNIT - IV		10Hrs
INTRODUCTION TO OPTICAL FIBERS: Evolution of fiber optic system, element of an Optical Fiber Transmission link, Ray Optics, optical Fiber Modes and Configurations, Mode theory of Circular Wave guides, Single Modeand Multimode Mode Fiber structures.		
UNIT - V		16Hrs
OPTICAL FIBER SOURCES AND RECEIVERS Direct and indirect bandgap structures, Light Emitting Diode (LED) Structures, Laser Diode structures, PIN and APD, Fiber to Fiber Joints, Fiber Splicing, Fiber Connectors. OpticalIsolators and Circulators.		
Textbooks:		
1.Microwave devices and circuits-Samuel Y. Liao, Pearson, 3rd Edition, 2003. 2.Microwave principles-Herbert J. Reich, J. G. Skalnik, P. F. Ordung and H. L. Krauss, CBSpublishers and distributors, New Delhi,2004. 3.Gerd Keiser,"Optical Fiber Communication"McGraw–Hill International,Singapore,3rd ed.,2000.		
Reference Books:		

1.Carl Hamacher, ZvonksVranesic, SafwatZaky, "Computer Organization" 5th Edition, McGraw Hill, 2002. 2.Andrew S.Tanenbaum, "Structured Computer Organization",4th Edition PHI/Pearson 3.John L.Hennessy and David A.Patterson, "Computer Architecture a quantitative approach", Fourth Edition Elsevier
Online Learning Resources:
nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	2
CO2	3	3	2										3	3
CO3	3	3	1										3	3
CO4	2	3											2	2
CO5	3	3	1										3	3

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	**12**	**17%**	**1**	**Understand**	**L2**	**PO1, PO2**	**PO1: Apply (L3) PO2: Review (L2)**	**2 3**
2	**20**	**27%**	**3**	**Evaluate**	**L5**	**PO1,PO2, PO3**	**PO1: Apply (L3) PO2: Identify (L3) PO3: Design (L6)**	**3 3 2**
3	**14**	**20%**	**2**	**Analyze**	**L4**	**PO1,PO2,PO3**	**PO1:Apply (L3) PO2:Identify (L3) PO3:Design (L6)**	**3 3 1**
4	**10**	**14%**	**1**	**Understand**	**L2**	**PO1, PO2**	**PO1:Apply (L3) PO2:Review (L2)**	**2 3**
5	**16**	**22%**	**3**	**Analyze**	**L4**	**PO1,PO2, PO3**	**PO1:Apply (L3) PO2:Review (L2) PO3:Design (L6)**	**3 3 1**
	72	**100%**						

Justification Statements :

CO1: Understand different fields in rectangular waveguides and principles of Gunn diode.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action Verb is less than PO1 action verb by 1 level therefore correlation is moderate(2).
PO2 Verb: Review (L2)
CO1 Action Verb is equal to PO2 action verb therefore correlation is high (3).
CO2: Evaluate S parameters of different wave guide junctions.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO2 Action Verb is higher than PO1 action verb by 2 level therefore correlation is high (3).
PO2 Verb: Identify (L3)
CO2 Action Verb is higher than PO2 action verb by 2 level therefore correlation is high (3)
PO3 Verb: Design (L6)
CO2 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2)
CO3: Analyze the operation of O type tubes and measure different parameters of microwave test benchsetup.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action Verb is higher than PO1 action verb by 1 level therefore correlation is high (3)

PO2 Verb:Identify (L3)
CO3 Action Verb is higher than PO2 action verb by 1 level therefore correlation is high (3)
PO3 Verb:Design (L6)
CO3 Action Verb is less than PO3 action verb by 2 level therefore correlation is low (1)**CO4:** Understand the fundamental concepts of Optical fibre modes in various configurations
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO4 Action Verb is less than PO1 action verb by 1 level therefore correlation is moderate (2)
PO2 Verb: Review (L2)
CO4 Action Verb is equal to PO2 action verb; therefore correlation is high (3)
CO5: Analyze the types of Optical sources, detectors and their working principles.
Action Verb: Apply (L4)PO1 Verb: Apply (L3)
CO5 Action Verb is higher than PO1 action verb by 1 level therefore correlation is high (3)
PO2 Verb: Review (L2)
CO5 Action Verb is higher than PO2 action verb by 2 level therefore correlation is high (3)
PO3 Verb: Design (L6)
CO5 Action Verb is less than PO3 action verb by 2level; therefore correlation is Low(1)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	LOW POWER VLSI CIRCUITS AND SYSTEMS (ECE)	L	T	P	C
20APE0404	III-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1**: Understand** the concepts of low power for VLSI circuits and their Design methodologies.

CO2: **Understand** the characteristics of MOS Inverters and MOS combinational circuits**.**

CO3: **Evaluate** the sources of power dissipation and supply voltage scaling using different scaling approaches.

CO4**: Analyze** various switched capacitance minimization techniques of VLSI Circuits using system level Approaches

CO5: **Analyze** various Leakage power minimization techniques in VLSI circuits using CAD Tools

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The concepts of low power for VLSI circuits and		their Design methodologies	L2
CO2	Understand	The characteristics of MOS Inverters and the MOS combinational circuits			L2
CO3	Evaluate	the sources of power dissipation and supply voltage scaling	Using different scaling approaches		L5
CO4	Analyze	The switched capacitance Minimization techniques of VLSI Circuits	Using system level Approaches		L4
CO5	Analyze	The Leakage power Minimization techniques in VLSI circuits	Using CAD Tools		L4

UNIT - I		12Hrs
Introduction: Historical background, why low power, sources of power dissipations, low power design methodologies**.** **MOS Transistors**: Introduction, the structure of MOS Transistor, the Fluid model, Modes of operation of MOS Transistor, Electrical characteristics of MOS Transistors, MOS Transistors asa switch.		
UNIT - II		14Hrs
MOS Inverters: Introduction, inverter and its characteristics, configurations, inverter ratio in different situations, switching characteristics, delay parameters, driving parameters, driving largecapacitive loads. **MOS Combinational Circuits:** Introduction, Pass-Transistor logic, Gate logic, MOS DynamicCircuits		
UNIT - III		24Hrs
Sources of Power Dissipation: Introduction, short-circuit power dissipation, switching power dissipation, glitching power dissipation, leakage power dissipation. **Supply voltage scaling for low power:** Introduction, device features size scaling, architecture- level approaches, voltage scaling, multilevel voltage scaling, challenges, dynamic voltage and frequency scaling, adaptive voltage scaling.		
UNIT - IV		17Hrs
Minimizing Switched Capacitance: Introduction, system-level approaches, transmeta's Crusoe processor, bus encoding, clock gating, gated-clock FSMs, FSM state encoding,FSM Partitioning,operand isolation, precomputation, logic styles for low power.		
UNIT - V		12Hrs
Minimizing Leakage Power: Introduction, fabrication of multiple threshold voltages, approaches for minimizig leakage power, Adiabatic Logic Circuits, Battery-Driven System,CAD Tools for Low Power VLSI Circuits.		

Textbooks:

1.Ajit. Pal, Low power VLSI Circuits and systems,springer

2.Sung Mo Kang, Yusuf Leblebici, CMOS Digital Integrated Circuits, Tata McgraHill.

3.Neil H.E.Weste and K. Ehraghian, Principles of CMOS VLSI Design, 2nd Edition,Addison Wesley.

Reference Books:

1. Kaushik Roy and Sharat C. Prasad, Low-Power CMOS VLSI Design, Wiley Interscience, 2000.

Online Learning Resources:

nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2												2	
CO2	2	2											2	
CO3	3		2	2								1	3	
CO4	3		1	1								1	3	
CO5	3		1	3	1							1	3	3

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	12	16	2	Understand	L2	PO1	PO1: Apply (L3)	2
2	14	18	2	Understand	L2	PO1,PO2	PO1: Apply (L3) PO2: Identify (L3)	2 2
3	24	30	3	Evaluate	L5	PO1,PO3,PO4 ,PO12	PO1:Apply(L3) PO3:Develop(L6) PO4:Design(L6) PO12:ThumbRule	3 2 2 1
4	17	22	3	Analyze	L4	PO1,PO3,PO4 ,PO12	PO1:Apply(L3) PO3:Develop(L6) PO4:Design(L6) PO12:ThumbRule	3 1 1 1
5	12	16	2	Analyze	L4	PO1,PO3,PO4 ,PO5,PO12	PO1:Apply(L3) PO3:Develop(L6) PO4:Analyze(L4) PO5:Create(L6) PO12:ThumbRule	3 1 3 1 1
	79							

Justification Statements :

CO1: Understand the concepts of low power for VLSI circuits and their Design methodologies.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
CO2: Understand the characteristics of MOS Inverters and MOS combinational circuits.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO2 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verb: Identify(L3)
CO2 Action Verb is less than PO2 verb by one level; Therefore correlation is moderate (2).
CO3: Evaluate the sources of power dissipation and supply voltage scaling using different scaling approaches.
Action Verb: Evaluate(L5)
PO1 Verbs: Apply(L3)
CO3 Action Verb is greater than PO1 verb by two level; Therefore correlation is high (3).
PO3 Verb: Develop (L6)
CO3 Action Verb is less than PO3 verb by one level; Therefore correlation is Moderate(2).
PO4:Design(L6)
CO3 Action Verb is less than PO4 verb by one level; Therefore correlation is Moderate(2).
PO12 CO3 using thumb rule L5 Correlates PO12 as low (1).
CO4: Analyze various switched capacitance minimization techniques of VLSI Circuits using system level Approaches.
Action Verb: Analyze (L4)
PO1 Verb: Apply(L3)
CO4 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

PO3 Verb: Develop (L6)

CO4 Action Verb is less than PO3 verb by two level; Therefore correlation is low(1).

PO4:Design(L6)

CO4 Action Verb is less than PO4 verb by two level; Therefore correlation is low(1).

PO12: CO4 using thumb rule L6 Correlates PO12 as low (1).

CO5: Analyze various Leakage power minimization techniques in VLSI circuits using CAD Tools.
Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO5 Action verb is greater than PO1 verb; therefore the correlation is high (3).

PO3 verb: Develop (L6)

CO5 Action verb is less than PO3 verb by two level. Therefore the correlation is low (1).

PO4 verb: Analyze (L4)

CO5 Action verb is equal to PO4 verb. Therefore the correlation is high (3).

PO5 verb: Create(L6)

CO5 Action verb is less than PO5 verb by two level. Therefore the correlation is low (1).

PO12: CO5 using thumb rule L6 Correlates PO12 as low (1).

Annamacharya Institute of Technology and Sciences (Autonomous) Tirupati
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	MEMS AND MICROSYSTEMS	L	T	P	C
20APE0405	III-II		3	0	0	3

Course Outcomes:

CO1: UnderstandtheMicrosensors anddifferentmaterialproperties
CO2: Apply different techniques in Micro machine processes.
CO3: Analyze various characteristics in different types of Microsensors
CO4: AnalyzeMEMSaccelerometers functionalityanditsapplications.
CO5: Apply MEMS devices in various applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1.	Understand	The Micro sensors and different material Properties			L2
2.	Apply	different techniques in Micro machine processes			L3
3.	Analyze	various characteristics in different types of Microsensors		MEMS Sensors	L4
4.	Analyze	MEMSaccelerometers functionalityanditsapplications		MEMS Sensors	L4
5	Apply	MEMS devices in various applications			L3

UNIT - I	**Introduction**	**9 Hrs**
Introduction to MEMS & Microsystems, Introduction to Microsensors, Evaluation of MEMS, Microsensors, Market Survey, Application of MEMS, MEMS Materials, MEMS Materials Properties, MEMS Materials Properties.		
UNIT - II	**Microelectronic Technology for MEMS:**	**9Hrs**
Microelectronic Technology for MEMS, Micromachining Technology for MEMS, Micromachining Process, Etch Stop Techniques and Microstructure, Surface and Quartz Micromachining, Fabrication of Micro machined Microstructure, Micro stereo lithography.		
UNIT - III	**Micro Sensors**	**9 Hrs**
MEMS Microsensors, Thermal Microsensors, Mechanical Micro machined Microsensors, MEMS Pressure Sensor, MEMS Flow Sensor, Micro machined Flow Sensors, MEMS Inertial Sensors, MEMS Gyro Sensor.		
UNIT - IV	**MEMS Accelerometers**	**9 Hrs**
Micro machined Micro accelerometers for MEMS, MEMS Accelerometers for Avionics, Temperature Drift and Damping Analysis, Piezo resistive Accelerometer Technology, MEMS Capacitive Accelerometer, MEMS Capacitive Accelerometer Process, MEMS for Space Application.		
UNIT - V	**MEMS Applications**	**9 Hrs**
Polymer MEMS & Carbon Nano Tubes CNT, Wafer Bonding & Packaging of MEMS, Introduction to Bio MEMS and Micro Fluidics, Introduction to Bio Nano Technology, Bio Sensors, Fluidics, MEMS for Biomedical Applications (Bio-MEMS)		
Textbooks:		
1.Nadim Maluf Kirt Williams “An Introduction to Micro electro mechanical Systems Engineering”, Second Edition, Artech House, Inc. Boston London, International Standard Book Number: 1-58053-590-9. 2.Varadan, V KandVaradan “Microsensors, actuators, MEMS, and electronics for smart structures” Rai-Choudhury P (ed.) Handbook of Microlithography, Micromachining, and Micro fabrication, SPIE Optical Engineering Press		

CourseTitle	COS	ProgrammeOutcomes(POs)&ProgrammeSpecificOutcomes(PSOs)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
MEMS AND MICROSYSTEMS	CO1		3											2	
	CO2	3												3	
	CO3		3		3									3	
	CO4				3									3	
	CO5	3	3											3	

Correlation Matrix:

CO	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
				Verb	BTL			
1				Understand	L2	PO2	PO2: Review (L2)	3
2				Apply	L3	PO1	PO1:Apply(L3)	3
3				Analyze	L4	PO2, PO4	PO2: Review (L2) PO4: Analyze(L4)	3 3
4				Analyze	L4	PO4	PO4: Analyze(L4)	3
5				Apply	L3	PO1, PO2	PO1: Review (L2) PO2:Apply(L3)	3 3

CO PO Justification statements:

CO1: . UnderstandtheMicrosensors anddifferentmaterialproperties**.**

Action Verb: Understand (L2)

PO2 Verbs: Review (L2) CO1 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO2: Apply different techniques in Micro machine processes**.**

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3) CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze various characteristics in different types of Microsensors**.**

Action Verb: Analyze (L4)

PO2 Verbs: Review (L2) CO3 Action Verb is greater than PO1 verb by two level ; Therefore correlation is high (3).

PO4 Verb: Analyze (L4) CO3 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).

CO4: Analyze MEMS accelerometers functionality and its applications.

Action Verb: Analyze (L4)

PO4 Verbs: Analyze (L4) CO4 action verb is equal to PO4 verb. Therefore correlation is high(3)

CO5: Apply MEMS devices in various applications**.**

Action Verb: Apply(L3)

PO1 Verb: Apply (L3) CO5 Action verb is equal to PO1 verb; therefore the correlation is high (3).

PO2 Verb: Review (L2) CO5 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	INDUSTRIAL ELECTRONICS	L	T	P	C
20APE0406	III-II		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Review** of semi-conductors and the operation of Diodes
CO2: **Understand** the operation of Semiconductor Devices.
CO3: **Analyze** the characteristics of various Rectifiers and Voltage regulator circuits
CO4: **Analyze** the techniques of Heating and Welding methods.
CO5: **Apply** Ultrasonic waves in various Industrial applications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Review	conductors and the operation of Diodes			**L2**
CO2	Understand	The operation of Semiconductor Devices.			**L2**
CO3	Analyze	characteristics of various Rectifiers and Voltage regulator circuits			**L4**
CO4	Analyze	techniques of Heating and Welding methods			**L4**
CO5	Apply	Ultrasonic waves		In Various Industrial applications	**L3**

UNIT - I	**Review of Semiconductors & Diodes**	**9 Hrs**
Scope of industrial Electronics, Semiconductors, Merits of semiconductors, crystalline structure, Intrinsic semiconductors, Extrinsic semiconductors, current flow in semiconductor, Open circuited p-n junction, Diode resistance, Zener diode, Photoconductors and junction photo diodes, Light emitting diodes (LED)		
UNIT - II	**Transistor Characteristics**	**9Hrs**
Introduction, The junction transistor, Conventions for polarities of voltages and currents, Open circuited transistor, Transistor biased in the active region, Current components in transistors Currents in a transistor, Emitter efficiency, Transport factor and transistor-α, Dynamic emitter resistance, Transistor as an amplifier, Transistor construction, Letter symbols for semiconductor Devices, Characteristic curves of junction transistor in common configuration, static characteristic curves of PNP junction transistor in common emitter configuration, The transistor in common collector Configuration.		
UNIT - III	**Rectifier, Filter & Regulators**	**9 Hrs**
AC to DC converters- Introduction, Classification of Rectifiers, Half wave Rectifiers, Full wave Rectifiers, Comparison of Half wave and full wave rectifiers, Bridge Rectifiers, Bridge Rectifier meter, Voltage multiplying Rectifier circuits, Capacitor filter, LC Filter, Regulated Power Supplies, Classification of Voltage Regulators, Short period Accuracy of Regulators, Long period Accuracy of Voltage Regulator, Principle of automatic voltage Regulator, Simple D.C. Voltage stabilizer using Zener diode, D.C. Voltage Regulators, Complete series voltage regulator circuit, Simple series voltage regulator.		
UNIT - IV	**Welding & Heating**	**9 Hrs**
Resistance welding controls: Introduction, Resistance welding process, Basic Circuit for A.C. resistance welding, Types of Resistance welding, Electronic welding control used in Resistance welding, Energy storage welding. Induction heating: Principle of induction heating, Theory of Induction heating, merits of induction heating. Dielectric heating: Principle of dielectric heating, theory of dielectric heating, dielectric properties of typical materials, electrodes used in dielectric heating, method of coupling of electrodes to the R.F. generator, Thermal losses in Dielectric heating.		
UNIT - V	**Ultrasonics**	**9 Hrs**
Ultrasonics: Introduction, Generation of Ultrasonic waves, Application of Ultrasonic waves, Ultrasonic stroboscope, ultrasonic as means of communication, ultrasonic flaw detection, Optical image on non-homogeneities, ultrasonic study of structure of matter, Dispersive study of structure of matter, Dispersive and colloidal effect of Ultrasonic, separation of mixtures by ultrasonic waves, cutting and machining of hard materials by ultrasonic vibrations, Degassing of liquids by ultrasonic waves, Thermal effects of Ultrasonics, soldering and welding by ultrasonics, Ultrasonic Drying.		
Textbooks:		
1 G. K. Mithal, "Industrial Electronics", Khanna Publishers, Delhi, 2000. 2. J. Gnanavadivel, R.Dhanasekaran, P.Maruthupandi, "Industrial Electronics", Anuradha Publications, 2011.		
Reference Books:		

1. F. D. Petruzulla, “Industrial Electronics”, McGraw Hill, Singapore, 1996.
2. M. H. Rashid, “power Electronics Circuits, Devices and Application”, PHI, 3rd edition, 2004.
3. G. M. Chute and R. D. Chute, “Electronics in Industry”, McGraw Hill Ltd, Tokyo, 1995.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		1	2								2	
CO2	2	3		1	2								2	
CO3	3	3	1	3	3									3
CO4	3	3	1	3	3									3
CO5	3	3		2	3									3

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co’s Action verb	BTL			
1				CO1 :Review	L2	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO4:Analysis(L4) PO5:Apply(L3)	2 3 1 2
2				CO2 : Understand	L2	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO4:Analysis(L4) PO5:Apply(L3)	2 3 1 2
3				CO3 :Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Design(L6) PO4:Analysis(L4) PO5:Apply(L3)	3 3 1 3 3
4				CO4 : Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Design(L6) PO4:Analysis(L4) PO5:Apply(L3)	3 3 1 3 3
5				CO5 :Apply	L3	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO4:Analysis(L4) PO5:Apply(L3)	3 3 2 3

Justification Statements :

CO1: Review of semi-conductors and the operation of Diodes
Action Verb: Review(L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Review(L2)
CO1 Action verb is same level as PO2 verb . Therefore the correlation is high(3)
PO4: Analysis(L4)
CO1 Action verb is less than PO4 verb by two level. Therefore the correlation is low (1)
PO5: Apply(L3)
CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is medium(2)

CO2: Understand the operation of Semiconductor Devices.
Action Verb :Understand(L2)
PO1 Verb: Apply(L3)
CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Review(L2)
CO2 Action verb is same level as PO2 verb . Therefore the correlation is high(3)
PO4: Analysis(L4)
CO2 Action verb is less than PO4 verb by two level. Therefore the correlation is low (1)
PO5: Apply(L3)
CO2 Action verb is less than PO5 verb by one level. Therefore the correlation is medium(2)

CO3: Analyze the characteristics of various Rectifiers and Voltage regulator circuits
Action Verb :Analyze(L4)
PO1: Apply(L3)
CO3 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO3 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO3 Action verb is less than as PO3 verb by two level. Therefore the correlation is low (1)
PO4: Analysis(L4)
CO3 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO3 Action verb is greater than as PO5 verb. Therefore the correlation is high(3)

CO4: Analyze the techniques of Heating and Welding methods.
Action Verb :Analyze(L4)
PO1: Apply(L3)
CO4 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is less than as PO3 verb by two level. Therefore the correlation is low (1)
PO4: Analysis(L4)
CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb is greater than as PO5 verb. Therefore the correlation is high(3)

CO5: Apply Ultrasonic waves in various Industrial applications
Action Verb :Apply (L3)
PO1: Apply(L3)
CO5 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)
PO4: Analysis(L4)
CO5 Action verb is less than as PO4 verb by one level. Therefore the correlation is medium (2)
PO5: Apply(L3)
CO5 Action verb is same as PO5 verb. Therefore the correlation is high(3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & sem		L	T	P	C
20APC0421	III-II	MICROPROCESSORS AND MICROCONTROLLERS LAB	0	0	3	1.5

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the execution of assembly language program using MASM software
CO2**: Evaluate** Arithmetic and Logical operations using 8086 processor.
CO3:**Evaluate** sorting and string operations using 8086 processor.
CO4: **Analyze** interfacing of various I/O devices using MSP 430.
CO5: **Analyze** MSP 430 operations in various Low power modes.

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CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the execution of assembly language program	using MASM software		L2
CO2	Evaluate	Arithmetic and Logical operations	using 8086 processor		L4
CO3	Evaluate	sorting and string operations	using 8086 processor		L4
CO4	Analyze	interfacing of various I/O devices		using MSP 430	L4
CO5	Analyze	MSP 430 operations in		various Low power modes.	L4

Minimum of Ten experiments to be conducted (Five from each Part- A&B) Part A: 8086 Microprocessor Programs using MASM/8086 microprocessor kit.

1. Introduction to MASM Programming. **(CO1)**
2. Programs using arithmetic and logical operations **(CO2)**
3. Programs using ASCII arithmetic operations **(CO2)**
4. Programs for code conversion**(CO2)**
5. Sorting of the given numbers**(CO2)**
6. String operations**(CO3)**

Part B: Embedded C Experiments using MSP430 Microcontroller

1. Interfacing and programming GPIO ports in C using MSP430 (blinking LEDs, push buttons) **(CO4)**
2. Usage of Low Power Modes: (Use MSPEXP430FR5969 as hardware platform and demonstrate the low power modes and measure the active mode and standby modecurrent) **(CO5)**
3. Interrupt programming examples through GPIOs **(CO4)**
4. Interfacing potentiometer with MSP430 **(CO4)**
5. Using ULP advisor in Code Composer Studio on MSP430 **(CO5)**
6. Low Power modes and Energy trace++ **(CO5)**

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2	1	2									2
CO2	3	3	3	3	3									3
CO3	3	3	3	3	3									3
CO4	3	3	3	3	3									3
CO5	3	3	3	3	3									3

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Understand	L2	PO1, PO3,PO4,PO5	PO1: Apply (L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	2 2 1 2
2	Evaluate	L5	PO1,PO2, PO3,PO4,PO5	PO1: Apply (L3) PO2:Identify(L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3 3 3
3	Evaluate	L5	PO1,PO2, PO3,PO4,PO5	PO1: Apply (L3) PO2:Identify(L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3 3 3

4	Analyze	**L4**	PO1,PO2, PO3,PO4,PO5	PO1: Apply (L3) PO2:Identify(L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3 3 3
5	Analyze	**L4**	PO1,PO2, PO3,PO4,PO5	PO1: Apply (L3) PO2:Identify(L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3 3 3

Justification Statements :

CO 1: Understand the execution of assembly language program using MASM software
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2)
PO3 Verb: Develop (L3)
CO1Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2)
PO4 Verbs: Analyze (L4)
CO1 Action Verb is less than PO4 verb by two level Therefore correlation is low (1).
PO5 Verbs: Apply (L3)
CO1Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2)
CO 2: Evaluate Arithmetic and Logical operations using 8086 processor.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)
Po2 Verb: Identify (L3)
CO2Action Verb is equal PO2 verb by one level; Therefore correlation is high (3)
PO3 Verb: Develop (L3)
CO2 Action Verb is greater than PO3 verb by one level; Therefore correlation is high (3)
PO4 Verbs: Analyze (L4)
CO2Action Verb is equal PO4 verb by one level; Therefore correlation is high (3)
PO5 Verbs: Apply (L3)
CO2 Action Verb is greater than PO5 verb by one level; Therefore correlation is high (3)
CO 3: Evaluate sorting and string operations using 8086 processor.
PO1 Verbs: Apply (L3)
CO3 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)
Po2 Verb: Identify (L3)
CO3Action Verb is equal PO2 verb by one level; Therefore correlation is high (3)
PO3 Verb: Develop (L3)
CO3 Action Verb is greater than PO3 verb by one level; Therefore correlation is high (3)
PO4 Verbs: Analyze (L4)
CO3Action Verb is equal PO4 verb by one level; Therefore correlation is high (3)
PO5 Verbs: Apply (L3)
CO3 Action Verb is greater than PO5 verb by one level; Therefore correlation is high (3)
CO 4: Analyze interfacing of various I/O devices using MSP 430.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO4 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)
Po2 Verb: Identify (L3)
CO4Action Verb is equal PO2 verb by one level; Therefore correlation is high (3)
PO3 Verb: Develop (L3)
CO4 Action Verb is greater than PO3 verb by one level; Therefore correlation is high (3)
PO4 Verbs: Analyze (L4)
CO4Action Verb is equal PO4 verb by one level; Therefore correlation is high (3)
PO5 Verbs: Apply (L3)
CO4 Action Verb is greater than PO5 verb by one level; Therefore correlation is high (3)
CO 5 Analyze MSP 430 operations in various Low power modes.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3)
Po2 Verb: Identify (L3)
CO5Action Verb is equal PO2 verb by one level; Therefore correlation is high (3)
PO3 Verb: Develop (L3)
CO5 Action Verb is greater than PO3 verb by one level; Therefore correlation is high (3)
PO4 Verbs: Analyze (L4)
CO5Action Verb is equal PO4 verb by one level; Therefore correlation is high (3)
PO5 Verbs: Apply (L3)
CO5 Action Verb is greater than PO5 verb by one level; Therefore correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
AK20-REGULATIONS

B. Tech III Year VI Semester

Course Code	Course Title	L	T	P	Credits
20APC0422	DIGITAL SIGNAL PROCESSING LABORATORY	0	0	3	1.5

Course Outcomes: **After studying the course, Student will be able to:**
Upon completion of the course students will be able to
CO1: Analyze the power or energy of a discrete time sequence.
CO2: Evaluate the convolution and correlation of discrete time sequences.
CO3: Apply the Fourier Transform to discrete time sequences for finding it's spectrum.
CO4: Analyze the steps in the design of analog filters for the given specifications.
CO5: Analyze the steps in the design of digital filters for the given specifications

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms Level
1	Analyze	the power or energy of a discrete time sequence			L4
2	Evaluate	the convolution and correlation of discrete time sequences.			L5
3	Apply	the Fourier Transform to discrete time sequences	.	for finding it's spectrum	L3
4.	Analyze	the steps in the design of analog filters	for the given specifications.		L4
5	Analyze	the steps in the design of digital filters	for the given specifications		L4

List of Experiments: (Minimum of 5 experiments are to be conducted from each part)

Software Experiments

(Part – A)

1. Power or Energy of a discrete time sequence (CO1)
2. Convolution & Correlation of discrete time sequences(CO2)
3. DTFT of a discrete time signal/sequence(CO3)
4. N – Point Fast Fourier Transform Algorithm(CO3)
5. Design of Analog filters and verify the frequency response(CO4)
6. Design of Digital IIR filters and verify the frequency response(CO5)
7. Design of Digital FIR filters using Windowing Technique(CO5)

Using DSP Processor kits (Floating point) and Code Composure Studio (CCS)

(Part – B)

1. Power or Energy of a discrete time sequence.(CO1)
2. Convolution & Correlation of discrete time sequences(CO2)
3. DTFT of a discrete time signal/sequence(CO3)
4. N – Point Fast Fourier Transform Algorithm(CO3)
5. Design of Analog filters and verify the frequency response(CO4)
6. Design of Digital IIR filters and verify the frequency response(CO5)
7. Design of Digital FIR filters using Windowing Technique(CO5)

Equipment/Software Required:

1 Licensed MATLABORATORY software with required toolboxes for 30users.2 DSP floating Processor Kits with Code Composure Studio (8nos.)
Function Generators
CROs
Regulated Power Supplies.

Mapping of Course OutComes with Program Outcomes:

Course Title	Course Outcomes COs	Programme Outcomes(POs) & Programme Specific Outcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO 2
Integrated Circuits and Applications Laboratory	CO1	3	1		3										3
	CO2	3	2		3										3
	CO3	3		3	2										3
	CO4	3		3	3										3
	CO5	3		3	3										3

	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
Expt. No.	Lesson Plan (Hrs)	%	Correlation	Action Verb	BTL			
A1,B1	6	14.3%		Analyze	L4	PO1, PO2, PO4	PO1: Apply (L3) PO2: Formulate (L6) PO4: Analyze(L4)	3 1 3
A2,B2	6	14.3%		Evaluate	L5	PO1, PO2, PO4	PO1: Apply (L3) PO2: Formulate (L6) PO4: Analyze(L4)	3 2 3
A3,A4 B3,B4	12	28.5%		Apply	L3	PO1, PO3, PO4	PO1: Apply (L3) PO3: Develop(L3) PO4: Analyze (L4)	3 3 2
A5,B5	6	14.4%		Analyze	L4	PO1, PO3, PO4	PO1: Apply(L3) PO2: Develop(L3) PO4: Analyze (L4)	3 3 3
A6,A7, B6,B7	12	28.5%		Analyze	L4	PO1, PO3, PO4	PO1: Apply(L3) PO2: Develop(L3) PO4: Analyze (L4)	3 3 3
	42	100%						

Justification Statements:

CO1: Analyze the characteristics of negative feedback, regenerative feedback and ICs
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO1 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Formulate(L6)
CO1 Action Verb is less than the PO2 verb by two levels. Therefore, the correlation is low (1).
PO4 Verbs: Analyze(L4)
CO1 Action Verb is same as the PO4 verb. Therefore, the correlation is high (3).

CO2: Evaluate the convolution and correlation of discrete time sequences.
Action Verb: Evaluate(L5)
PO1 Verbs: Apply (L3)
CO1 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 Verbs: Formulate(L6)
CO1 Action Verb is less than the PO2 verb by one level. Therefore, the correlation is medium (1).
PO4 Verbs: Analyze(L4)
CO1 Action Verb is same as the PO4 verb. Therefore, the correlation is high (3).
CO3: Apply the Fourier Transform to discrete time sequences for finding it's spectrum
Action Verb: Apply(L3)
PO1 Verbs: Apply (L3)
CO3 Action Verb is same as the PO1 verb. Therefore, the correlation is high (3).
PO3 Verbs: Develop(L3)
CO3 Action Verb is in the same level of the PO2 verb by one level. Therefore, the correlation is high (3).
PO4 Verbs: Analyze(L4)
CO3 Action Verb is less than the PO3 verb by one level. Therefore, the correlation is medium (2).

CO4: Analyze the steps in the design of analog filters for the given specifications
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO4 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3)
CO4 Action Verb level is more than the PO3 verb. Therefore, the correlation is high (3).
PO4 Verbs: Analyze (L4)
CO4 Action Verb is same as the PO4 verb. Therefore, correlation is high (3).

CO5: Analyze the steps in the design of digital filters for the given specifications
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO3 Verb: Develop (L3)
CO5 Action Verb level is more than the PO3 verb. Therefore, the correlation is high (3).
PO4 Verbs: Analyze (L4)
CO5 Action Verb is same as the PO4 verb. Therefore, correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)AK20-REGULATIONS
B. Tech III Year VI Semester

Course Code	Course Title	L T P Credits
20APC0423	MICROWAVE AND OPTICAL COMMUNICATIONS LABORATORY	0 0 3 1.5

Course Outcomes:
Upon completion of the course students will be able to
CO1: Analyze the Characteristics of Reflex Klystron
CO2: Evaluate the V-I Characteristics of Gunn Diode
CO3: Analyze the performance of Reflex Klystron using Directional Coupler, Fixed and Variable Attenuator.
CO4: Evaluate the parameters of LED and LASER from its V-I characteristics.
CO5: Evaluate the parameters of Analog and Digital Optical Fiber Communication link.

Microwave Laboratory (PART – A) --- Any Six (6) Experiments
1. Reflex Klystron Mode Characteristics.
2. Reflex Klystron Voltage Characteristics.
3. Gunn Diode Characteristics.
4. Fixed Attenuation Measurement.
5. Variable attenuation measurement
6. Directional Coupler Characteristics.
7. Frequency and Wavelength measurements using slotted section.

Optical Fiber Laboratory (PART – B) --- Any four (4) Experiments
1. Characterization of LED.
2. Characterization of Laser Diode.
3. Measurement of Numerical Aperture of the given fiber.
4. Measurement of Data rate for Digital Optical link.
5. Measurement of losses for Analog Optical link.

Equipment required for Laboratory:
1. Regulated Klystron Power Supply 6 nos.
2. VSWR Meter 6 nos.
3. Milli/Micro Ammeters 10 nos.
4. Multi meters 10 nos.
5. CROs 8 nos.
6. GUNN Power Supply, Pin Moderator4 nos.
7. Relevant Microwave components --
8. Fiber Optic Analog Trainer based LED3 nos.
9. Fiber Optic Analog Trainer based laser2nos.
10. Fiber Optic Digital Trainer 1 no.
11. Fiber cables - (Plastic, Glass)

Mapping of Course OutComes With Program Outcomes:

Course Title	Course Outcomes COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
Microwave and Optical Communications	CO1	3	3	1	3									3	3
	CO2	3	3	2	3									3	3
	CO3	3	3	1	3									3	3
	CO4	3	3	2	3									3	3
	CO5	3	3	2	3									3	3

Expt No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Analyze	L4	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 3
2				Analyze	L4	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 3
3				Evaluate	L5	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 2 3
4				Analyze	L4	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 3
5				Analyze	L4	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 3
6				Analyze	L4	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 3
7				Analyze	L4	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 1 3
1				Evaluate	L5	PO1,PO2,PO3,PO4	PO1: Apply (L3) PO2: Review (L2) PO3: Design (L6) PO4: Analyze (L4)	3 3 2 3

2				**Evaluate**	**L5**	**PO1,PO2,PO3,PO4**	**PO1: Apply (L3)** **PO2: Review (L2)** **PO3: Design (L6)** **PO4: Analyze (L4)**	**3** **3** **2** **3**
3				**Evaluate**	**L5**	**PO1,PO2,PO3,PO4**	**PO1: Apply (L3)** **PO2: Review (L2)** **PO3: Design (L6)** **PO4: Analyze (L4)**	**3** **3** **2** **3**
4				**Evaluate**	**L5**	**PO1,PO2,PO3,PO4**	**PO1: Apply (L3)** **PO2: Review (L2)** **PO3: Design (L6)** **PO4: Analyze (L4)**	**3** **3** **2** **3**
5				**Evaluate**	**L5**	**PO1,PO2,PO3,PO4**	**PO1: Apply (L3)** **PO2: Review (L2)** **PO3: Design (L6)** **PO4: Analyze (L4)**	**3** **3** **2** **3**
		100 %						

CO Statements:
Upon completion of the course students will be able to
CO1: Analyze the Characteristics of Reflex Klystron
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO1 Action Verb is greater than PO1 action verb by 1 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO1 Action Verb is greater than PO2 action verb by 1 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO1 Action Verb is less than PO3 action verb by 2 level therefore correlation is low (1).
PO4 Verb: Analyze (L4)
CO1 Action Verb is equal to PO4 action verb therefore correlation is high (3).
CO2: Evaluate the V-I Characteristics of Gunn Diode
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO2 Action Verb is greater than PO1 action verb by 2 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO2 Action Verb is greater than PO2 action verb by 3 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO2 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2).
PO4 Verb: Analyze (L4)
CO2 Action Verb is greater than PO4 action verb by 1 level therefore correlation is high (3).
CO3: Analyze the performance of Reflex Klystron using Directional Coupler, Fixed and Variable Attenuator.
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3 Action Verb is greater than PO1 action verb by 1 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO3 Action Verb is greater than PO2 action verb by 1 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO3 Action Verb is less than PO3 action verb by 2 level therefore correlation is low (1).
PO4 Verb: Analyze (L4)
CO3 Action Verb is equal to PO4 action verb therefore correlation is high (3).
CO4: Evaluate the parameters of LED and LASER from its V-I characteristics.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)

CO4 Action Verb is greater than PO1 action verb by 2 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO4 Action Verb is greater than PO2 action verb by 3 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO4 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2).
PO4 Verb: Analyze (L4)
CO4 Action Verb is greater than PO4 action verb by 1 level therefore correlation is high (3).
CO5: Evaluate the parameters of Analog and Digital Optical Fiber Communication link.
Action Verb: Evaluate (L5)
PO1 Verb: Apply (L3)
CO5 Action Verb is greater than PO1 action verb by 2 level therefore correlation is high (3).
PO2 Verb: Review (L2)
CO5 Action Verb is greater than PO2 action verb by 3 level therefore correlation is high (3).
PO3 Verb: Design (L6)
CO5 Action Verb is less than PO3 action verb by 1 level therefore correlation is moderate (2).
PO4 Verb: Analyze (L4)
CO5 Action Verb is greater than PO4 action verb by 1 level therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year &Sem	Basics of Cloud Computing	L	T	P	C
20ASA0501	III-II		1	0	2	2

Course Outcomes:

CO1: **Understand** thevarious basic concepts related to cloud computing technologies.
CO2: **Understand**the cloud architecture and service delivery models
CO3: **Analyze** the need for cloud service providers in a cloud environment.
CO4: **Design**the various virtualization tools such as Virtual Box, VMware workstation.
CO5: **Analyze** the security issues in cloud services and disaster management

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	various basic concepts related		to cloud computing technologies	L2
CO2	Understand	cloud architecture and service delivery models			L2
CO3	Analyze	the need for cloud service providers		in a cloud environment	L4
CO4	Design	the various virtualization tools such as Virtual Box, VMware workstation			L6
CO5	Analyze	the security issues in cloud services and disaster management			L4

UNIT I:

Cloud Computing Fundamentals: Motivation for Cloud Computing, The Need for Cloud Computing, Defining Cloud Computing, Definition of Cloud computing, a Service Principles ofCloud computing, Five Essential Characteristics, Four Cloud Deployment Models, ChallengesAhead, and Historical Developments.

1. To study in detail about cloud computing.
2. Working of Google Drive to make spreadsheet and notes.
3. Installation and Configuration of Just cloud.
4. Working in Cloud9 to demonstrate different language.

UNIT II:

Cloud Architecture, programming model: NIST reference architecture, architectural styles of cloud applications, deployment models-public, private, hybrid, community; Types of cloudcomputing: utility computing, cluster; computing Cloud services: Amazon, Google, Azure,online services Applications of cloud computing

1. Install Google App Engine. Create hello world app and other simple web applications using Python/java.
2. Deployment and Configuration options in Google Cloud
3. Deployment and Configuration options in Microsoft Azure

UNIT III:

Cloud Service Models: Defining Clouds for the Enterprise- Storage-as-a-Service, Databases- as-Service, Platform-as-a-Service, Pros and Cons of PaaS, Infrastructure-as-a-Service. Pros andCons of IaaS, Software as a Service, Pros and Cons of SaaS, Other Cloud Service Models.

Programs on SaaS

1. Create an word document of your class time table and store locally and on the cloud with doc,andpdf format . (use www.zoho.com anddocs.google.com)
2. Create a spread sheet which contains employee salary information and calculate grossand total sal using the formula DA=10% OF BASIC HRA=30% OF BASIC PF=10% OFBASIC IF BASIC<=3000 12% OF BASIC IF BASIC>3000 TAX=10% OF BASIC IFBASIC<=1500 =11% OF BASIC IF BASIC>1500 AND BASIC<=2500 =12% OFBASIC IF BASIC>2500 (
3. use www.zoho.com and docs.google.com)NET_SALARY=BASIC_SALARY+DA+HRA-PF-TAX
4. Prepare a ppt on cloud computing –introduction, models, services, and architecture PPTshould contain explanations, images and at least 20 pages (use www.zoho.com anddocs.google.com)
5. Create your resume in a neat format using Google and zoho cloud

Programs on PaaS

1. Write a Google app engine program to generate n even numbers and deploy it to googlecloud
2. Google app engine program multiply two matrices
3. Write a Google app engine program to display nth largest no from the given list ofnumbers and deploy it into Google cloud

UNIT IV:

Cloud resource virtualization: Basics of virtualization, types of virtualization techniques, merits and demerits of virtualization, Full vs. Para - virtualization, virtual machinemonitor/hypervisor. Virtual machine basics, taxonomy of virtual machines, process vs. systemvirtual machines.

1. Install Virtual box/VMware Workstation with different flavours of Linux or windows OSon top of windows7 or 8.
2. Install a C compiler in the virtual machine created using virtual box and executes SimplePrograms

UNIT V:

Security: Disaster Recovery, Privacy Design, Data Security, Network Security, CompromiseResponse Disaster Recovery, Disaster Recovery, Planning, Cloud Disaster Management.

Case Study: PAAS (Face book, Google App Engine), AWS Case Study: Amazon.com

Text Books:

1. Essentials of cloud Computing: K. Chandrasekhran, CRC press, 2014
2. Cloud Computing – Web Based Applications That Change the way you Work and ColLaboratoryorate Online – Michael Miller, Pearson Education.
3. Cloud Application Architectures, 1st Edition by George Reese O'Reilly Media.

Reference Books:

1. Cloud Computing: Principles and Paradigms by RajkumarBuyya, James Broberg and Andrzej M. Goscinski, Wiley, 2011.
2. Distributed and Cloud Computing, Kai Hwang, Geoffery C. Fox, Jack J. Dongarra, Elsevier, 2012.
3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, SubraKumaraswamy, ShahedLatif, O'Reilly, SPD, rp 2011.

Online Learning Resources:

https://nptel.ac.in/courses/106105167

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2											3	
CO2	2	2			2								2	
CO3	2	2		3	1				1	1			2	
CO4	3			2	3				2				2	
CO5		1	1	3		1	1	1				1	2	2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify(L3)	2 2
2				CO2 :Understand	L2	PO1 PO2 PO5	PO1: Apply(L3) PO2: Identify(L3) PO5: Apply(L3)	2 2 2 2
3				CO3 :Analyze	L4	PO1 PO2 PO4 PO5 PO9 PO10	PO1: Apply(L3) PO2: Identify (L3) PO4: Analyze(L4) PO5: Create(L6) PO9: Thumb rule PO10: Thumb rule	3 3 3 1 1 1
4				CO4 :Design	L6	PO3 PO4 PO5 PO9	PO3: Design (L6) PO4: Interpret(L5) PO5: Create(L6) PO9: Thumb rule	3 3 3 2
5				CO5 :Analyze	L4	PO2 PO3 PO4 PO6 PO7 PO8 PO12	PO2: Formulate(L6) PO3: Design (L6) PO4: Analyze(L4) PO6: Thumb rule PO7: Thumb rule PO8: Thumb rule PO12: Thumb rule	1 1 3 1 1 1 1

Justification Statements :

CO1: Understand the various basic concepts related to cloud computing technologies.
Action Verb : Understand(L2)

PO1 Verb : Apply(L3)

CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)

PO2 Verb : Identify(L3)

CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)

CO2: Understand the cloud architecture and service delivery models

Action Verb : Understand(L2)

PO1: Apply(L3)

CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)

PO2: Identify(L3)

CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)

PO5: Apply(L3)

CO2 Action verb is less than PO5 verb by one level. Therefore the correlation is medium (2)

CO3: Analyze the need for cloud service providers in a cloud environment

Action Verb : Analyze (L4)

PO1: Apply(L3)

CO3 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)

PO2: Identify (L3)

CO3 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)

PO4: Analyze (L4)

CO3 Action verb is same PO2 verb. Therefore the correlation is high (3)

PO5: Create(L6)

CO3 Action verb is less than PO5 verb by two levels. Therefore the correlation is low (1)

PO9 : Thumb rule

Team work is required between cloud provider and consumers. Hence the correlation is low (1)

PO10: Thumb rule

Effective communication is required , reports to be generated between cloud users and providers. Therefore the correlation is low (1)

CO4: Design the various virtualization tools such as Virtual Box, VMware workstation.

Action Verb : Design (L6)

PO3: Design (L6)

CO4 Action verb is same level as PO3 verb. Therefore the correlation is high (3)

PO4: Interpret (L5)

CO4 Action verb is less than PO4 verb by one level. Therefore the correlation is medium(2)

PO5: Create(L6)

CO4 Action verb is same level as PO5 verb. Therefore the correlation is high (3)

PO9: Thumb rule

Team work is required between cloud provider and consumers in multi disciplinary activities. Therefore the correlation is medium(2)

CO5: Analyze the security issues in cloud services and disaster management

Action Verb : Analyze (L4)

PO2: Formulate (L6)

CO5 Action verb is less than two levels as PO2 verb. Therefore the correlation is low(1)

PO3: Design (L6)

CO5 Action verb is less than two levels as PO2 verb. Therefore the correlation is low(1)

PO4: Analyze (L4)

CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)

PO6 : Thumb rule

Since ethical principles should be followed to create a cloud and providing services to cloud. Therefore the correlation is low(1)

PO7 : Thumb rule

Since ethical principles should be followed to create a cloud and providing services to cloud. Therefore the correlation is low(1)

PO8 : Thumb rule

Team work is required between cloud consumers and providers. Hence the correlation is low (1)

PO12: Thumb rule

For some of real world applications we use cloud services. Therefore the correlation is low (1)

Year: III **Semester: II** **Branch: ECE**

Subject Code	Subject Name	L	T	P	Credits
20AMC9903	Environmental Studies	3	0	0	0

Course Outcomes (CO): After studying the course, Student will be able to:

CO1. Understand the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.

CO2. Understand the ecosystem and biodiversity to solve complex environmental problems

CO3. Apply the various types of pollution, solid waste management, and related preventive measures

CO4. Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.

CO5. Analyze the population explosion and impact of environmental health issues on human being.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.			**L2**
2	**Understand**	the ecosystem and biodiversity	to solve complex environmental problems		**L2**
3	**Apply**	the various types of pollution, solid waste management, and related preventive measures			**L3**
4	**Apply**	the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation			**L3**
5	**Analyze**	the population explosion and impact of environmental health issues on human being.			**L4**

UNIT – I

Multidisciplinary Nature of**Environmental Studies:** Introduction – Multidisciplinary NatureofEnvironmental Studies – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable energy resources –Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and over utilization of surface and sub-surface – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.

Energy resources: Renewable and non-renewable energy resources.

UNIT – II

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

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

UNIT – III

Environmental Pollution: Definition, Causes, effects and its controlmeasures of: Air Pollution, Water

pollution, Soil pollution, Marine pollution, Noise pollution, and Thermal pollution and Nuclear hazards.

Solid Waste Management: Causes**,** effects and control measures ofurban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone, Tsunami and landslides.

UNIT – IV

Social Issues and the Environment: From Unsustainable toSustainable development – Urban problems related to energy – Water conservation, rain water harvesting and watershed management – Resettlement and rehabilitation of people – Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies–Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Public awareness.

UNIT – V

Human Population and the Environment: Population growth,variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

TEXT BOOKS:

1. Text book of Environmental Studies for Undergraduate Courses by ErachBharucha for University Grants Commission, Universities Press.
2. Environmental Studies by Kaushik, New Age Publishers.
3. Environmental Studies by Sri Krishna Hitech publishing Pvt. Ltd.

REFERENCES:

1. Environmental studies by R.Rajagopalan, Oxford University Press.
2. Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.
3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P. Ela - Printice hall of India Private limited.
4. Environmental studies by A. Ravi Krishnan, G. Sujatha Sri Krishna Hitech publications.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						2	2							
2							2							
3						2	2							
4						2	2							
5							2							

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**				**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Register (Hrs)	**Lesson Plan (Hrs)**	**%**	**corr**	**Verb**	**BTL**			
1	**10**	**12**	23	3	**Understand**	**L2**	PO6, PO7	Thumb Rule Thumb Rule	2, 2
2	**15**	**15**	28	3	**Understand**	**L2**	PO7	Thumb Rule	2
3	**8**	**8**	15	2	**Apply**	**L3**	PO6 PO7	Thumb Rule Thumb Rule	2, 2
4	**9**	**10**	19	2	**Apply**	**L3**	PO6, PO7	Thumb Rule Thumb Rule	2, 2
5	**8**	**8**	15	2	**Analyze**	**L4**	PO7	Thumb Rule	2
	50	**53**	**100**						

CO1: Understand the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.

Action Verb: Understand (L2)

Using Thumb rule, CO1correlates PO6 and PO7 as a moderate (2)

CO2: Understand the ecosystem and biodiversity to solve complex environmental problems
Action Verb: Understand (L2)
Using Thumb rule, CO2 correlates PO7 as a moderate (2)
CO3: Apply the various types of pollution, solid waste management, and related preventive measures
Action Verb: APPLY (L3)
Using Thumb rule, CO3 correlates PO6 and PO7 as a moderate (2)

CO4: Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.
Action Verb: APPLY (L3)
Using Thumb rule,CO4 correlates PO6 and PO7 as a moderate (2)

CO5: Analyze the population explosion and impact of environmental health issues on human being
Action Verb: Analyze (L4)
Using Thumb rule,CO5 correlates PO7 as a moderate (2)

VII Semester (B.Tech –IV year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	PC	20APC0424	Pattern Recognition and Applications	3	0	0	3	30	70	100
2	PEC	20APE0407	Digital Image Processing	3	0	0	3	30	70	100
		20APE0408	Adaptive Signal Processing							
		20APE0409	Television Engineering							
3	PEC	20APE0410	Electronic Measurements and Instrumentation	3	0	0	3	30	70	100
		20APE0418	Sensors and IOT							
		20APE0412	RF Integrated Circuits							
4	PEC	20APE0413	Radar Systems	3	0	0	3	30	70	100
		20APE0414	Satellite Communications							
		20APE0415	Wireless Communications							
5	OEC	20APC0516	Computer Networks	3	0	0	3	30	70	100
		20APE0203	Neural Networks and Fuzzy Logic							
		20AOE0402	Bio Medical Instrumentation							
6	OEC	20APC0502	Data Base Management Systems	3	0	0	3	30	70	100
		20APE0416	Computer System Architecture							
		20AOE0301	Robotics							
7	SOC	20ASA0401	Embedded Systems and Unmanned Aerial Vehicle	1	0	2	2	100	-	100
8	PR	20APR0401	Evaluation of Industry Internship (III-II Summer Internship)	0	0	0	3	100	-	100
TOTAL							**23**	**380**	**420**	**800**

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Pattern Recognition and Applications	L	T	P	C
20APC0424	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand the** concepts of pattern recognition system for Differential approaches
CO2: **Analyze** the statistical pattern recognition using supervised and unsupervised learning.
CO3: **Understand** the grammars and graphical approaches for syntactic pattern recognition.
CO4: **Analyze** the pattern preprocessing clustering techniques using feature selection..
CO5: **Evaluate** the different real time applications through pattern recognition techniques

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The concepts of pattern recognition system.		For Differential approaches	L2
CO2	Analyze	**the** statistical pattern recognition	using supervised and unsupervised learning.		L4
CO3	Understand	The Grammars and graphical approaches.		for syntactic pattern recognition	L2
CO4	Analyze	The Pattern pre-processing clustering techniques	Using feature selection		L4
CO5	Evaluate	The Different real time applications.	through Pattern recognition techniques.		L5

UNIT - I	12hrs
PATTERN RECOGNITION OVERVIEW: Typical Pattern Recognition System, Patterns and Features Extraction, Training and Learning in Pattern Recognition system, Different types of Pattern Recognition Approaches – Statistical, Syntactic, Neural. Discriminant functions.	
UNIT - II	14hrs
STATISTICAL PATTERN RECOGNITION: Parametric estimation and supervised learning, Maximum likelihood estimation, Bayesian parameter estimation,Non-parametric approaches - Parzen window, K-NN estimation, Unsupervised Learning – Clustering Concepts.	
UNIT - III	18hrs
SYNTACTIC PATTERN RECOGNITION: Grammar Based Approaches, Elements of Formal Grammars, Parsing Concepts – Parsing Algorithm, TransitionNetworks in Parsing, Higher Dimensional Grammars, Stochastic Grammars, Graphical Approaches – Graph Isomorphism, Attributed Graphs.	
UNIT - IV	10hrs
PATTERN PREPROCESSING AND FEATURE SELECTION: Introduction, distance measures, clustering transformation and feature ordering, clustering in feature selection through entropy minimization, features selection through orthogonal expansion, binary feature selection.	
UNIT - V	18hrs
APPLICATION OF PATTERN RECOGNITION: Introduction, concepts from formal language theory, formulation of syntactic pattern recognition problem, syntactic pattern description, recognition grammars, automata as pattern recognizers, Application of pattern recognition techniques in bio-metric, facial recognition, IRIS scan, Finger prints, etc.	
Textbooks:	
1. Gose. Johnsonbaugh.Jost.“ Pattern recognition and Image Analysis”,PHI. Tou. Rafael. Gonzalez. “Pattern Recognition Principle”, PearsonEducation	
Reference Books:	
1. Richard duda, Hart., David Strok, “Pattern Classification”, John Wiley	
Online Learning Resources:	
nptel videos	

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1									2	
CO2	3	3	3		3								2	
CO3	2	3		1									2	
CO4		3		3	3								2	
CO5	3		2	3	2	1						3	3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	12	18 %	2	Understand	L2	PO1, PO2, PO3, PO4	PO1 :Apply (L3) PO2 :Review (L2) PO3:Develop (L3) PO4:Analyze (L4)	2 3 2 1
2	14	20%	2	Analyze	L4	PO1, PO2, PO3, PO5	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop (L3) PO5: Apply (L3)	3 3 3 3
3	18	27%	3	Understand	L2	PO1, PO2, PO4	PO1 : Apply (L3) PO2: Review (L2) PO4 : Analyze (L4)	2 3 1
4	10	15%	2	Analyze	L4	PO2, PO4, PO5	PO2: Identify (L3) PO4: Analysis (L4) PO5: Apply (L3)	3 3 3
5	14	20%	2	Evaluate	L5	PO1, PO3, PO4, PO5,PO6, PO12	PO1: Apply (L3) PO3: Design (L6) PO4: Interpret (L5) PO5 : Create (L6) PO6: Thumb Rule PO12: Thumb Rule	3 2 3 2 1 3
	68	**100%**						

Justification Statements :

CO1: Understand the concepts of pattern recognition system for Differential approaches

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2)CO1 Action Verb is the same level of PO2 verb; Therefore correlation is high (3).

PO3 Verbs: Develop (L3CO1 Action Verb is less than PO3 verb by one level; therefore correlation is moderate (2).

PO4 Verbs: Analyze (L4)CO1 Action Verb is less than PO4 verb by two level; Therefore correlation is low (1).

CO2: Analyze the statistical pattern recognition using supervised and unsupervised learning.

Action Verb: Analyze (L4)

PO1 Verbs: Apply CO2 Action Verb is the same level of PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)CO2 Action Verb is the same level of PO2 verb; Therefore correlation is high (3).

PO3 Verbs: Develop (L3)CO2 Action Verb is the same level of PO3 verb; Therefore correlation is high (3).

PO5 Verbs: Apply (L3)CO2 Action Verb is the same level of PO5 verb; Therefore correlation is high (3).

CO3: Understand the grammars and graphical approaches for syntactic pattern recognition.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO3 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verb: Review (L2) CO3 Action Verb level is the same level of PO2 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4) CO3 Action Verb is less than PO4 verb by Two level; Therefore correlation is low (1).

CO4: Analyze the pattern preprocessing clustering techniques using feature selection..

Action Verb: Analyze (L4)

PO2 Verbs: Identify (L3) CO4 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO4 Verb: Analysis (L4) CO4 Action Verb level is the same level of PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3) CO4 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO5: Evaluate the different real time applications through pattern recognition techniques

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3) CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).
PO3 verb: Design (L6) CO5 Action verb is less than PO3 verb therefore the correlation is moderate (2).
PO4 verb: Interpret (L5) CO5 Action verb is the same level of PO4 verb; therefore the correlation is high (3).
PO5 Verbs: Create (L6) CO5 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).
PO 6: CO5 Using Thumb rule, L1 correlates PO6 as low (1).
PO 12:CO5Using Thumb rule, L5 correlates PO12 as low(3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Digital Image Processing	L	T	P	C
20APE0407	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the fundamental concepts of digital image processing
CO2. **Analyze** the images in frequency domain using image transforms
CO3. **Apply** the techniques for image enhancement in spatial and frequency domains
CO4. **Analyze** various image restoration and image segmentation techniques
CO5. Evaluate different coding methods for image compression to save memory & bandwidth.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the fundamental concepts of digital image processing			L2
CO2	Analyze	the images in frequency domain	using image transforms		L4
CO3	Apply	the techniques for image enhancement		in spatial and frequency domains	L3
CO4	Analyze	the various image restoration and image segmentation techniques.			L4
CO5	Evaluate	the different coding methods	for image compression	to save memory & bandwidth	L5

UNIT - I		15Hrs
IMAGE PROCESSING FUNDAMENTALS: Introduction to Digital Image processing – Example fields of its usage-Fundamental steps in ImageProcessing, Components of general image processing system, Image sensing and Acquisition–image Modeling- Sampling, Quantization and Digital Image representation - Basic relationships between pixels, -Mathematicaltools/ operations applied on images-imaging geometry		
UNIT - II		14Hrs
IMAGE TRANSFORMS: Discrete Fourier Transform- Discrete Cosine Transforms- Discrete Sine Transform,Walsh-Hadamard Transforms- Haar Transform-Hotelling Transform, Comparison of properties of the above.		
UNIT - III		15Hrs
IMAGE ENHANCEMENT TECHNIQUES: Background enhancement by point processing Histogram processing, Spatial filtering, Enhancement infrequency Domain, Image smoothing, Image sharpening, Color image enhancement		
UNIT - IV		16Hrs
IMAGE RESTORATION: Degradation model, Algebraic approach to restoration–Inverse filtering–Least Mean Square filters, ConstrainedLeast square restoration, Blind Deconvolution. **IMAGE SEGMENTATION:** Edge detection-,Edge linking, Threshold based segmentation methods–Regionbased Approaches –Template matching–use of motion in segmentation.		
UNIT - V		15Hrs
IMAGE COMPRESSION: Redundancies in Images - Compression models, Information theoretic perspective-Fundamental coding theorem. Huffman Coding, Arithmetic coding, Bit plane coding, Run length coding, Transform coding, Image Formats and compression standards.		
Textbooks:		
1. R.C .Gonzalez & R.E. Woods, "Digital Image Processing", Addison Wesley/Pearson education, 3rd Edition, 2010. 2. A.K.Jain,"Fundamentals of Digital Image processing",PHI.		
Reference Books:		
1. Rafael C. Gonzalez, Richard E woods and Steven L.Eddins, "Digital Image processing using MATLAB", Tata McGrawHill, 2010. 2. Sjayaraman,SEsakkirajan,TVeerakumar,"DigitalImageprocessing",TataMcGrawHill 3. WilliamK.Pratt,"DigitalImageProcessing",JohnWilely,3rdEdition,2004.		

Online Learning Resources:
nptel videos

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3				2						1	2	
CO2	2	1											3	
CO3	3		3		3	2	1					2	3	
CO4	3			3	3	2	1					3	3	
CO5	3	2	2			2						2	3	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	20%	2	Understand	L2	PO1, PO2, PO6, PO12,	PO1: Apply (L3) PO2: Review (L2) PO6:Thumb rule PO12:Thumb rule	2 3 2 1
2	14	19%	2	Analyze	L4	PO1, PO2	PO1: Apply (L3) PO2: Formulate(L6)	3 1
3	15	20%	2	Apply	L3	PO1, PO3, PO5, PO6, PO7, PO12	PO1: Apply(L3) PO3: Develop(L3) PO5: Apply(L3) PO6:Thumb rule PO7:Thumb rule PO12:Thumb rule	3 3 3 2 1 2
4	16	21%	3	Analyze	L4	PO1, PO4, PO5, PO6, PO7, PO12	PO1: Apply(L3) PO4: Analyze(L4) PO5: Apply(L3) PO6:Thumb rule PO7:Thumb rule PO12:Thumb rule	3 3 3 2 1 3
5	15	20%	2	Evaluate	L5	PO1, PO2, PO3, PO6, PO12	PO1: Apply(L3) PO2: Formulate(L6) PO3: Develop (L6) PO6:Thumb rule PO12:Thumb rule	3 2 2 2 2
	75	100%						

Justification Statements :

CO1: Understand the fundamental concepts of digital image processing.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)CO1 Action Verb is less than PO1 verb by one level. Therefore, the correlation is medium (2).

PO2 Vers: Review (L2)CO1 Action Verb is in the same level of less than PO2 verb. Therefore, the correlation is high (3).

PO6: CO1 using Thumb rule, L2 correlates PO6 as medium (2).

PO12: CO1 using Thumb rule, L1 correlates PO12 as low (1).

CO2: Analyze the images in frequency domain using image transforms.

Action Verb: Analyze(L4)

PO1 Verbs: Apply (L3)CO2 Action Verb is more than the PO1 verb. Therefore,the correlation is high (3).

PO2 Verbs: Formulate(L6)CO2 Action Verb is less than the PO2 verb by two levels.Therefore,the correlation is low (1).

CO3: Apply the techniques for image enhancement in spatial and frequency domains.

Action Verb: Apply(L3)

PO1 Verbs: Apply (L3)CO3 Action Verb is equal to PO1 verb. Therefore,the correlation is high (3).

PO3 Verb: Develop(L3)CO3 Action Verb level is in the same level of PO3 verb. Therefore,the correlation is high (3).

PO5 Verb: Apply (L3)CO3 Action Verb is equal to PO5 verb. Therefore, the correlation is high (3).

PO6: CO3 using Thumb rule, L2 correlates PO6 as medium (2).
PO7: CO3 using Thumb rule, L1 correlates PO7 as low (1).
PO12: CO3 using Thumb rule, L3 correlates PO12 as medium (2).

CO4: Analyze various image restoration and image segmentation techniques.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)CO4 Action Verb is more than the PO1 verb.Therefore,the correlation is high (3).
PO4 Verb: Formulate (L4)CO4 Action Verb level is equal to PO4 verb. Therefore,the correlation is high (3).
PO5 Verbs: Develop (L3)CO4 Action Verb is more than the PO5 verb.Therefore, correlation is high (3).
PO6: CO4 using Thumb rule, L2 correlates PO6 as medium (2).
PO7: CO4 using Thumb rule, L1 correlates PO7 as low (1).
PO12: CO4 using Thumb rule, L4 correlates PO12 as high (3).

CO5: Evaluate different coding methods for image compression to save memory & bandwidth.

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)CO5 Action verb is more than the PO1 verb. Therefore, the correlation is high (3).
PO2 verb: Formulate (L6)CO5 Action verb is less than the PO2 verb by one level. Therefore, the correlation is medium(2).
PO3 verb: Develop (L6)CO5 Action verb is less than the PO3 verb by one level. Therefore, the correlation is medium (2)
PO6: CO5 using Thumb rule, L2 correlates PO6 as medium (2).
PO12: CO5 using Thumb rule, L3 correlates PO12 as medium (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	ADAPTIVE SIGNAL PROCESSING	L	T	P	C
20APE0408	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** device filtering solutions for optimizing the cost function indicating error in estimation ofparameters and appreciate the need for adaptation in design.

CO2: **Evaluate** the performance of various methods for designing adaptive filters through estimation ofdifferent parameters of stationary random process clearly considering practical application specifications.

CO3:**Analyze** convergence and stability issues associated with adaptive filter design and come up withoptimum solutions for real life applications taking care of requirements in terms of complexity and accuracy.

CO4: **Analyze** Multipath communication channel and synthesis of FIR digital filter.

CO5: **Design** filtering solutions for applications such as channel equalization, interference cancelling and prediction considering present day challenges.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand (L2)	device filtering solutions	for optimizing the cost function indicating error	in estimation of parameters and appreciate the need for adaptation in design	L2
CO2	Evaluate(L5)	the performance of various methods for designing adaptive filters	through estimation of different parameters of stationary random process	clearly considering practical application specifications	L5
CO3	Analyze(L4)	convergence and stability issues associated	with adaptive filter design and come up with optimum solutions	for real life applications taking care of requirements in terms of complexity and accuracy	L4
CO4	Analyze(L4)	Multipath communication channel and synthesis of FIR digital filter.			L4
CO5	Design(L6)	The filtering solutions for applications .		such as channel equalization, interference cancelling and prediction considering present day challenges.	L6

Adaptive Signal Processing Syllabus

UNIT 1

ADAPTIVE SYSTEMS: Definitions and characteristics - applications – properties examples - adaptive linear combiner input signal and weight vectors - performance function-gradient and minimum mean square error - introduction to filtering smoothing and prediction - linear optimum filtering-orthogonality - Wiener – Hopf equation-performance surface

UNIT 2

SEARCHING PERFORMANCE SURFACE-STABILITY AND RATE OF CONVERGENCE: Learning curve gradient search - Newton's method - method of steepest descent - comparison - Gradient estimation - performance penalty - variance - excess MSE and time constants – mis adjustments

UNIT 3

LMS ALGORITHM CONVERGENCE OF WEIGHT VECTOR: LMS/Newton algorithm - properties - sequential regression algorithm - adaptive recursive filters - random search algorithms - lattice structure - adaptive filters with orthogonal signals

UNIT 4

APPLICATIONS-ADAPTIVE MODELING AND SYSTEM IDENTIFICATION: Multipath communication channel, geophysical exploration, FIR digital filter synthesis. **UNIT 5**

INVERSE ADAPTIVE MODELING: Equalization, and de convolution adaptive equalization of telephone channels-adapting poles and zeros for IIR digital filter synthesis.

Text Books:

1. Bernard Widrow and Samuel D. Stearns, ―Adaptive Signal Processing‖, Person Education, 1985.

Reference Books:

1. Simon Haykin, ―Adaptive Filter Theory‖, Pearson Education, 2003. 2. John R. Treichler, C. Richard Johnson, Michael G. Larimore, ―Theory and Design of Adaptive Filters‖, Prentice-Hall of India, 2000

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2	1	2								2	
CO2	3		2	2	3								3	
CO3	3		1	3	3								3	
CO4		3		3									3	
CO5	3		3	3	3								3	

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Understand	L2	PO1, PO2 , PO3,P04,PO5	PO1: Apply (L3) PO2: Identify (L3) PO3: Develop(L3) P04:Analyze(L4) P05: Apply (L3)	2 2 2 1 2
2	Evaluate	L5	PO1, PO3 ,P04,PO5	PO1: Apply (L3) PO3: Design(L6) PO4: Design(L6) P05: Apply (L3)	3 2 2 3
3	Analyze	L4	PO1, PO3 ,P04,PO5	PO1: Apply (L3) PO3: Design(L6) P04:Analyze(L4) P05: Apply (L3)	3 1 3 3
4	Analyze	L4	PO2,PO4	PO2: Identify(L3) P04: Analyze(L4)	3 3
5	Design	L6	PO2,PO4,P05	PO1: Apply (L3) PO3: Design(L6) P04: Design(L6) P05: Apply (L3)3	3 3 3 3

Justification Statements :

CO 1: Understand device filtering solutions for optimizing the cost function indicating error in estimation ofparameters and appreciate the need for adaptation in design.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO2 Verbs: Identify (L3)

CO1 Action Verb is less than PO2 verb by one level; Therefore correlation is moderate (2).

PO3 Verbs: Develop(L3)

CO1 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).

PO4 Verbs: Analyze (L4)

CO1 Action Verb is less than PO4 verb by two level; Therefore correlation is low(1).

PO5 verbs: Apply (L3)

CO1 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).

CO 2: Evaluate the performance of various methods for designing adaptive filters through estimation ofdifferent parameters of stationary random process clearly considering practical application specifications

Action Verb: Evaluate(L5)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater than PO1; Therefore correlation is high (3).

PO3 Verbs: Design(L6)

CO2 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).

PO4 Verbs: Design(L6)

CO2 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).

PO5 Verbs: Apply (L3)

CO2 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO 3: Analyze convergence and stability issues associated with adaptive filter design and come up withoptimum solutions for real life applications taking care of requirements in terms of complexity and accuracy.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1; Therefore correlation is high (3).

PO3 Verbs: Design(L6)

CO3 Action Verb is less than PO3 verb by two level; Therefore correlation is low(1).

PO4 Verbs: Analyze (L4)

CO3 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

PO5 Verbs: Apply (L3)

CO3 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO4: Analyze Multipath communication channel and synthesis of FIR digital filter.

Action Verb: Analyze (L4)

.

PO2 Verb: Identify (L3)

CO4 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO4 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

CO5: Design filtering solutions for applications such as channel equalization, interference cancelling and prediction considering present day challenges

Action Verb: Design(L6)

PO1 Verb: Apply (L3)

CO5 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO3 Verb: Design (L6)

CO5 Action Verb is equal to PO3 verb; Therefore correlation is high (3).

PO4 Verb: Design (L6)

CO5 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

PO5 Verb: Apply (L3)

CO5 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

ANNAMACHARYAINSTITUTEOFTECHNOLOGYANDSCIENCES,TIRUPATI(AUTONOMOUS)

Course Code	TELEVISION ENGINEERING (ECE)		L	T	P	C
20APE0409			3	0	0	3
		Semester	IV-I			

Course Outcomes: After studying the course, Student will be able to:

CO1 Understand different modules present in the TV transmitter and receiver with their design considerations.

CO2 Analyze essentials of Television cameras and Color picture tube

CO3 Understand different modules present in the Monochrome TV receiver and IF subsystem.

CO4 Understand the concepts of Color signal decoding.

CO5 Analyze the functioning of modern televisions system such as direct to home satellite TV, digital TV receiver, digital terrestrial TV.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	different modules present in the TV transmitter and receiver with their design considerations			L2
CO2	Analyze	Television cameras and Color picture tube.			L4
CO3	Understand	Different modules present in the Monochrome TV receiver and IF subsystem			L2
CO4	Understand	The concepts of Color signal decoding.			L2
CO5	Analyze	Thefunctioningofmodern televisionssystemsucha sdirecttohomesatelliteTV,digitalTVreceiver,digital terrestrial TV			L4

UNIT–I	INTRODUCTION	9Hrs
INTRODUCTION: TV transmitter and receivers, synchronization, Television pictures: Geometric form and aspect Ratio, image continuity, interlaced scanning, picture Resolution, composite video signal: Horizontal and vertical sync, Scanning sequence, color signal generation and encoding: perception of brightness and colors, , Luminance signal, color difference signals, encoding of color difference signals, formation of Chrominance signals, PAL encoder TV SIGNAL TRANSMISSION AND PROPAGATION: Picture signal transmission, positive and negative modulation, VSB transmission, sound signal transmission, standard channel BW, TV transmitter, TV signal propagation, Interference, TV broadcast channels, TV transmission antennas.		
UNIT –II	TV CAMERAS	9Hrs
TV CAMERAS: Camera tube types: Vidicon, silicon diode array vidicon, monochrome TV camera, color camera. PICTURE TUBES: Monochromatic picture tube, electrostatic focusing, color picture tubes, TV standards: American 525 line B&W TV system, NTSC color system, 625-line monochrome system, bPAL color system.		
UNIT–III	MONOCHROME TV RECEIVER	9Hrs
MONOCHROME TV RECEIVER: RF tuner, IF sub system, video amplifier, sound section, sync separation and processing, scanning circuits, PAL-D color receiver: electron tuners, IF sub system, Y-signal channel, Chroma decoder, separation of U & V color phasors, Raster circuits. VISION IF SUB SYSTEM: AGC, video and inter carrier sound signal detection, vision IF sub system of Black & White receivers, color Receivers IF sub system. Receiver sound system: FM detection, FM sound detectors, typical applications.TV receiver tuners: tuner operation, VHF and UHF tuners, digital tuning techniques, Remote control of receiver functions.		
UNIT–IV	COLOR SIGNAL DECODING	9Hrs
COLOR SIGNAL DECODING: PAL-D decoder, chroma signal amplifiers, separation of U & V signals, color Burst separation, Burst phase discriminator, Reference Oscillator, Indent and color killer circuits, RO phase shift, U & V demodulators, color signal mixing.		
UNIT –V	SYNC.SEPARATION, AFC AND DEFLECTION OSCILLATORS	9Hrs
SYNC.SEPARATION, AFC AND DEFLECTION OSCILLATORS: Synchronous separation, K Noise in sync. Pulses, separation of frame and line sync. Pulses, AFC, single ended AFC circuit. Deflection oscillators, Receiver antennas, Digital TV digital satellite TV, direct to home satellite TV, digital TV receiver, digital terrestrial TV.		

Textbooks:
1. Modern television practice-Principles, Technology and service-R.R. Gulati, New Age International publication, 2002. 2. Monochrome and color TV-R.R Gulati, New Age International publication, 2002.
Reference Books:
1. Color Television Theory and practice-S.P.Bali, TMH, 1994. 2. Television and Video engineering-A.M. Dhake, 2nd Edition, Tata McGraw Hill. 3. Basic television and video systems-B.Grob and C.E.Herndon, McGraw Hill, 1999.

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											2	
CO2		3											3	
CO3	3					3							2	
CO4	2			2									2	
CO5	3			2	2	1						3	3	

Correlation matrix

Unit No.	**CO**					**Program Outcome (PO)**	**PO(s) :Action Verb and BTL(for PO1 to PO12)**	**Level of Correlation (0-3)**
	Lesson plan(Hrs)	**%**	**Correlation**	**Co's Action verb**	**BTL**			
1				**CO1 :Understand**	**L2**	**PO1** **PO2**	**PO1: Apply(L3)** **PO2: Review(L2)**	**2** **3**
2				**CO2 :** Analyze	**L4**	**PO2** **PO10**	**PO1: Apply(L3)**	**3**
3				**CO3 : Understand**	**L2**	**PO1** **PO6**	**PO1: Apply(L3)**	**2** **2**
4				**CO4 : Understand**	**L2**	**PO1** **PO4** **PO10**	**PO1: Apply(L3)** **PO4: Interpret (L2)**	**2** **1**
5				**CO5 :Evaluate**	**L4**	**PO1** **PO4** **PO5** **PO6** **PO10** **PO12**	**PO1: Apply (L3)** **PO4: Analyze(L3)** **PO5:Apply(L3)** **PO6:Thumb Rule** **PO12:Thumb Rule**	**3** **3** **3** **3** **3**

CO1: Understand different modules present in the TV transmitter and receiver with their design considerations.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2)

CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO2: Analyze essentials of Television cameras and Color picture tube.

Action Verb: Analyze (L4)

PO2 Verbs: Identify (L3)

CO2 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

CO3: Apply the Knowledge of Monochrome TV receiver and IF subsystem.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO3 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO6 from thumb rule L2 the correlation is moderate (2)

CO4: Understand the concepts of Color signal decoding..

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO4 Verbs: Analyze (L4)
CO4 Action Verb is less than PO1 verb by one level; Therefore correlation is low (1).

CO5:

Analyzethefunctioningofmodernteleviosionssystemsuchasdirecttohomesatellite TV,digitalTVreceiver,digital terrestrial TV.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).

PO4 Verbs: Analyze (L4)
CO5 Action Verb is less than PO1 verb by one level; Therefore correlation is high (3).
PO5 Verbs: Apply (L3)

CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).

PO6from thumb rule L2 correlation is high (3)
PO12 from thumb rule L2 correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	Electronic Measurements and Instrumentation	L	T	P	C
20APE0410	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the basic principles involved in the meters for measuring voltage, current, resistance, frequency and so on
CO2: **Understand** the working of CRO for measuring voltage, current, resistance, frequency and so on
CO3: **Analyze** the working of advanced instruments such as wave analyzer and spectrum analyzers.
CO4: **Apply** the Principles of measurements associated with different bridges
CO5: **Analyze** Electrical Parameters using advanced Electrical and Mechanical Transducer

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The basic principles involved in the meters for measuring voltage, current, resistance, frequency and so on.			L2
CO2	Understand	the working of CRO for measuring voltage, current, resistance, frequency and so on			L2
CO3	Analyze	the working of advanced instruments such as wave analyzer and spectrum analyzers		.	L4
CO4	Apply	The Principles of measurements associated with different bridges			L3
CO5	Analyze	Electrical Parameters using advanced Electrical and Mechanical Transducers			L4

UNIT - I		10Hrs
PERFORMANCE CHARACTERISTICS OF INSTRUMENTS: Static characteristics: Accuracy, Precision, Resolution, Sensitivity, static and dynamic calibration, Errors in Measurement, and their statistical analysis, dynamic characteristics: speed of Response, fidelity, Lag and dynamic error. DC ammeters, DC voltmeters: multirange, range extension/solid state and differential voltmeters, AC voltmeters–multirange, range extension. Thermocouple type RF ammeter, ohmmeters: series type, shunt type, multimeters for voltage, current and resistance measurements		
UNIT - II		10Hrs
OSCILOSCOPES: Standard specifications of CRO, CRT features, vertical and horizontal amplifiers, horizontal and verticaldeflection systems, sweep trigger pulse, delay line, probes for CRO – active, passive,and attenuator type, triggered sweep CRO, dual trace CRO and dual beam CRO, Measurement of amplitude, frequency (Lissajous method) and phase. Principles of sampling oscilloscope, storage oscilloscope and digital storage oscilloscope, Digital frequency counters, time& Period measurements.		
UNIT - III		15Hrs
SIGNAL GENERATORS: Fixed and variable, AF oscillators, Function generators, Pulse, Random Noise, sweep, and arbitrary waveformgenerators,theirstandards,specificationsandprinciplesofworking(Blockdiagramapproach).Waveanaly zers,Harmonic distortion analyzers,Spectrum analyzers.		
UNIT - IV		14Hrs
REVIEW OF DCBRIDGES: Wheatstone bridge, Kelvin Bridge, errors and precautions in using bridges, AC bridges: Measurement ofinductance- Maxwell's bridge, Anderson Bridge, Hays Bridge. Measurement of capacitance: Schearing Bridge, Wein Bridge, Q-meter.		
UNIT - V		14Hrs
SENSORS AND TRANSDUCERS: Active and passive transducers: Measurement of displacement-inductance (LVDT), Force (strain gauges), Pressure (piezoelectric transducers) Temperature (resistance thermometers, thermocouples, and thermistors), Velocity, Acceleration, pH measurement, Signal ConditioningCircuits.		

Textbooks:

1 A.D.HelfrickandW.D.Cooper,"ModernElectronicInstrumentationandMeasurementTechniques", PHI, 5th Edition, 2002.
2. H.S.Kalsi,"Electronicinstrumentation",secondedition,TataMcGrawHill,2004.
3. K. Lal Kishore, "Electronic Measurements & Instrumentations", Pearson Education, 2009

Reference Books:

1. H.S.Kalsi,"Electronic instrumentation", second edition,TataMcGrawHill,2004.
2 Ernest O Doebelin and Dhanesh N Manik,"Measurement Systems Application and Design", TMH,5th Edition, 2009
3. Oliver and Cage, "Electronic Measurement and Instrumentation", TMH
4. Robert A.Witte, "Electronic Test Instruments, Analog and Digital Measurements", Pearson Education,2nd Ed., 2004.
5. DavidA.Bell,"ElectronicInstrumentation&Measurements",PHI,2ndEdition,2003

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3											2	
CO2	2	2											2	
CO3	3	3		3									3	
CO4	3	3		2									3	
CO5	3	3												3

Correlation matrix

Justification Statements :

CO1: Understand basic principles involved in the meters for measuring voltage, current, resistance, frequency

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	10	16	2	Understand	L2	PO1, PO2,	PO1: Apply(L3) PO2: Review (L2)	2 3
2	10	16	2	Understand	L2	PO1,PO2	PO1: Apply (L3) PO2: Identify (L3)	2 2
3	15	23	3	Analyze	L4	PO1,PO2	PO1:Apply(L3) PO2:Identify(L3) PO4:Analyze(L4)	3 3 3
4	14	22	3	Apply	L3	PO1, PO2 PO4	PO1:Apply(L3) PO2:Review(L2) PO4:Analyze(L4)	3 3 2
5	14	22	3	Analyze	L4	PO1,PO2	PO1:Apply(L3) PO2: Identify(L3)	3 3
	63	100						

and so on

Action Verb: Understand (L2)

PO1 Verbs: Identify (L2)

CO1 Action Verb is less than PO1 verb; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2)

CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO2: Understand & analyze the CRO for measuring voltage, current, resistance, frequency and so on..

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO2 Action Verb is less than by one level PO1 verb; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2)

CO2 Action Verb is less than by one level PO2 verb; Therefore correlation is moderate (2).

CO3: Analyze the working of advanced instruments such as wave analyzer and spectrum analyzers.

Action Verb: Apply(L3)

PO1 Verbs: Apply (L3)

CO3 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

PO2 Verb: Identify (L3)

CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO3 Action Verb level is equal to PO4 verb; Therefore correlation is high (3).

CO4: Analyze the propagation of electromagnetic waves in conductors and dielectric media.

Action Verb: Apply (L3)

PO1 Verbs: Apply (L3)

CO4 Action Verb is greater to PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Review?(L2)

CO4 action verb is greater than PO2 verb. Therefore correlation is high(3)

PO4 Verb: Analyze (L4)

CO4 Action Verb level is less than by one level to PO4 verb; Therefore correlation is moderate (2).

CO5: understand the concepts of transmission line parameters and its applications.

Action Verb: Analyze(L4)

PO1 Verb: Apply (L3)

CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).

PO2 Verb: Identify (L3)

CO5 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	SENSORS AND IOT	L	T	P	C
20APE0418	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand the** concepts of data converters and sensor data acquisition systems
CO2:**Understand** the concepts of various sensing technologies.
CO3:**Analyze** the basics of IoT and enabling technologies.
CO4:**Design** basic IoT applications using Arduino
CO5:**Design** IoT applications using Raspberry Pi

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	Data converters and sensor data acquisition systems			**L2**
CO2	**Understand**	Various sensing technologies			**L2**
CO3	**Analyze**	Basics of IoT and enabling technologies			**L4**
CO4	**Design**	IoT applications		To study and design using Arduino	**L6**
CO5	**Design**	IoT applications		To study and design using Arduino	**L6**

UNIT - I	**SENSOR DATA ACQUISITION SYSTEMS AND ARCHITECTURES**	**9 Hrs**
Introduction, General measurement system, Analog-to-digital converter architectures-Different types of ADCs – parallel comparator type ADC, Counter type ADC, successive approximation ADC and dual slope ADC Digital-to-Analog conversion-Basic DAC techniques, Weighted resistor DAC, R-2R ladder DAC, inverted R2R DAC		
UNIT - II	**INTRODUCTION AND CLASSIFICATION OF SENSORS**	**9Hrs**
: Introduction to sensors- Principles, Classifications, Parameters- Characteristics, Passive sensors- Introduction, Resistive Potentiometer, Strain Gauge, Inductive sensor, Capacitive senor, Recent trends in sensor technologies -Film sensors-Thin & Thick, MEMS-Micromachining, Nano sensors.		
UNIT - III	**INTRODUCTION TO INTERNET OF THINGS**	**9 Hrs**
Characteristics of IoT, Design principles of IoT, IoT Architecture and Protocols, Enabling Technologies for IoT, IoT levels and IoTvs M2M. IoT Design Methodology: Design methodology, Challenges in IoT Design, IoT System Management, IoT Servers		
UNIT - IV	**BASICS OF ARDUINO**	**9 Hrs**
Introduction to Arduino, Arduino IDE, Basic Commands for Arduino, Connecting LEDs with Arduino, Connecting LCD with Arduino. Arduino IDE Sketch examples – Blink LED, Control Actuator using Bluetooth, Read data from analog and digital sensor		
UNIT - V	**BASICS OF RASPBERRY PI**	**9 Hrs**
Introduction to Raspberry pi, Installation of NOOBS on SD Card, Installation of Raspbian on SD Card, Terminal Commands, Installation of Libraries on Raspberry Pi, Getting the static IP address of Raspberry Pi, Run a Program on Raspberry Pi, Installing the Remote Desktop Server, Pi Camera, Face Recognition using Raspberry Pi, Installation of I2C driver on Raspberry Pi, SPI (serial peripheral interface) with Raspberry Pi, Programming a Raspberry Pi, Play with LED and Raspberry Pi, Reading the digital input, Reading an edge triggered input, Interfacing of Relay with Raspberry Pi, Interfacing of Relay with Raspberry Pi, Interfacing of LCD with Raspberry Pi, Interfacing LCD with Raspberry Pi in I2C mode, Interfacing of DHT11 sensor with Raspberry Pi, Interfacing of ultrasonic sensor with Raspberry Pi, Interfacing of camera with Raspberry pi.		
Textbooks:		
1. D. Patranabis, “Sensors & Transducers”, PHI, 2nd ed., 2018. 2. Rajesh Singh, AnithaGehlot, Loviraj Gupta, “Internet of Things with Raspberry pi and Arduino” CRC Press, 2020		
Reference Books:		

1. Jacob Fraden, "Hand book of Modern Sensors", Springer, Fourth Edition, 2010.
2. D. Roy Choudhury&ShailB.Jain, "Linear Integrated Circuits" Fourth Edition, New age International Publications

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	1									2	2
CO2	2	2	2	3	2								2	2
CO3	3	3	3	3	3								3	3
CO4	3	3	3	3	3								3	3
CO5	3	3	3	3	3								3	3

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				CO1 :Understand	L2	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review(L2) PO3 : Develop (L3) PO4 : Analysis(L4)	2 3 2 1
2				CO2 : Understand	L2	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO 3: Develop (L3) PO4: Interpret (L2) PO5: Apply(L3)	2 2 2 3 2
3				CO3 : Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Interpret (L2) PO5: Apply(L3)	3 3 3 3 3
4				CO4 :Design	L6	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop (L3) PO4: Interpret (L2) PO5: Apply(L3)	3 3 3 3 3
5				CO5 : Design	L6	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO 3: Develop (L3) PO4: Interpret (L2) PO5: Apply(L3)	3 3 3 3 3

Justification Statements :

CO1:Understand the concepts of data converters and sensor data acquisition systems
Action Verb: Understand(L2)
PO1 Verb:Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb :Identify (L3)
CO1 Action verb is same as PO2 verb. Therefore the correlation is high (3)
PO3Verb :Develop (L3)
CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate(2)
PO4 Verb : Analysis(L4)
CO1 Action verb is less than PO4 verb by two level. Therefore the correlation is low (1)

CO2:Understand the concepts of various sensing technologies
Action Verb :Understand(L2)
PO1: Apply(L3)
CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is Medium (2)
PO2 Verb : Identify (L3)
CO2 Action verb is less than PO2 verb by one level. Therefore the correlation is Medium (2)
PO 3 Verbs: Develop (L3)
CO2 Action Verb is less than PO 3 verb by one level; therefore correlation is moderate (2).
PO4: Interpret (L2)

CO2 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO2 Action verb is less than PO5 verb by one level. Therefore the correlation is Medium (2)

CO3: Analyze the basics of IoT and enabling technologies
Action Verb :Analyze(L4)
PO1: Apply(L3)
CO3 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)
PO2 Verb : Identify (L3)
CO3 Action verb is greater than as PO2 verb by one level. Therefore the correlation is high (3)
PO 3 Verbs: Develop (L3)
CO1 Action Verb is greater than PO3 verb by one levels; therefore correlation is high (3).
PO4: Interpret (L2)
CO3 Action verb is greater than PO4 verb by two levels. Therefore the correlation is high (3)
PO5: Apply(L3)
CO3 Action verb is same as PO5 verb by one level. Therefore the correlation is high (3)

CO4: Design basic IoT applications using Arduino
Action Verb :Design (L6)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb by three levels. Therefore the correlation is high (3)
PO2 Verb : Identify (L3)
CO4 Action verb is greater than as PO2 verb by three levels. Therefore the correlation is high(3)
PO 3 Verbs: Develop (L3)
CO4 Action Verb is greater than PO 3 verb by three levels; therefore correlation is high (3).
PO4: Interpret (L2)
CO4 Action verb is greater than PO4 verb by four levels. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb is same as PO5 verb by three levels. Therefore the correlation is high (3)

CO5:Design IoT applications using Raspberry Pi
Action Verb :Design (L6)
PO1: Apply(L3)
CO5 Action verb is greater than PO1 verb by three levels. Therefore the correlation is high (3)
PO2 Verb : Identify (L3)
CO5 Action verb is greater than as PO2 verb by three levels. Therefore the correlation is high(3)
PO 3 Verbs: Develop (L3)
CO5 Action Verb is greater than PO3 verb by three levels; therefore correlation is high (3).
PO4: Interpret (L2)
CO5 Action verb is greater than PO4 verb by four levels. Therefore the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is same as PO5 verb by three levels. Therefore the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	RF Integrated circuits	L	T	P	C
20APE0412	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Analyze** the working of RLC networks and Transmission lines at Radio frequencies.
CO2: **Evaluate** the parameters of various high frequency amplifiers.
CO3: **Analyze** the different types of Noises and operations of various Mixer circuits.
CO4: **Evaluate** the efficiency of RF power amplifiers and frequency of Oscillators.
CO5: **Understand** the concepts of frequency synthesis and radio architectures.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Analyze**	the working principles of RLC networks and Transmission lines	at Radio frequencies.		**L4**
CO2	**Evaluate**	the parameters of various high frequency amplifiers			**L5**
CO3	**Analyze**	the different types of Noises and		operations of various Mixer circuits.	**L4**
CO4	**Evaluate**	the efficiency of RF power amplifiers and frequency of Oscillators.			**L5**
CO5	**Understand**	the concepts of frequency synthesis and		Radio architectures	**L2**

UNIT - I	**INTRODUCTION RF SYSTEMS**	**9 Hrs**
Basic architectures, Transmission media and reflections, Maximum power transfer , Passive RLC Networks, Parallel RLC tank, Q, Series RLC networks, matching, Pi match, T match, Passive IC Components Interconnects and skin effect, Resistors, capacitors Inductors		
UNIT - II	**REVIEW OF MOS DEVICE PHYSICS**	**9Hrs**
MOS device review, Distributed Systems, Transmission lines, reflection coefficient, the wave equation, examples, Lossy transmission lines, Smith charts – plotting Gamma, High Frequency Amplifier Design, Bandwidth estimation using open-circuit time constants, Bandwidth estimation, using short-circuit time constants, Rise time, delay and bandwidth, Zeros to enhance bandwidth, Shunt-series amplifiers, tuned amplifiers, Cascaded amplifiers		
UNIT - III	**NOISE**	**9 Hrs**
Thermal noise, flicker noise review, Noise figure, LNA Design, Intrinsic MOS noise parameters, Power match versus, noise match, large signal performance, design examples & Multiplier based mixers. Mixer Design, Subsampling mixers.		
UNIT - IV	**RF POWER AMPLIFIERS**	**9 Hrs**
Class A, AB, B, C amplifiers, Class D, E, F amplifiers, RF Power amplifier design examples, Voltage controlled oscillators, Resonators, Negative resistance oscillators, Phase locked loops, Linearized PLL models, Phase detectors, charge pumps, Loop filters, and PLL design examples		
UNIT - V	**FREQUENCY SYNTHESIS AND OSCILLATORS**	**9 Hrs**
Frequency division, integer-N synthesis, Fractional frequency, synthesis, Phase noise, General considerations, and Circuit examples, Radio architectures, GSM radio architectures, CDMA, UMTS radio architectures		

Textbooks:

1.The design of CMOS Radio frequency integrated circuits by Thomas H. Lee Cambridge university press,2004.
2.RF Micro Electronics by Behzad Razavi, Prentice Hall, 1997.

Reference Books:

1. 1.M The Art of Electronics, Horowitz and Hill, Second Edition, Cambridge University Press, 1989. ISBN 0521370957.
2. US Navy, Basic Electronics, Dover, 1973. ISBN 0486210766
Introduction to Electric Circuits, Dorf and Svoboda, Sixth Edition, John Wiley & Sons, 2004. ISBN0471447951

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3		3									**3**	
CO2	3	2		3									**3**	
CO3	3	3	3										**3**	
CO4	3	2		2									**3**	
CO5	2		2	1									**2**	

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Analyze	L4	PO1 PO2 PO4	PO1: Apply(L3) PO2: Review(L2) PO4: Analyze(L4)	3 3 3
2				Evaluate	L5	PO1 PO2 PO4	PO1: Apply(L3) PO2: Formulate(6) PO4: Interpret(L2)	3 2 3
3				Analyze	L4	PO1 PO2 PO3	PO1: Apply(L3) PO2: Identify (L3) PO3:Develop(L3)	3 3 3
4				Evaluate	L5	PO1 PO2 PO4	PO1: Apply(L3) PO2: Formulate(L6) PO3: Design(L6)	3 2 2
5				Understand	L2	PO1 PO3 PO4	PO1: Apply (L3) PO3: Develop(L3) PO4: Analyze (L4)	2 2 1

Justification Statements :

CO1: Analyze the working of RLC networks and Transmission lines at Radio frequencies.

Action Verb: Analyze (L4)

PO1 Verb: Apply(L3) CO1 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)

PO2 Verb : Review(L2) CO1 Action verb is same level as PO2 verb . Therefore the correlation is high(3)

PO4: Analyze(L4)

CO1 Action verb is equal to PO4 verb. Therefore the correlation is high (3)

CO2: Evaluate the parameters of various high frequency amplifiers.

Action Verb : Evaluate (L5)

PO1 Verb: Apply(L3)

CO2 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)

PO2 Verb :formulate(L6)

CO2 Action verb is lesser than PO2 verb by one level. Therefore the correlation is moderate (2)

PO4: Interpret(L2)

CO2 Action verb is greater than as PO4 verb. Therefore the correlation is high (3)

CO3 Analyze the different types of Noises and operations of various Mixer circuits.

Action Verb :Analyze(L4)

PO1 Verb: Apply(L3)

CO3 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Identify(L3)

CO3 Action verb is greater than as PO2 verb. Therefore the correlation is high (3)

PO3: Develop (L3)

CO3 Action verb is greater than as PO3 verb. Therefore the correlation is high (3)

CO4: Evaluate the efficiency of RF power amplifiers and frequency of Oscillators.

Action Verb : Evaluate (L5)

PO1 Verb: Apply(L3)

CO4 Action verb is greater than as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : formulate(L6)

CO4 Action verb is equal as PO2 verb. Therefore the correlation is high (3)

PO3: Design(L6)

CO4 Action verb is lesser than as PO3 verb by one level. Therefore the correlation is moderate (2)

CO5: Understand the concepts of frequency synthesis and radio architectures.

Action Verb : Understand (L2)

PO1 Verb: Apply(L3)

CO5 Action verb is lesser than as PO1 verb by one level. Therefore the correlation is moderate (2)

PO3: Develop (L3)

CO5 Action verb is lesser than as PO3 verb by one level. Therefore the correlation is moderate (2)

PO4: Analyze(L4)

CO5 Action verb is lesser than as PO4 verb by two levels. Therefore the correlation is low (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	RADAR SYSTEMS	L	T	P	C
20APE0413	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the factors affecting the Radar performance using Radar range equation.
CO2: **Analyze** the Analyze the principles of continuous Wave Radar and FM-CW Radar.
CO3: **Analyze** the performance of Moving Target Indicator and Pulse Doppler Radars.
CO4: **Evaluate** the Principles of Tracking methods with Radars for range, acquisition and patterns.
CO5: **Apply** the matched filter concepts for detection of Radar signals in the presence of RADAR

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	basics of RADAR		detection of RADAR Signals	L2
CO2	Analyze	characteristics of CW RADAR	Frequency Modulated (FM)		L4
CO3	Analyze	performance of RADARs		MTI and Pulse Doppler	L4
CO4	Evaluate	Principles of different Tracking RADARs			L5
CO5	Apply	matched filter concepts to RADAR Receiver	in the presence of RADAR		L3

UNIT - I		15Hrs
BASICS OF RADAR: Introduction, Maximum Unambiguous Range, Simple form of RADAR Equation, Radar Block Diagram and Operation, RADAR Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, IllustrativeProblems. **RADAR EQUATION:** SNR, Envelope Detector, False Alarm Time and Probability, Integration of RADAR Pulses, Radar Cross Section of Targets (simple targets - sphere, Cone sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.		
UNIT - II		14Hrs
CW AND FREQUENCY MODULATED RADAR: Doppler Effect, CW Radar– Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver and width Requirements, Applications of CW radar, Illustrative Problems. **FM CW RADAR:** Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/RecedingTargets), FM-CWaltimeter, Multiple Frequency CWRadar.		
UNIT - III		15Hrs
MTI AND PULSE DOPPLER RADAR: Introduction, Principle, MTI Radar with – Power AmplifierTransmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation and Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.		
UNIT - IV		16Hrs
TRACKINGRADAR: Tracking with Radar, Sequential Lobing, Conical Scan, Mono pulse Tracking Radar –Amplitude Comparison Monopulse (one-and two- coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparisonof Trackers.		
UNIT - V		15Hrs
DETECTION OF RADAR SIGNALS IN NOISE: Introduction, Matched Filter Receiver – ResponseCharacteristics and Derivation, Correlation Function and Cross-correlation Receiver, Efficiency of Non-matchedFilters, MatchedFilterwith Non-white Noise. **RADAR RECEIVERS:** Noise Figure and Noise Temperature, Displays – types. Duplexers– Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes, Series versus Parallel Feeds, Applications, Advantages and Limitations.		
Textbooks:		
1. Introduction to Radar Systems– Merrill I. Skolnik, TMH Special Indian Edition, 2 nd Edition,2007.		
Reference Books:		
1. Introduction to Radar Systems–MerrillI. Skolnik, 3rdEdition, TataMcGraw-Hill,2001. 2. Radar Principals, Technology, Applications–Byron Edde, Pearson Education,2004. 3. Radar Principles–Peebles, Jr.,P.Z.Wiley, New York,1998.		
Online Learning Resources:		
nptel videos		

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2	2										2	
CO2	3	1		3									3	
CO3	3	1		3									3	
CO4	3	3	2				1						3	
CO5	3	3			3		2						3	

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	20%	2	Understand	L2	PO1, PO2, PO3	PO1: Apply (L3) PO2: Identify(L3) PO3: Develop(L3)	2 2 2
2	14	19%	2	Analyze	L4	PO1, PO2, PO4,	PO1: Apply (L3) PO2: Formulate (L6) PO4:Analyze(L4)	3 1 3
3	15	20%	2	Analyze	L4	PO1, PO2, PO4,	PO1: Apply (L3) PO2: Formulate (L6) PO4:Analyze(L4)	3 1 3
4	16	21%	3	Evaluate	L5	PO1, PO2, PO3, PO7	PO1: Apply (L3) PO2: Identify(L3) PO3: Develop (L6) PO7:Thumb rule	3 3 2 1
5	15	20%	2	Apply	L3	PO1, PO2, PO5, PO7	PO1: Apply(L3) PO2: Identify (L3) PO5: Apply(L3) PO7:Thumb rule	3 3 3 2
	75	100%						

Correlation matrix

Justification Statements :

CO1. Understand the basics of RADAR and detection of RADAR Signals.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level. Therefore, the correlation is medium (2).

PO2 Verbs: Identify (L3)

CO1 Action Verb is less than PO2 verb by one level. Therefore, the correlation is medium (2).

PO3 Verb: Develop (L3)

CO1 Action Verb is less than PO3 verb by one level. Therefore, the correlation is medium (2).

CO2. Analyze the characteristics of Frequency Modulated (FM) CW RADAR

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO2 Action Verb is greater than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verbs: Formulate (L3)

CO2 Action Verb is less than the PO2 verb by two levels. Therefore, the correlation is low (1).

PO4 Verb: Analyze (L4)

CO2 Action Verb is greater than the PO4 verb. Therefore, the correlation is high (3).

CO3: Analyze the linear and nonlinear applications of operational amplifiers.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than the PO1 verb. Therefore, the correlation is high (3).

PO2 Verbs: Formulate (L6)

CO3 Action Verb is less than the PO2 verb by two levels. Therefore, the correlation is low (1).

PO4 Verb: Analyze (L4)

CO3 Action Verb is greater than the PO4 verb. Therefore, the correlation is high (3).

CO4: Evaluate the Principles of different Tracking RADARs

Action Verb: Evaluate (L5)

PO1 Verbs: Apply (L3)

CO4 Action Verb is greater than the PO1 verb. Therefore, the correlation is high(3).
PO4 Verb: Identify (L3)
CO4 Action Verb is greater than the PO2 verb. Therefore, the correlation is high (3).
PO3 Verbs: Develop (L6)
CO4 Action Verb is less than the PO3 verb by two levels. Therefore, correlation is medium (2).
PO7: CO4 using Thumb rule, correlates PO7 as low (1).

CO 5: Apply the matched filter concepts to RADAR Receiver in the presence of RADAR

Action Verb: Apply (L3)

PO1 Verb: Apply (L3)
CO5 Action verb is same as PO1 verb. Therefore, the correlation is high (3).
PO2 verb: Identify (L3)
CO5 Action verb is equal to the PO2 verb. Therefore, the correlation is high (3).
PO5 verb: Apply (L3)
CO5 Action verb is equal to the PO5 verb. Therefore, the correlation is high (3).
PO7: CO5 using Thumb rule, correlates PO7 as medium (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	SATELLITE COMMUNICATIONS	L	T	P	C
20APE0414	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the principles of satellite communication and its architecture.
CO2: **Analyze** various aspects related to satellite systems
CO3 **Analyze** the effects on satellite communication.
CO4: **Design** of Satellite link for specified parameters .
CO5: **Apply** Various modulation and multiple access schemes in satellite communication

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	The principles of satellite communication and its architecture			**L2**
CO2	**Analyze**	various aspects related to satellite systems			**L4**
CO3	**Analyze**	the effects on satellite communication.			**L4**
CO4	**Design**	Satellite link Design	specified parameters		**L6**
CO5	**Apply**	Various modulation and multiple access schemes in satellite communication			**L3**

UNIT - I	**INTRODUCTION TO SATELLITE COMMUNICATION**	**9 Hrs**
Principles and architecture of satellite Communication, Brief history of Satellite systems, advantages, disadvantages, applications and frequency bands used for satellite communication. Orbital Mechanics: Orbital equations, Kepler's laws, Apogee and Perigee for an elliptical orbit, evaluation of velocity, orbital period, angular velocity of a satellite, concepts of Solar day and Sidereal day.		
UNIT - II	**SATELLITE SUB-SYSTEMS**	**9Hrs**
Study of Architecture and Roles of various sub-systems of a satellite system such as Telemetry, tracking, command and monitoring (TTC & M), Attitude and orbit control system (AOCS), Communication sub-system, power sub-systems.		
UNIT - III	**EFFECTS ON SATELLITE COMMUNICATION**	**9 Hrs**
Solar Eclipse on satellite, its effects, remedies for Eclipse, Sun Transit Outage phenomena, its effects and remedies, Doppler frequency shift phenomena and expression for Doppler shift.		
UNIT - IV	**SATELLITE LINK DESIGN**	**9 Hrs**
Basic transmission theory, system noise temperature and G/T ratio, design of down links, uplink design, design of satellite links for specified C/N.		
UNIT - V	**MODULATION AND MULTIPLE ACCESS SCHEMES**	**9 Hrs**
Various modulation schemes used in satellite communication, Meaning of Multiple Access, Multiple access schemes based on time, frequency, and code sharing namely TDMA, FDMA and CDMA.		

Textbooks:

1. Timothy Pratt Charles W. Bostian, Jeremy E. Allnutt: Satellite Communications: Wiley India. 2nd edition 2002.

Reference Books:

1. Tri T. Ha: Digital Satellite Communications: Tata McGraw Hill, 2009. 3. Dennis Roddy: Satellite Communication: 4th Edition, McGraw Hill, 2009

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	**2**	**2**		**1**						**2**		**2**	**2**	
CO2	**3**	**3**	**3**	**3**						**3**		**3**	**3**	
CO3	**3**	**1**		**3**						**3**		**3**	**3**	
CO4		**3**	**3**	**3**						**3**		**3**	**3**	
CO5	**3**	**3**		**2**						**2**		**2**	**3**	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				CO1: **Understand**	L2	PO1 PO2 PO4 PO12	PO1: Apply(L3) PO2: Identify(L3) PO4: Analyze(L4) PO12: Thumb rule	2 2 1 2 2
2				CO2 : Analyze	L4	PO1 PO2 PO3 PO4 PO12	PO1: Apply(L3) PO2: Identify(L3) PO3: Develop (L3) PO4: Analyze(L4) PO12: Thumb rule	3 3 3 3 3 3
3				CO3 : Analyze	L4	PO1 PO2 PO4 PO12	PO1: Apply(L3) PO2: Formulate (L6) PO4: Analyze(L4) PO12: Thumb rule	3 1 3 3 3
4				CO4 : Design	L6	PO2 PO3 PO4 PO12	PO2: Formulate (L6) PO3: Design (L6) PO4: Design (L6) PO12: Thumb rule	3 3 3 3 3
5				CO5 : Apply	L3	PO1 PO2 PO4 PO12	PO1: Apply (L3) PO2: Identify(L3) PO4: Analyze(L4) PO12:Thumb Rule	3 3 2 2 2

Justification Statements :

CO1:Understand The principles of satellite communication and its architecture
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Identify(L3)
CO1 Action verb is less than PO2 verb by one level. Therefore the correlation is medium (2)
PO4 Verb : Analyze(L4)
CO1 Action verb is less than PO4 verb by two level. Therefore the correlation is low (2)
PO12 Verb : Thumb rule(L2)
CO1 Action verb is correlates PO12 verb as per Thumb Rule.

CO2: Analyze various aspects related to satellite systems
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO2 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)
PO2: Identify(L3)
CO2 Action verb is greater than PO2 verb by one level. Therefore the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than PO3 verb by one level. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO2 Action verb is greater than PO4 verb by one level. Therefore the correlation is high (3)
PO12: Thumb rule
CO2 Action verb is correlates PO12 verb as per Thumb Rule.

CO3: Analyze the effects on satellite communication.
Action Verb : Analyze (L4)
PO1: Apply(L3)
CO3 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)
PO2: Formulate (L6)
CO3 Action verb is less than PO2 verb by two level. Therefore the correlation is low(1)
PO4: Analyze(L4)
CO3 Action verb is same as than PO4 verb. Therefore the correlation is high (3)
PO12: Thumb rule

CO3 Action verb is correlates PO12 verb as per Thumb Rule.

CO4: Design of Satellite link for specified parameters .
Action Verb : Design (L6)
PO2: Formulate (L6)
CO4 Action verb is same as PO2 verb. Therefore the correlation is high (3)
PO3: Design (L6)
CO4 Action verb is same as PO3 verb. Therefore the correlation is high (3)
PO4: Design (L6)
CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO12: Thumb rule
CO4 Action verb is correlates PO12 verb as per Thumb Rule.

CO5: Apply Various modulation and multiple access schemes in satellite communication
Action Verb : Apply (L3)
PO1: Apply (L3)
CO4 Action verb is same as PO1 verb. Therefore the correlation is high (3)
PO2: Identify(L3)
CO4 Action verb is same as PO2 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO4 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate(2)
PO12:Thumb Rule
CO4 Action verb is correlates PO12 verb as per Thumb Rule.

ANNAMACHARYAINSTITUTEOFTECHNOLOGYANDSCIENCES,TIRUPATI

(AUTONOMOUS)

Course Code	WIRELESSCOMMUNICATIONS (Common to ECE, SE,CIC,AIDS)		L	T	P	C
20APE0415			3	0	0	3
Pre-requisite	COMPUTERNETWORKS	Semester	IV-I			

Course Outcomes: After studying the course, Student will be able to:

Wireless Communications	
CO1	Understand the effective bandwidth utilization to accommodate large number of mobile users by using various accessing techniques.
CO2	Analyze networking considerations, practical networking approaches with mobile data services.
CO3	Understand WAP architecture and services, WML scripts.
CO4	Analyze the protocols used in wireless LAN technologies.
CO5	Apply Various services in mobile data networks and HIPER LAN.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The effective bandwidth utilization to accommodate large number of mobile users		using various accessing techniques	L2
CO2	Analyze	Networking considerations, practical networking approaches with mobile data services.			L4
CO3	Understand	WAP architecture and services, WML scripts			L2
CO4	Analyze	the protocols used in wireless LAN technologies			L4
CO5	Apply	Various services in mobile data networks and HIPER LAN			L3

UNIT–I	**INTRODUCTIONTOWIRELESSCOMMUNICATION SANDMULTIPLEACCESSTECHNIQUES**	9Hrs
INTRODUCTIONTOWIRELESSCOMMUNICATIONSANDMULTIPLEACCESSTECHNIQUES: Evolutionofmobileradiocommunications,examplesofWirelessCommunicationsystems,comparisonofcommon WirelessCommunicationsystems,Multipleaccesstechniques:Introduction,FDMA,TDMA,SpreadSpectrum,MultipleAccess,SDMA,Packetradio,Packetradioprotocols,CSMAprotocols,Reservationprotocols.		
UNIT –II	**WIRELESSNETWORKINGANDDATASERVICES**	9Hrs
WIRELESSNETWORKINGANDDATASERVICES: WirelessNetworking:Differencebetweenwirelessandfixedtelephonenetworks,Developmentofwirelessnetworks,Trafficroutinginwirelessnetworks.DataServices:Dataservices,CCS,BISDNandATM,SignallingSystemNo7		
UNIT–III	**MOBILEIPANDWIRELESSACCESSPROTOCOL**	9Hrs
MOBILEIPANDWIRELESSACCESSPROTOCOL: **MobileIP:**MobileIPOperationofmobileIP,Co-locatedaddress,Registration,Tunneling.WAP:WAPArchitecture,overview,WMLscripts,WAPservice,WAPsessionprotocol.		
UNIT–IV	**WIRELESSLANTECHNOLOGYANDBLUETOOTH**	9Hrs
WIRELESSLANTECHNOLOGYANDBLUETOOTH: WirelessLAN:InfraredLANs,SpreadspectrumLANs,NarrowbankmicrowaveLANs,IEEE802.11Protocolarchitectureandservices.Bluetooth:Overview,Radiospecification,Basebandspecification,Linksmanager specification,Logical linkcontroland adaptationprotocol.		
UNIT –V	**MOBILEDATANETWORKSANDHIPERLAN**	9Hrs
MOBILEDATANETWORKSANDHIPERLAN: MobileDataNetworks:GPRSandhigherdatarates,ShortmessagingserviceinGSM,HIPERLAN:HIPERLAN-1.		

Textbooks:
1. WirelessCommunications,Principles,Practice–TheodoreS.Rappaport,PHI,2ndEd.,2002.2.WirelessCommunicationandNetworking 2. WirelessCommunicationandNetworking–WilliamStallings,PHI,2003. 3. PrinciplesofWirelessNetworks–KavehPahLavenandP.KrishnaMurthy,PearsonEducation,2002.
ReferenceBooks:
1.WirelessDigitalCommunications–KamiloFeher,PHI,1999.

PO CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2				2						2	2	
CO2		3				3						3	3	
CO3	3					2						2	2	
CO4		2				3						3	3	
CO5	3					2						2	3	

CO	**CO**					**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Lesson Plan (Hrs)	**%**	**corr**	**Verb**	**BTL**			
1	**13**	22	2	Understand	L2	PO1 PO2 PO6 PO12	PO1:Apply (L3) PO2:Identify (L3) PO6 PO12	3 2 2 2
2	**12**	20	3	Analyze	L4	PO2 PO6 PO12	PO2: Identify (L3) PO6 PO12	3 3 3
3	**11**	**18**	**2**	**Understand**	L2	PO1 PO6 PO12	PO1:Apply(L3) PO6 PO12	3 2 2
4	**12**	**20**	**2**	**Analyze**	L4	PO2 PO6 PO12	PO2: Identify (L3) PO6 PO12	2 3 3
5	**12**	**20**	**2**	**Apply**	L3	PO6 PO6 PO12	PO6: Apply (L3) PO6 P12	2 2 2
	60							

CO1: Understand the effective bandwidth utilization to accommodate large number of mobile users by using various accessing techniques.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

PO2 Verbs: Review (L2)

CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

PO6 from thumb rule L2 correlation is moderate (2)

PO12 from thumb rule L2 correlation is moderate (2)

CO2: Analyze networking considerations, practical networking approaches with mobile data services.

Action Verb: Analyze (L4)

PO2 Verbs: Identify (L3)

CO2 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO6 from thumb rule L4 the correlation is high (3)
PO12 from thumb rule L4 the correlation is high (3)
CO3: Understand WAP architecture and services, WML scripts.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO6 from thumb rule L2 correlation is moderate (2)
PO12 from thumb rule L2 correlation is moderate (2)
CO4: Analyze the protocols used in wireless LAN technologies.
Action Verb: Analyze (L4)
PO2 Verb: Identify (L3)
CO4 Action Verb is less than PO2 verb; Therefore correlation is moderate(2).
PO6 from thumb rule L4 the correlation is high (3)
PO12 from thumb rule L4 the correlation is high (3)
CO5: Apply Various services in mobile data networks and HIPER LAN.
Action Verb: Apply (L3)
PO6 Verb: Apply (L3)
CO5 Action verb is greater to PO1 verb; therefore the correlation is high (3).
PO6 from thumb rule L2 correlation is moderate (2)
PO12 from thumb rule L2 correlation is moderate (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Computer Networks	L	T	P	C
20APC0516	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understan**d the basics of data communications and networking by using OSI model.
CO2: **Apply** the Data link Layer functionalities to solve real world problems.
CO3: **Analyze** the various routing algorithms and protocols.
CO4: **Analyze** the Transport Layer services by using TCP and UDP protocols.
CO5: **Understand** the various services protocols offered by application layer.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	understand	the basics of data communications and networking by using OSI model.			L2
CO2	Apply	The Data link Layer functionalities		to solve real world problems.	L3
CO3	Analyze	the various routing algorithms and protocols.			L4
CO4	Analyze	the Transport Layer services	by using TCP and UDP protocols		L4
CO5	understand	The various services protocols offeredby application layer			L2

UNIT - I		9Hrs
Introduction: Data Communications, Networks, Network Types, Internet History, Standards and Administration. **Network Models:** Protocol Layering, TCP/IP Protocol Suite, The OSI Model **Introduction to Physical Layer**: Data and Signals, Transmission Impairment, Data Rate Limits, Performance. Transmission Media: Introduction, Guided Media, Unguided Media, Switching: Introduction, Circuit Switched Networks, Packet Switching		
UNIT - II		9Hrs
The Data Link Layer: Introduction, Link layer addressing, Error detection and Correction: Cyclic codes, Checksum, Forward error correction, Data link control: DLC Services, Data link layer protocols, HDLC, Point to Point Protocol. **Media Access control**: Random Access, Controlled Access, Channelization, Connecting devices and virtual LANs: Connecting Devices.		
UNIT - III		9Hrs
The Network Layer: Network layer design issues, Routing algorithms, Congestion control algorithms, Quality of service, Internetworking. **The network layer in the Internet:** IPV4 Addresses, IPV6, Internet Control protocol, OSPF, BGP, IP, ICMPv4, IGMP.		
UNIT - IV		9Hrs
The Transport Layer: The Transport Service, Elements of Transport Protocols, Congestion Control, The internet transport protocols: UDP, TCP, Performance problems in computer networks, Network performance measurement.		
UNIT - V		9 Hrs
The Application Layer: Introduction, Client-Server Programming, WWW and HTTP, FTP, e-mail, TELNET, Secure Shell, Domain Name System, SNMP.		
Textbooks:		
1. "Data communications and networking", Behrouz A. Forouzan, Mc Graw Hill Education, 5th edition, 2012. 2. "Computer Networks", Andrew S. Tanenbaum, Wetherall, Pearson, 5th edition, 2010.		
Reference Books:		

1. Data Communication and Networks, Bhushan Trivedi, Oxford
2. "Internetworking with TCP/IP – Principles, protocols, and architecture - Volume 1, Douglas E. Comer, 5th edition, PHI
3. "Computer Networks", 5E, Peterson, Davie, Elsevier.
4. "Introduction to Computer Networks and Cyber Security", Chawan- Hwa Wu, Irwin, CRC Publications.
5. "Computer Networks and Internets with Internet Applications", Comer.

Online Learning Resources:

https://www.youtube.com/watch?v=O--rkQNKqls&list=PLbRMhDVUMngf-peFloB7kyiA40EptH1up

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	1											2	
CO2	3	2				1							2	
CO3	3	3		3	3	1							2	
CO4	3	3		3	3								3	2
CO5	2	1											1	

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	15	23%	3	CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Analyze(L4)	2 1
2	10	15%	2	CO2 : Apply	L3	PO1 PO2 PO6	PO1: Apply(L3) PO2: Analyze (L4) PO6:Thumb rule	3 2 1
3	15	23%	3	CO3 : Analyze	L4	PO1 PO2 PO4 PO5 PO6	PO1: Apply(L3) PO2: AnalyzeL4) PO4: Analyze(L4) PO5:Apply(L3) PO6:Thumb rule	3 3 3 3 1
4	11	17%	2	CO4 :Analyze	L4	PO1 PO2 PO4 PO5	PO1: Apply(L3) PO2: Analyze(L4) PO4: Analyze(L4) PO5:Apply(L3)	3 3 3 3
5	15	23%	3	CO5 : Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Analyze(L4)	2 1
	66	100%						

Correlation matrix

Justification Statements :

CO1: understand the basics of data communications and networking by using OSI model.
Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Analyze(L4)
CO1 Action verb is less than PO2 verb by two levels. Therefore the correlation is low (1)

CO2: Apply Data link Layer functionalities to solve real world problems.
Action Verb : Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Analyze(L4)
CO2 Action verb is less than PO2 verb by One levels. Therefore the correlation is medium (2)
PO6: Thumb rule
Data link Layer functionalities are useful for realtimeapplications.Therefore the correlation is (1)

CO3: Analyze various routing algorithms and protocols.
Action Verb : Analyze(L4)
PO1: Apply(L3)

CO3 Action verb is greater than PO1 verb. Therefore the correlation is high (3)
PO2: Analyze(L4)
CO3 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO3 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO3 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO6 : Thumb rule
Various routing algorithms are useful for finding distance between routers in real life.Therefore the correlation is (1)

CO4: Analyze the Transport Layer services by using TCP and UDP protocols.
Action Verb : Analyze(L4)
PO1: Apply(L3)
CO4 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)
PO2: Analyze(L4)
CO4 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO4 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb is greater than PO5 verb by one level. Therefore the correlation is high (3)

CO5: Understand various services protocols offered by application layer.
Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO5 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Analyze(L4)
CO5 Action verb is less than PO2 verb by two levels. Therefore the correlation is low (1)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year/Semester: IV / VII
Branch of Study: ECE

Course Name: NEURAL NETWORKS AND FUZZY LOGIC
Course Code: 20APE0203

L	T	P	Credits
3	0	0	3

COURSE OUTCOMES: After studying the course, Student will be able to:

CO1: Understand the evolution and basic architecture of artificial neural networks.
CO2: Analyze various learning process of Artificial Neural Networks.
CO3: Analyze various learning rules used to train neural networks to produce desired results.
CO4: Understand basic fuzzy logic operations and properties.
CO5: Apply fuzzy logic control operations to real world applications.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Bloom's level
CO1	Understand	the evolution and basic architecture of artificial neural networks			L2
CO2	Analyze	various learning process of Artificial Neural Networks			L4
CO3	Analyze	various learning rules used to train neural networks to produce desired results			L4
CO4	Understand	Basic Fuzzy Logic Operations and properties			L2
CO5	Apply	fuzzy logic control operations	to real world applications		L3

SYLLABUS:

UNIT–IARTIFICIALNEURAL NETWORKS
Approaches to AI – Architectures of AI – Symbolic Reasoning System – Rule based Systems–KnowledgeRepresentation–ExpertSystems. Introductionandmotivation:NeuralNetwork,HumanBrain,Structureofbiological neuron,Memory,Comparisonbetween Artificial and Biological Neural Networks – Basic Building Blocks of ANN – Artificial Neural Network Terminologies, Artificial Intelligence and Neural Networks.

UNIT–II LEARNING PROCESS
Layers, activation functions, learning methods: Error Correction Learning, Memory Based Learning, Hebbian Learning, Competitive, Boltzmann Learning, Memory, Adaption, Back Propagation and Differentiation, Supervised Learning, unsupervisedlearning.

UNIT–III NETWORKS
Basic Building Blocks of ANN – Artificial Neural Network Terminologies – McCulloch Pitts Neuron Model – Learning Rules – ADALINE and MADALINEModels – Perceptron Networks – Back Propagation Neural

Networks – Associative Memories - Self-Organization Map – Hopfield models – ART networks.

UNIT–IVUNIT–IVFUZZYLOGIC

ClassicalSets–FuzzySets–FuzzyPropertiesandOperations–FuzzyLogicSystem – Fuzzification – Defuzzification – Membership Functions – Fuzzy Rule base – Fuzzy Logic Controller Design.

UNIT–VFUZZYLOGICAPPLICATIONS

Fuzzy pattern recognition – Fuzzy control system – Aircraft landing control problem - Statistical process control- Fuzzy cognitive mapping – Probability measures – Possibility and necessity measures.

TEXT BOOKS:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Neural Networks using MATLAB", McGraw Hill Edition, 2006.
2. Timothy J. Ross, "Fuzzy Logic with Engineering Applications", Third Edition, WILEY india Edition, 2012.

REFERENCEBOOKS:

1. S. N. Sivanandam, S. Sumathi and S. N. Deepa, "Introduction to Fuzzy Logic using
2. MATLAB", Springer International Edition, 2013.
3. Laurene V. Fausett "Fundamentals of Neural Networks: Architectures, Algorithms and Applications" United States Edition.
4. Yung C. Shin and Chengying Xu, "Intelligent System – Modeling, Optimization & Control, CRC Press, 2009.

Mapping of course outcomes with program outcomes

CourseTitle	COs	ProgrammeOutcomes(POs)&ProgrammeSpecificOutcomes(PSOs)													
		PO 1	PO 2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO2
NEURAL NETWORKS AND FUZZY LOGIC	CO1	2	1							2				1	2
	CO2	3	3	3		3				3				3	3
	CO3	3	3	3		3				3				3	3
	CO4	2	1							2				1	2
	CO5	3	2	3		3				2				2	3

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES::TIRUPATI
(AUTONOMOUS)
Department of Electrical and Electronics Engineering
Program: B. Tech Regulation: AK20 Year/Semester: IV / VII
Branch of Study: ECE

Justification Table:

CO	CO					Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	**12**	18.18	2	**Understand**	**L2**	PO1, PO2,PO9	PO1: Apply (L3) PO2: Identify(L3) PO9: Thumb Rule	2 2 2
2	**12**	18.18	2	**Analyze**	**L4**	PO1, PO2,PO3, PO5,PO9	PO1: Apply (L3) PO2: Analyze(L4) PO3: Develop(L3) PO5: Apply(L3) PO9: Thumb Rule	3 3 3 3 3
3	**11**	**16.66**	**2**	**Analyze**	**L4**	PO1, PO2,PO3, PO5,PO9	PO1: Apply (L3) PO2: Analyze(L4) PO3: Develop(L3) PO5: Apply(L3) PO9: Thumb Rule	3 3 3 3 3
4	**11**	**16.66**	**2**	**Understand**	**L2**	PO1, PO2,PO9	PO1: Apply (L3) PO2: Identify (L3) PO9: Thumb Rule	2 1 2
5	**10**	**15.15**	**2**	**Apply**	**L3**	PO1, PO2,PO3, PO5,PO9	PO1: Apply (L3) PO2: Analyze(L4) PO3: Develop(L3) PO5: Apply(L3) PO9: Thumb Rule	3 2 3 3 2
	66							

CO1: Understand the evolution, basic architecture of artificial neural networks.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Analyze (L4)
CO1 Action Verb is less than PO verb by one level; therefore correlation is moderate (1).
Based on thumb rule, Students' participate in CLC Activities, CO Action verb is 2. So, its moderate (2)
CO2: Analyze various learning process of Artificial Neural Networks
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Analyze (L4)
CO2 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO3 Verbs: Develop (L3)
CO2 Action Verb is greater than PO3 verb by one level; Therefore correlation is moderate high(3).
PO5 Verbs: Apply (L3)
CO2 Action Verb is one level greater than to PO2 verb; Therefore correlation is high (3).
Based on thumb rule, Students' participate in CLC Activities, CO Action verb is 4. So, its high (3)
CO3: Analyze various learning rules used to train neural networks to produce desired results.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).
PO2 Verbs: Analyze (L4)
CO3 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO3 Verbs: Develop (L3)
CO3 Action Verb is greater than PO3 verb by one level; Therefore correlation is moderate high(3).
PO5 Verbs: Apply (L3)
CO3 Action Verb is one level greater than to PO2 verb; Therefore correlation is high (3).
Based on thumb rule, Students' participate in CLC Activities, CO Action verb is 4. So, its high (3)
CO4: Understand basic fuzzy logic operations.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Analyze (L4)
CO4 Action Verb is less than PO verb by two level; therefore correlation is low (1).
Based on thumb rule, Students' participate in CLC Activities, CO Action verb is 2. So, its moderate (2)
CO 5: Apply fuzzy logic control operations to real world applications.
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO5 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Analyze (L4)
CO5 Action Verb is less than PO2 verb by one level; therefore correlation is moderate (2).
PO3 Verbs: Develop (L3)
CO5 Action Verb is equal to PO3 verb; Therefore correlation is moderate high(3).
PO5 Verbs: Apply (L3)
CO5Action Verb is equal to PO5 verb; therefore correlation is high (3).
Based on thumb rule, Students' participate in CLC Activities, CO Action verb is 3. So, its moderate (2)

Program Specific Outcomes:

PSO1 Verb: Analyze (L4)

CO1 Action Verb level is less than to PSO1verb by two level; Therefore correlation is low (1).
CO2 Action Verb level equal to PSO1verb; Therefore correlation is high (3).
CO3 Action Verb level is equal to PSO1verb; Therefore correlation is high (3).
CO4 Action Verb level is less than to PSO1verb by two level; Therefore correlation is low (1).

CO5 Action Verb level is less than to PSO1verb by one level; Therefore correlation is moderate(2).

PSO2 Verb: Develop (L3)

CO1 Action Verb level is less than PSO2 verb by one level; Therefore correlation is moderate (2).CO2 Action Verb level is one greater than PSO2 verb by one level; Therefore correlation is high (3).
CO3 Action Verb level is one greater than PSO2 verb by one level; Therefore correlation is high (3).
CO4Action Verb level is less than PSO2 verb by one level; Therefore correlation is moderate (2).

CO5 Action Verb level is equal to PSO2 verb; Therefore correlation is high (3).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	BIO MEDICAL INSTRUMENTATION	L	T	P	C
20AOE0402	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1 **Understand** the Cell structure of the heart, lungs, blood circulation and Respiratory systems.

CO2 **Apply** various sensing and measurement devices of electrical origin.

CO3 **Analyze** various electrical parameters and electrical safety in medical environment.

CO4 **Analyze** the modern methods of Imaging techniques and Biometric systems.

CO5 **Understand** various Medical Assistance/techniques, Robotic and Therapeutic equipment.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Cell structure of the heart, lungs, blood circulation and Respiratory systems			L2
CO2	Apply	sensing and measurement devices of electrical origin			L3
CO3	Analyze	electrical parameters and electrical safety in medical environment			L4
CO4	Analyze	modern methods of Imaging techniques and Biometric systems.			L4
CO5	Understand	Medical Assistance/techniques, Robotic and Therapeutic equipment			L2

UNIT - I		
INTRODUCTION: Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals - Basic components of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and blood flow - Biomechanics of bone - Biomechanics of soft tissues -Physiological signals and transducers - Transducers – selection criteria – Piezo electric, ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.		
UNIT - II		
NON ELECTRICAL PARAMETERS MEASUREMENT AND DIAGNOSTIC PROCEDURES: Measurement of blood pressure - Cardiac output - Heart rate - Heart sound - Pulmonary function measurements – spirometer – Photo Plethysmography, Body Plethysmography – Blood Gas analysers, pH of blood –measurement of blood pCO2, pO2, finger-tip oxymeter - ESR, GSR measurements.		
UNIT - III		
ELECTRICAL PARAMETERS ACQUISITION AND ANALYSIS: Electrodes – Limb electrodes –floating electrodes – pregelled disposability electrodes - Micro, needle and surface electrodes – Amplifiers, Preamplifiers, differential amplifiers, chopper amplifiers – Isolation amplifier - ECG – EEG – EMG – ERG – Lead systems and recording methods – Typical waveforms - Electrical safety in medical environment, shock hazards – leakage current-Instruments for checking safety parameters of biomedical equipment		
UNIT - IV		
IMAGING MODALITIES AND ANALYSIS: Radio graphic and fluoroscopic techniques – Computer tomography – MRI – Ultrasonography – Endoscopy – Thermography –Different types of biotelemetry systems - Retinal Imaging - Imaging application in Biometric systems.		
UNIT - V		
LIFE ASSIS ING, THERAPEUTIC AND ROBOTIC DEVICES: Pacemakers – Defibrillators – Ventilators – Nerve and muscle stimulators – Diathermy – Heart – Lung machine – Audio meters – Dialysers – Lithotripsy - ICCU patient monitoring system - Nano Robots - Robotic surgery –Orthopedic prostheses fixation.		
Textbooks:		
1. Leslie Cromwell, "Biomedical Instrumentation and Measurement", Prentice Hall of India, New Delhi, 2007. 2. Khandpur R.S, Handbook of Biomedical Instrumentation, Tata McGraw-Hill, New Delhi,2nd edition, 2003 3. Joseph J Carr and John M.Brown, Introduction to Biomedical Equipment Technology, John Wiley and sons, New York, 4th edition, 2012		

Reference Books:

1. John G. Webster, Medical Instrumentation Application and Design, John Wiley and sons, New York, 1998.
2. Duane Knudson, Fundamentals of Biomechanics, Springer, 2nd Edition, 2007.
3. Suh, Sang, Gurupur, Varadraj P., Tanik, Murat M., Health Care Systems, Technology and Techniques, Springer, 1st Edition, 2011.
4. Ed. Joseph D. Bronzino, The Biomedical Engineering Hand Book, Third Edition, Boca Raton, CRC Press LLC, 2006.
5. M.Arumugam, 'Bio-Medical Instrumentation', Anuradha Agencies, 2003.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3		1	2								2	
CO2	3	3		2	3								3	
CO3	1	3	1	3	3								3	
CO4	3	3	1	3	3									3
CO5	2	3		1	2									2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				Understand	L2	PO1, PO2, PO4, PO5	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze(L4) PO5:Apply(l3)	2 3 1 2
2				Apply	L3	PO1, PO2, PO4, PO5	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze(L4) PO5:Apply(l3)	3 3 2 3
3				Analyze	L4	PO1, PO2, PO3,PO4, PO5	PO1: Apply (L3) PO2: Review (L2) PO3: Develop(L6) PO4: Analyze(L4) PO5:Apply(l3)	1 3 1 3 3
4				Analyze	L4	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2: Review (L2) PO3: Develop L6) PO4: Analyze(L4) PO5:Apply(l3)	3 3 1 3 3
5				Understand	L2	PO1, PO2, PO4, PO5	PO1: Apply (L3) PO2: Review (L2) PO4: Analyze(L4) PO5:Apply(l3)	2 3 1 2

Justification Statements :

CO 1: Understand the Cell structure of the heart, lungs, blood circulation and Respiratory systems.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3) CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Review (L2) CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze(L4) CO1 Action Verb is less than PO4 verb by two levels; Therefore correlation is Low (1).
PO5 Verbs: Apply (L3) CO1 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).

CO2: Apply various sensing and measurement devices of electrical origin.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3) CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Review (L2) CO2 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze(L4) CO2 Action Verb is less than PO4 verb by one level; Therefore correlation is moderate (2).
PO5 Verbs: Apply (L3) CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO3: Analyze various electrical parameters and electrical safety in medical environment
Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3) CO3 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Review (L2) CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verbs: Develop (L6) CO3 Action Verb less than PO3 verb by two level; Therefore correlation is low (1).

PO4 Verbs: Analyze(L4) CO3 Action Verb is greater than PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3) CO3 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO4: Analyze the modern methods of Imaging techniques and Biometric systems.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3) CO4 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Review (L2) CO4 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verbs: Develop (L6) CO4 Action Verb less than PO3 verb by two level; Therefore correlation is low (1).
PO4 Verbs: Analyze(L4) CO4 Action Verb is greater than PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3) CO4 Action Verb is greater than PO5 verb; Therefore correlation is high (3).

CO5: Understand various Medical Assistance/techniques, Robotic and Therapeutic equipment.

Action Verb: (L4)

PO1 Verbs: Apply (L3) CO5 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).
PO2 Verbs: Review (L2) CO5 Action Verb is equal to PO2 verb; Therefore correlation is high (3).
PO4 Verbs: Analyze(L4) CO5 Action Verb is less than PO4 verb by two level; Therefore correlation is low (1).
PO5 Verbs: Apply (L3) CO5 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Database Management Systems	L	T	P	C
20APC0502	IV-I	**(common to ECE,CSE,CIC,AIDS,AIML,CSE(DS))**	**3**	**0**	**0**	**3**

Course Outcomes: After studying the course, Student will be able to:

CO1: Understand the fundamentals of databases to design relational models.
CO2: Applythe SQL and PL/SQL concepts to formulate queries.
CO3: Applythe E-R model for data base designof real world applications.
CO4: Analyzethe query processing and optimization for data manipulation.
CO5:Analyzethe concurrent transactions and recover systems to prevent data loss in system crash.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals of databases		To design relational models.	L2
CO2	Apply	the SQL and PL/SQL concepts		To formulate queries.	L3
CO3	Apply	the E-R model		for data base design of real world applications	L3
CO4	Analyze	the query processing and optimization		For data manipulation.	L4
CO5	Analyze	the concurrent transactions and recover systems		to prevent data loss in system crash.	L4

UNIT- I	**Introduction, Introduction to Relational Model**	9Hrs
Introduction: Database systems applications, Purpose of Database Systems, view of Data, Database Languages, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture, Data Mining and Information Retrieval, Specialty Databases, Database users and Administrators, Introduction to Relational Model: Structure of Relational Databases, Database Schema, Keys, Schema Diagrams, Relational Query Languages, Relational Operations		
UNIT-II	**Introduction to SQL, Advanced SQL**	9Hrs
Introduction to SQL: Overview of the SQL Query Language, SQL Data Definition, Basic Structure of SQL Queries, Additional Basic Operations, Set Operations, Null Values, Aggregate Functions, Nested Sub-queries, Modification of the Database. Intermediate SQL: Joint Expressions, Views, Transactions, Integrity Constraints, SQL Data types and schemas, Authorization. Advanced SQL: Accessing SQL from a Programming Language, Functions and Procedures, Triggers, Recursive Queries, OLAP, Formal relational query languages.		
UNIT-III	**Database Design and the E-R Model, Relational Database Design**	9Hrs
Database Design and the E-R Model: Overview of the Design Process, The Entity-Relationship Model, Constraints, Removing Redundant Attributes in Entity Sets, Entity-Relationship Diagrams, Reduction to Relational Schemas, Entity-Relationship Design Issues. Relational Database Design:Features of Good Relational Designs, Atomic Domains and First Normal Form, Decomposition Using Functional Dependencies, Functional-Dependency Theory, Algorithms for Decomposition, Decomposition Using Multivalued Dependencies, More Normal Forms.		
UNIT-IV	**Query Processing, Query optimization**	9Hrs
Query Processing: Overview, Measures of Query cost, Selection operation, sorting, Join Operation, other operations, Evaluation of Expressions. Query optimization: Overview, Transformation of Relational Expressions, Estimating statistics of Expression results, Choice of Evaluation Plans, Materialized views, Advanced Topics in Query Optimization.		
UNIT-V	**Transaction Management, Concurrency control and Recovery System**	10Hrs
Transaction Management: Transactions: Concept, A Simple Transactional Model, Storage Structures, Transaction Atomicity and Durability, Transaction Isolation, Serializability, Isolation and Atomicity, Transaction Isolation Levels, Implementation of Isolation Levels, Transactions as SQL Statements. Concurrency Control: Lock-based Protocols, Deadlock Handling, Multiple granularity, Timestamp-based Protocols, and Validation-based Protocols. Recovery System: Failure Classification, Storage, Recovery and Atomicity, Recovery Algorithm, Buffer Management, Failure with Loss of Nonvolatile Storage, Early Lock Release and Logical Undo Operations.		
Textbooks:		
1.A. Silberschatz,H.F.Korth,S.Sudarshan,"DatabaseSystemConcepts",6/e,TMH2019		
Reference Books:		
1. DatabaseManagementSystem,6/eRamez Elmasri,ShamkantB.Navathe,PEA 2. DatabasePrinciplesFundamentalsofDesignImplementationandManagement,CarlosCoronel,StevenMorris,PeterRobb, Cengage Learning. 3. DatabaseManagement Systems,3/e,RaghuramaKrishnan,JohannesGehrke,TMH		

Online Learning Resources:
https://onlinecourses.nptel.ac.in/noc21_cs04/preview

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3												
CO2	3	3										2		
CO3	3	3	3	2	3			2	2			2		
CO4	3	3	3	3	3			3					2	
CO5		3	3	3	3			2	2			2		

Correlation matrix

Justification Statements :
CO1: Understand the fundamentals of databases to design relational models.

Action Verb : Understand(L2)
PO1 Verb : Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Review(L2)
CO1 Action verb is same level asPO2 verb. Therefore the correlation is high (3)

CO2: Apply the SQL and PL/SQL concepts to formulate queries.

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	13	14%	2	CO1 :Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	19	20%	2	CO2 :Apply	L3	PO1 PO2 PO12	PO1: Apply(L3) PO2: Review(L2) PO12: Thumb rule	3 3 2
3	18	19%	2	CO3 :Apply	L3	PO1 PO2 PO3 PO4 PO5 PO8 PO9 PO12	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO9: Thumb rule PO12: Thumb rule	3 3 3 2 3 2 2 2
4	18	19%	2	CO4 :Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO8	PO1: Apply(L3) PO2: Analyze(L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule	3 3 3 3 3 3
5	25	27%	3	CO5 :Analyze	L4	PO2 PO3 PO4 PO5 PO8 PO9 PO12	PO2: Analyze(L4) PO3: Develop (L3) PO4: Analyze (L4) PO5: Apply(L3) PO8: Thumb rule PO9: Thumb rule PO12: Thumb rule	3 3 3 3 2 2 2
	93	100 %						

Action Verb :Apply (L3)
PO1: Apply(L3)
CO2 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2: Review (L2)
CO2 Action verb is greater than PO2 verb. Therefore the correlation is high (3)
PO12: Thumb rule
For some of DB applications, PL/SQL concepts are used to formulate queries. Therefore the correlation is medium (2)

CO3: Apply the E-R model for data base design of real world applications.
Action Verb : Apply(L3)
PO1: Apply(L3)

CO3 Action verb is same level as PO1 verb. Therefore the correlation is high (3)
PO2:Review (L2)
CO3 Action verb is higher level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO3 Action verb is same level as PO3 verb. Therefore the correlation is high (3)
PO4: Analyze(L4)
CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is medium (2)
PO5: Apply(L3)
CO3 Action verb is same level as PO5 verb. Therefore the correlation is high (3)
PO8 : Thumb rule
Since ethical principles should be followed to create a database. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required between DBA and Database designer to create a database. Hence the correlation is medium (2)
PO12: Thumb rule
For some of DB applications, ER model concepts are used to create designs. Therefore the correlation is medium(2)

CO4: Analyzethe query processing and optimization for data manipulation.
Action Verb :Analyze(L4)
PO1: Apply(L3)
CO4 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2: Analyze (L4)
CO4 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is same as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO4 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO8: Thumb rule
Since ethical principles shall be followed in data manipulation. Therefore the correlation is high(3)

CO5:Analyze the concurrent transactions and recover systems to prevent data loss in system crash.
Action Verb :Analyze (L4)
PO2: Analyze (L4)
CO5 Action verb is same level as PO2 verb. Therefore the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than PO3 verb. Therefore the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same level as PO4 verb. Therefore the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is greater than PO5 verb. Therefore the correlation is high (3)
PO8 : Thumb rule
Since ethical principles should be followed for transaction management. Therefore the correlation is medium(2)
PO9 : Thumb rule
Team work is required for transaction management and recovery of failure transactions. Hence the correlation is medium (2)
PO12: Thumb rule
In real time transaction management is continuously updating. Therefore the correlation is medium (2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
COMPUTER SCIENCE AND ENGINEERING (CSE)

Course Code	Year & Sem	Computer System Architecture	L	T	P	C
20APE0416	IV-I		3	0	0	3

Course Outcomes: After studying the course, Student will be able to:

CO1: **Understand** the basic structure of computers and data representations.

CO2: **Understand** the register transfer language concepts and micro operations.

CO3: **Analyze** the central processing unit and various computer Arithmetic operations.

CO4: **Analyze** various memory systems and input and output organizations.

CO5: **Understand** the basics of pipelining, vector and array processing of multiprocessors.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic structure of computers and data representations.			L2
CO2	Understand	the register transfer language concepts and micro operations.			L2
CO3	Analyze	the central processing unit and various computer Arithmetic operations.			L4
CO4	Analyze	various memory systems and input and output organizations.			L4
CO5	Understand	the basics of pipelining, vector and array processing of multiprocessors.			L2

UNIT - I	BASIC STRUCTURE OF COMPUTERS	9 Hrs
Computer types, Functional units, Basic operational concepts, Bus structures, Software, performance, multiprocessors and multi computers. Data types, Complements, Data representation: Fixed point and floating point representations, Error detection codes.		
UNIT - II	**REGISTER TRANSFER LANGUAGE AND MICRO PERATIONS**	**9Hrs**
Register transfer language, register transfer, Bus and memory transfer, Arithmetic Micro Operations, logic micro operations, shift micro operations, arithmetic logic shift unit, Instruction codes, Computer registers computer instructions Instruction cycle, memory reference instructions, input output and interrupt.		
UNIT - III	**CENTRAL PROCESSING UNIT AND COMPUTER ARITHMETIC**	**9 Hrs**
Stack organization, Instruction formats, Addressing modes, data transfer and manipulation, Program control, reduced instruction set computer. COMPUTER ARITHMETIC: Addition and subtraction, multiplication algorithms, Division algorithms MICRO PROGRAMMED CONTROL: Control memory, Address sequencing, and micro program example.		
UNIT - IV	**THE MEMORY SYSTEM & INPUT OUTPUT ORGANIZATION**	**9 Hrs**
Memory hierarchy, Main memory, Auxiliary memory, Associative memory, Cache memory, virtual memory, memory management hardware. **INPUT OUTPUT ORGANIZATION**: Peripheral devices, input output interface, Priority Interrupt, Direct Memory Access, Input output processor (IOP).		
UNIT - V	**PIPELINE AND VECTOR PROCESSING**	**9 Hrs**
Parallel processing, pipelining, Arithmetic pipeline, Instruction Pipeline, RISC pipeline vector processing, Array Processing. Multi Processors: Characteristics of multiprocessors, interconnection structures, Inter processor Arbitration.		

Textbooks:

1. M.Moris Mano, Computer System Architecture, PHI, III Edition, 2006.

2. Car Hamacher, ZvonkoVranesic, SafwatZaky, Car Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, Mc.GrawHill Edition, 2002.

Reference Books:

1. William Stallings, Computer Organization and Architecture, PHI, Seventh Edition, 2006.

2. John P.Hayes, Computer Architecture and Organization, McGraw Hill International editions, 1998.

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	2	3									2	
CO2	2	3			2								2	
CO3	3	3	3		3								3	
CO4	3	3	3	3									3	
CO5	2		2	1	2							1	2	

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1				CO1: Understand	L2	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Interpret(L2)	2 3 2 3
2				CO2 : Understand	L2	PO1 PO2 PO5	PO1: Apply(L3) PO2: Review(L2) PO5:Apply(L3)	2 3 2
3				CO3 : Analyze	L4	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO5: Apply(L3)	3 3 3 3
4				CO4 : Analyze	L4	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO4: Interpret (L2)	3 3 3 3
5				CO5: Understand	L2	PO1 PO3 PO4 PO5 PO12	PO1: Apply (L3) PO3: Develop (L3) PO4: Analyze(L4) PO5:Apply(L3) PO12: Thumb rule	2 2 1 2 1

Justification Statements :

CO1: Understand the basic structure of computers and data representations.
Action Verb: Understand(L2)
PO1 Verb:Apply(L3)
CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is medium (2)
PO2 Verb : Review(L2)
CO1 Action verb is same level as PO2 verb . Therefore the correlation is high(3)
PO3 Verb : Develop (L3)
CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is medium (2)
PO4 Verb : Interpret(L2)
CO1 Action verb is same level as PO4 verb . Therefore the correlation is high(3)

CO2: Understand the register transfer language concepts and micro operations.
Action Verb :Understand(L2)
PO1: Apply(L3)

CO2 Action verb is less than PO1 verb by one level. Therefore the correlation is Medium (2)

PO2: Review (L2)

CO2 Action verb is equal to PO2 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO2 Action verb is less than PO5 verb by one level. Therefore the correlation is medium(2)

CO3: Analyze the central processing unit and various computer Arithmetic operations.

Action Verb :Analyze (L4)

PO1: Apply(L3)

CO3 Action verb is greater than PO1 verb. Therefore the correlation is high (3)

PO2: Review (L2)

CO3 Action verb is greater than PO2 verb. Therefore the correlation is high (3)

PO3: Develop (L3)

CO3 Action verb is greater than PO3 verb. Therefore the correlation is high (3)

PO5: Apply(L3)

CO3 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

CO4: Analyze various memory systems and input and output organizations.

Action Verb :Analyze(L4)

PO1: Apply(L3)

CO4 Action verb is greater than PO1 verb by one level. Therefore the correlation is high (3)

PO2: Review (L2)

CO4 Action verb is greater than PO2 verb by two level. Therefore the correlation is high (3)

PO3: Develop (L3)

CO4 Action verb is greater than PO3 verb by one level. Therefore the correlation is high (3)

PO4: interpret (L2)

CO4 Action verb is greater than PO4 verb by two level. Therefore the correlation is high (3)

CO5: Understand the basics of pipelining, vector and array processing of multiprocessors.

Action Verb : Understand (L2)

PO1: Apply(L3)

CO4 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)

PO3: Develop (L3)

CO5 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate(2)

PO4: Analyze (L4)

CO5 Action verb is less than PO4 verb by two level. Therefore the correlation is low(1)

PO5: Apply(L3)

CO5 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

PO12: Thumb rule

As per the thumb rule CO5 correlation is low(1)

ANNAMACHARYAINSTITUTEOFTECHNOLOGYANDSCIENCES:TIRUPATI

(AUTONOMOUS)

B.Tech IVYearVIISemester

COURSECODE	COURSETITLE	L	T	P	CREDITS
20AOE0301	ROBOTICS	3	0	0	3

CourseOutcomes: After studying the course, Student will be able to:

CO: 1 Thefundamentalconceptsofvariousconfigurationsoftherobotmanipulatorsandtheir working principles used in the industries

CO: 2 The basics of motion analysis of manipulator and process to find forward kinematics and inverse kinematics of the robot manipulator

CO: 3 The path planning of a robot manipulator for given polynomial equation and howto avoid obstacles in its path

CO: 4 Theperformanceofvariousfeedbackcomponents likesensors.

CO: 5 The performance of actuators and how they can be used according to the specifications of the manipulator

UNITI

INTRODUCTIONANDCOMPONENTS OFTHEINDUSTRIALROBOTICS

Introduction: **Automation** and Robotics, CAD/CAM and Robotics – An over view of Robotics – present and future applications. Components of the Industrial Robotics: common types of arms. Components, Architecture, number of degrees of freedom – Requirements and challenges of end effectors, Design of endeffectors, Precision of Movement: Resolution, Accuracy and Repeatability, Speed of Response and Load Carrying Capacity.

UNITII

MOTIONANALYSIS:

Motion Analysis: Basic Rotation Matrices, Equivalent Axis and Angle, Euler Angles, Composite Rotation Matrices. Homogeneous transformations as applicable to rotation and translation – problems. Manipulator Kinematics-H notation-H method of Assignment of frames-HTransformationMatrix,jointcoordinatesand worldcoordinates,Forwardandinverse kinematics – problems on Industrial Robotic Manipulation.

UNITIII

TRAJECTORYPLANNING(09)

Differentialtransformationofmanipulators,Jacobians–problems.Dynamics:Lagrange–Euler and Newton –Eulerformations– Problems.

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint interpolatedmotion–straight line motion.

UNITIV

ROBOTACTUATORSANDFEEDBACKCOMPONENTS(09)

Robot actuators and Feedback components: Actuators: Pneumatic, Hydraulicactuators, electric & stepper motors, comparison of Actuators, Feedback components: position sensors – potentiometers, resolvers, encoders – Velocity sensors, Tactile and Range sensors, Force and Torque sensors.

UNITV

ROBOTAPPLICATIONINMANUFACTURING(09)

MaterialTransfer-Materialhandling,loadingandunloading-Processing-spotand continuous arc welding& spray painting - Assembly and Inspection.

TextBooks:

1. GrooverMP,"IndustrialRobotics",McGrawHill.
2. RamachandranNagarajan,"IntroductiontoIndustrialRobotics",Pearson.

ReferenceBooks:

1. Spony,Vidyasagar,"RobotDynamicsandControls",JohnWiley,
2. Asada,Slotine,"RobotAnalysisandcontrol",WileyInter-Science

Course name: Robotics
Course code:20AOE0301
CO Statements:

CO1. Understand the concepts and functioning of industrial robots
CO2. Analyze the motion analysis of manipulators of in different movements for industries.
CO3. Apply the polynomial equations for path planning in industries
CO4. Understand the actuators and feedback components
CO5. Understand the applications of robots in manufacturing sector.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	concepts and functioning of industrial robots			L2
CO2	Analyze	Motion analysis of manipulators in different movements for industries.			L4
CO3	Apply	Polynomial equations for path planning for industrial robots.			L3
CO4	Understand	Actuators and feedback components.			L2
CO5	Understand	Applications of robots in manufacturing sector.			L2

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)													
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
	CO1	**2**													
	CO2		**1**		**3**										
	CO3		**3**		**3**										
	CO4	**2**													
	CO5	**2**													

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	-			Understand	L2	PO1	Apply –L3	2
2	-			Analyze	L4	PO2 PO4	Identify –L3 Analyze-L4	1 3
3	-			Apply	L3	PO2 PO4	Identify –L3 Apply-L3	3 3
4	-			Understand	L2	PO1	Apply-L3	2
5	-			Understand	L2	PO1	Apply-L3	2

Justification Statements:

CO1:understandconcepts and functioning of industrial robots
ActionVerb:Understand (L2)
PO1Verb:**Apply (L3)**
CO1ActionverbislessthanPO1verbbyonelevel.Thereforethecorrelationismedium(2)
CO2:Analyze the motion analysis of manipulators of in different movements for industries.
Action Verb:

PO2:Identify(L3)

CO2ActionverbislessthanPO2verbbyonelevels.Thereforethecorrelationislow(1)

PO4:Analyze(L4)

CO2ActionverbissamelevelasPO4verb. Thereforethecorrelationishigh(3)

CO3:Apply the polynomial equations for path planning in industries

ActionVerb:Identify(L3) PO2: Identify (L3) PO4:Apply(L3)

CO3Actionverbissame as PO2verb.So Thereforethecorrelationishigh(3)

PO4:Analyze(L4)

CO3ActionverbissamelevelasPO4verb. Thereforethecorrelationishigh(3)

CO4: Understand the actuators and feedback components

PO1:Apply(L3)

CO4ActionverbislessthanPO1verbbyonelevels.Thereforethecorrelationislow(2)

CO5: Understand the applications of robots in manufacturing sector

Action Verb: Understand(L2)

PO1:Apply(L3)

CO5ActionverbislessthanPO1verbbyonelevels.Thereforethecorrelationislow(2)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(AUTONOMOUS)
ELECTRONICS AND COMMUNICATION ENGINEERING (ECE)

Course Code	Year & Sem	EMBEDDED SYSTEMS AND UNMANNED AERIAL VEHICLE	L	T	P	C
20ASA0401	IV-I		1	0	2	2

Course Outcomes: After studying the course, Student will be able to:

Co1 **Understand** the fundamental concepts of embedded systems.

CO2 **Understand** the architectural features of TM4C Embedded Processor

CO3 **Analyze** the different configurations of TM4C by programming

CO4 **Understand** the fundamental concepts of Unmanned Aerial Vehicle

CO5 **Design** Various applications using Unmanned Aerial Vehicle.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	The fundamental concepts of embedded systems.			L2
CO2	**Understand**	The architectural features of TM4C Embedded Processor			L2
CO3	**Analyze**	The different configurations of TM4C	by programming		L4
CO4	**Understand**	The fundamental concepts of Unmanned Aerial Vehicle			L2
CO5	**Design**	Various applications of UAV.			L6

UNIT I

INTRODUCTIONTOEMBEDDEDSYSTEMS

Embeddedsystemintroduction,hostandtargetconcept,embeddedapplications,featuresand architectureconsiderationsforembeddedsystems-ROM,RAM,timers;dataandaddressbusconcept,EmbeddedProcessorandtheirtypes,Memorytypes,overviewofdesignprocessofembeddedsystems, programming languages and tools for embedded design.

UNIT II

EMBEDDEDPROCESSORARCHITECTURE

CISC Vs RISC design philosophy, Von-Neumann Vs Harvard architecture. Introduction to ARM architecture and Cortex – M series, Introduction to the TM4C family viz. TM4C123x & TM4C129xand its targeted applications. TM4C block diagram, address space, on-chip peripherals (analog and digital)Register sets, addressing modes and instruction set basics.

UNIT III

MICROCONTROLLERAPPLICATIONS

Program for configuration of GPIO ports for Input and output operation (blinking LEDs, pushbuttons interface). Program for EK-TM4C123GXL Launch pad and associated Timer ISR to toggleonboardLEDusinginterruptprogrammingtechnique.ConfigurehibernationmoduleoftheTM4C123GH6PM microcontroller for different applications.

UNIT IV

UNMANNEDAERIAL VEHICLE

Study of Unmanned Aerial Vehicle (UAV) System and its subsystems, sensors and their main characteristics. Assembling of Quadcopter Drone with GPS. Assembling of Hexacopter Drone with GPS.

UNIT V

APPLICATIONS OF UAV

UAV Applications of UAV-Take a snap shot using Quadcopter Drone with Camera. Takeoff and land Quadcopter

and Hexacopter drones. Fly RC Electric Glider Aircraft. Attach 5 Liter sprayer tank and fly Quadcopter Drone.

TextBooks:

1. EmbeddedSystems:Real-TimeInterfacingtoARMCortex-MMicrocontrollers,2014,CreatespacepublicationsISBN:978-1463590154.
2. Embedded Systems: Introduction to ARM Cortex - M Microcontrollers, 5th edition Jonathan WValvano,Create spacepublicationsISBN-13: 978-1477508992
3. Embedded Systems 2E Raj Kamal, Tata McGraw-Hill Education, 2011 ISBN-0070667640,9780070667648
4. Basicsof Unmanned AerialVehicles: Timeto startworkingonDroneTechnologyPaperback–byGarvit Pandya, 2021

ReferenceBooks:

1. http://processors.wiki.ti.com/index.php/HandsOn_Training_for_TI_Embedded_Processors
2. http://processors.wiki.ti.com/index.php/MCU_Day_Internet_of_Things_2013_Workshop
3. http://www.ti.com/ww/en/simplelink_embedded_wi-fi/home.html
4. CC3100/CC3200SimpleLink™Wi-Fi®Internet-on-a-ChipUserGuideTexasInstrumentsLiteratureNumber: SWRU368AApril 2014–Revised August 2015
5. UnmannedAerialVehicle:ApplicationsinAgricultureandEnvironment

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2		2										**2**	
CO2	2		2										**2**	
CO3	3	3	3	3	3								**3**	**3**
CO4	2		2		2								**2**	**2**
CO5	3	3	3	3	3								**3**	**3**

Correlation Matrix

CO	Co's Action verb	BTL	Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO12)	Level of Correlation (0-3)
1	Understand	**L2**	PO1,PO3,	PO1 : Apply (L3) PO3 : Develop(L3)	2 2
2	Understand	**L2**	PO1,PO3,	PO1 : Apply (L3) PO3 : Develop (L3)	2 2
3	Analyze	**L4**	PO1,PO2, PO3, PO4, PO5	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4) PO 5: Apply (L3)	3 3 3 3 3
4	Understand	**L2**	PO1,PO3, PO5	PO1 : Apply (L3) PO3 : Develop (L3) PO5 : Apply (L3)	2 2 2
5	Design	**L6**	PO1,PO2, PO3, PO4, PO5	PO1 : Apply (L3) PO2 : Identify (L3) PO3 : Develop (L3) PO4 : Analyze (L4) PO5 : Apply (L3)	3 3 3 3 3

Justification statements:

CO1: Understand the fundamental concepts of embedded systems.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO1 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO3 Verbs: Develop (L3)

CO1 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO2: Understand the architectural features of TM4C Embedded Processor

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO2 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO3 Verbs: Develop (L3)

CO2 Action Verb is less than PO2 verb by one level; Therefore, correlation is moderate (2).

CO3: Analyze the different configurations of TM4C by programming

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO3 Action Verb is greater than PO1 verb; Therefore correlation is high (3).

PO2 Verbs: Identify (L3)

CO3 Action Verb is greater than PO2 verb; Therefore correlation is high (3).

PO3 Verb: Develop (L3)

CO3 Action Verb is greater than PO3 verb; Therefore correlation is high (3).

PO4 Verb: Analyze (L4)

CO3 Action Verb is equal to PO4 verb; Therefore correlation is high (3).

PO5 Verb: Apply (L3)
CO3 Action Verb is greater than PO5 verb; Therefore, correlation is high (3).
CO4: Understand the fundamental concepts of Unmanned Aerial Vehicle
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO3 Verb: Develop (L3)
CO4 Action Verb is less than PO3 verb by one level; Therefore, correlation is moderate (2).
PO5 Verb: Apply (L3)
CO4 Action Verb is less than PO5 verb by one level; Therefore, correlation is moderate (2).
CO5: Design Various applications using Unmanned Aerial Vehicle.
Action Verb: Design (L6)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
PO2 Verbs: Identify (L3)
CO5 Action Verb is greater than PO2 verb; Therefore correlation is high (3).
PO3 Verb: Develop (L3)
CO5 Action Verb is greater than PO3 verb; Therefore correlation is high (3).
PO4 Verb: Analyze (L4)
CO5 Action Verb is greater than PO4 verb; Therefore correlation is high (3).
PO5 Verb: Apply (L3)
CO5 Action Verb is greater thanPO5 verb; Therefore correlation is high (3).

VIII Semester (B.Tech –IV year)

S. No.	Category	Course Code	Course Title	Hours per week			Credits	Scheme of Examination (Max. Marks)		
				L	T	P		CIE	SEE	Total
Theory										
1	MOOCS	20AOE0401	MOOC-NPTEL	0	0	0	3	25	75	100
2	PR	20APR0402	Internship	0	0	0	3	100	-	100
3	PR	20APR0403	Project work	0	0	0	9	60	140	200
TOTAL							**15**	185	215	400
Grand Total							**163**	2595	3925	6520