Title of the Course: Power Electronics	**L**	**T**	**P**	**Credit**
Course Code: UETC0701	**3**	**-**	**-**	**3**

Course Pre-Requisite:
Theory of semiconductor device, Fourier series

Course Description:
The course aims to Provide knowledge of Power Electronics & its applications

Course Objectives:
This course aims to

1. To study different types of semiconductor power devices.
2. To study different types of firing & commutation circuits of SCR.
3. To study various types of single phase controlled rectifiers & evaluate their performance parameter
4. To study various types of inverters.
5. To study various AC & DC motor control techniques.
6. To study fundamentals of PLC, UPS, SMPS

Course Learning Outcomes:

Course Outcomes: Upon successful completion of this course, the student will be able to:		**Descriptor**	**Level**
1	Demonstrate characteristics of various power devices	Demonstrate	Understandi
2	Demonstrate operation of firing circuits for SCR	Demonstrate	Understandi
3	Solve various performance parameters for controlled	Solve	Applying
4	Make use of controlled rectifiers for speed control of DC	Make use of	Applying
5	Demonstrate operation of inverters & various harmonic elimination techniques	Demonstrate	Understandi ng
6	Compile report of workshop on PLC	Compile	Creating

Mapping of Course Outcomes to Program Outcomes:
Strength of Correlation: High: 3 Medium: 2 Low: 1

	Program Outcomes											
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO-1	1			2						1		
CO-2				2						1		
CO-3	1		2	2								
CO-4				2						1		
CO-5	1											
CO-6			1	2								1
SUM	3		3	10						3		1
AVG	1		1.5	2						1		1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Semiconductor Power Devices: - Characteristics of power diodes, power transistors, power MOSFET, IGBT, SCRs, TRIAC, DIAC and GTO. Rating of power devices, SCR protections	7 **Hrs.**
Unit 2:--- Firing Circuits Turn ON Methods- study of single phase firing circuits using UJT, PUT, Diac, Triac. Turn OFF Methods - Class A to F	5 **Hrs.**
Controlled rectifier Circuits **a) Single Phase : -** Half wave, full wave, half controlled and full controlled converters with R & RL Load, effect of Freewheeling Diode. Calculations of performance parameters expected. **b) Three Phase: -** Half wave, full wave, fully controlled converters with R & RL Load.	7 **Hrs.**
Unit 4:--- Inverters Single phase bridge inverters, principle and operation of three phase inverters, Voltage control techniques	5 **Hrs.**
Unit 5:--- Choppers and its Applications Basic principles of chopper, time ratio control and current limit control techniques, voltage commutated chopper circuit, Jones chopper, Morgan's chopper, step-up chopper, step down chopper Speed control of DC series motors using chopper	6 **Hrs.**
Unit 6:--- Applications **a)** emergency lighting system, battery charger, Induction heating and Dielectric heating, Switched mode power supply (SMPS), Uninterrupted power supply (UPS). **b)** Introduction to PLC fundamentals, block diagram of PLC, Ladder diagram with examples, PLC programming	6 **Hrs.**

Textbooks:

1 P.S.Bhimbra :Power Electronics
2. P.C.Sen: Power electronics; MGH publication
3. M.D. Singh &Khanchandani : Power Electronics McGraw Hill publication
4. FederickD.Hackworth:ProgrammableLogicControllers; PearsonEducation

References:

1 Ned Mohan: Powerelectronics; WileyPub. 3rd Edition
2. Dr. Ramachandran: Mechatronics; Wiley Pub. (For SCADA)
3. Frank D.Petruzella : ProgrammableLogicControllers MGH publication

Unit wise Measurable students Learning Outcomes:

Upon successful completion of this course students will be able to:

1] Demonstrate characteristics of various power devices.
2] Demonstrate firing circuits for SCR
3] **E**valuate various performance parameters for controlled rectifiers
4] Demonstrate operation of various types of inverters
5] Explain application of choppers for speed control of DC motor
6] Describe operation of PLC & other miscellaneous applications

Title of the Course: Digital TV & Multimedia	**L**	**T**	**P**	**Credit**
Course Code: UETC0702	**3**	**-**		**3**

Course Pre-Requisite: Analog Communication Systems, Digital Communication, Electromagnetic Engineering, Antenna & Wave Propagation.

Course Description: NGSO satellite systems, and Internet access by satellite. There have been many changes in the thirty three years since Satellite Communications was changed lot. There has been a complete transition from analog to digital communication systems, with analog techniques replaced by digital modulation and digital signal processing. While distribution of television programming remains the largest sector of commercial satellite communications, low earth orbit constellations.

Course Objectives: The course aims to:
1 Study concept of digital & high definition TV system.
2 Study advanced TV systems like LCD, plasma, LED, CCTV, etc.
3 Study the broadcast standards of Multimedia.
4 Study compression techniques for efficient utilization of bandwidth.

Course Learning Outcomes:
Student will able to:
1 Understand concept of digital & high definition TV system.
2 Illustrate advanced TV systems like LCD, plasma, LED, CCTV, etc.
3 Compare the broadcast standards of Multimedia.
4 Analyze compression techniques for efficient utilization of bandwidth.

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy level	Descriptor
CO1	Understand concept of digital & high definition TV system.	**Understand(II)**	**Understand**
CO2	Illustrate advanced TV systems like LCD, plasma, LED, CCTV, etc.	**Understand(II)**	**Illustrate**
CO3	Compare the broadcast standards of Multimedia.	**Evaluate(V)**	**Compare**
CO4	Analyze compression techniques for efficient utilization of bandwidth.	**Analyze(VI)**	**Analyze**

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	1		2	3								
CO2	1		2	3								
CO3	1		2	3								
CO4	1		2	3								

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Digital TV Transmission and Reception Digital system hardware, Signal quantization and encoding, Digital signals and parameters , Digital Satellite Television, Digital T.V. Receiver system, Merits of Digital TV receiver.	07 **Hrs.**
Unit 2: High Definition TV Component coding ,MAC signals ,MAC encoding format ,scanning frequencies D2-MAC Packet Signal , Duo binary Coding ,HDTV Standards & compatibility, colorimetric characteristics & parameters of HDTV systems	07 **Hrs.**
Unit 3: Advanced TV systems LCD TV System :LCD Technology , LCD Matrix types & operations , Plasma TV System : Plasma & conduction of charge ,Plasma TV screen ,Signal processing in Plasma TV, Plasma color Receiver, LED TV, DTH Receiver System ,CCTV, working of block converter,: IR Remote control.	06 **Hrs.**
Unit 4: Introduction to Multimedia What is multimedia, Components of multimedia, Web and Internet multimedia applications, Transition from conventional media to digital media	06 **Hrs.**
Unit 5: Audio & Image Representation Compression and transmission of audio on Internet, Adding sound to your multimedia project, Audio software and hardware. Image Processing [Can Use Photoshop], Use of image editing software, White balance correction, Dynamic range correction, Gamma correction, Photo Retouching.	5 **Hrs.**
Unit 6: Video Representation Video Compression and File Formats. Video compression based on motion compensation, MPEG-1, MPEG-2, MPEG-4, MPEG-7, MPEG-21,	5 **Hrs.**

Textbooks:

1. Monochrome and Color TV – R.R. Gulati, 2nd revised edition,New Age International Publication
2. Digital Video Processing-A. Murat Tekalp, Prentice Hall Signal Processing Series, BS publications
3. Tay Vaughan, "Multimedia making it work", Tata McGraw-Hill, 2008. 2. Rajneesh Aggarwal & B. B Tiwari, " Multimedia Systems", Excel Publication, New Delhi, 2007.

References:

1.Television and Video Engineering - A.M. Dhake, 2nd Edition.
2. Parekh Ranjan, "Principles of Multimedia", Tata McGraw-Hill, 2007
3. Li & Drew, " Fundamentals of Multimedia" , Pearson Education, 2009.

Unit wise Measurable students Learning Outcomes: Student will be able to

1. Describe principle of digital TV system.
2. Explain high definition television system.
3. Describe advanced TV system like LCD, plasma, LED,CCTV, etc.
4. Understand the fundamentals of Multimedia.
5. Understand the audio & image compression techniques.
6. Understand Video compression techniques.

Title of the Course: RF & Microwave Engineering	**L**	**T**	**P**	**Credit**
Course Code: UETC0703	**3**	**-**	**-**	**3**

Course Pre-Requisite: Electromagnetic Field Theory. Transmission lines & Wave guides.

Course Description: Course deals with how microwave signal is transmitted using different microwave junctions. Course discuss different types of Microwave devices and Components. Also it deals with applications of Microwave and measurement of different microwave parameters.

Course Objectives:

The course aims to:

1 Make students aware of the fundamentals of microwave engineering in order to reach the desire industry skills sets.

2. Introduce the students about various microwave Devices, amplifiers and oscillators to know their applications in various domains.

3. Introduce different microwave junctions and use them to measure some parameters.

4. Aware students about different types of Microwave Hazards.

5. Study manufacturing technique of MMIC.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	Illustrate different modes of propagation in waveguides	Understanding	Illustrate
CO2	Classify microwave component for various applications.	Understanding	Classify
CO3	Illustrate different microwave devices.	Understanding	Illustrate
CO4	Select different devices for microwave measurement techniques.	Applying	Select
CO5	Make use of different MMIC fabrication techniques.	Applying	Make use of

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	2		2							2		1
CO2	1	2		2						2		1
CO3		2		2						2		1
CO4		2								2		1
CO5			1							2		1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content

(normally last three modules) covered after MSE.	
Course Contents:	
Unit 1:--- Microwave Wave Guides. Rectangular and circular wave guides: TE, TM and TEM modes in wave guides, power transmission in wave guide, power losses in wave guide, excitation modes in wave guide, Characteristics of standard wave guides.	**06 Hrs**
Unit 2:--- Microwave Components. Scattering parameters, microwave cavities, microwave hybrid circuits, directional coupler, two hole directional coupler, circulators and isolators, microwave attenuators(fixed and Variable Type), slotted lines, parallel, coplanar & shielded micro strip lines.(Operating principle & S-parameter equations of above mentioned microwave components.)	**07 Hrs**
Unit 3:--- Microwave Tubes. Linear beam: Klystrons, Reflex Klystrons, TWTs.Mgnetron (Operating principle, construction & analytical treatment of above mentioned microwave tube	**06 Hrs**
Unit 4:--- Microwave Solid State Devices. Microwave tunnel diodes, microwave FETs, Gunn effect diodes, RWH Theory, LSA diodes, InP diodes, CdTe diodes, PIN diodes, MESFETs and HEMT.(Operating principle, construction & analytical treatment of above mentioned microwave devices.)	**07 Hrs**
Unit 5:--- Microwave Measurements and Microwave Applications. Detection of microwave power: measurement of microwave, power bridge circuit, thermistor parameters, and waveguide thermister mounts, barreters, theory of operation of barreters, directreadingbarretersbridges, Measurement of wavelengths: single line cavity coupling system, Transmission cavity wavemeter& reaction wavemeter, measurement of VSWR, measurements of attenuation, free space attenuation, ISM Applications.	**06 Hrs**
Unit 6:--- Monolithic Microwave Integrated Circuits & Hazards. Materials: substrate, conductor dielectric & resistive MMIC growth, thin film formation, IC fabrication Techniques, Microwave hazards: HERO, HERF & HERP.	**04 Hrs**
Textbooks: 1) Microwave Engineering: Sushrut Das, Oxford Publication 2) Microwave Devices and Circuit – Samul Liao (Prentice hall of India) 3) Microwave Engineering-Annapurna Das ,TMH Publication	
References: 1) Foundation for Microwave Engg. – R.E.Collin, Wiley Publications 2) Microwave Engineering-David M. Pozer., Wiley Publications 3) Techniques of Microwave Measurement-Carol G. Montgomery 4) Microwave Active Devices vacuum and solid state – M.L. Sisodia 5) Basic laboratory microwave techniques- Manual, Sisodia and Raghuvanshi Wiley 6) Microwave Engineering:Dr.K.T.MathewsWiley Publications	
Unit wise Measurable students Learning Outcomes: After the completion of the course the student should be able to 1) Distinguish various TE and TM modes in Waveguides. 2) Distinguish various Microwave components. 3) Describe various types of Microwave Tubes. 4)Ilustrate various types of Microwave Solid state devices. 5) Demonstrate different types of Microwave measurement techniques. 6) Describe MMIC fabrication techniques & various microwave hazards.	

Title of the Course: Power Electronics Lab **Course Code:** UETC0731	**L**	**T**	**P**	**Credit**
	-	**-**	**2**	**1**

Course Pre-Requisite:
Theory of semiconductor device, Fourier series

Course Description:
The course aims to Provide knowledge of Power Electronics & its applications

Course Objectives:
This course aims to

1. To study different types of semiconductor power devices.
2. To study different types of protection circuits of SCR.
3. To study different types of firing & commutation circuits of SCR.
4. To study various types of single phase controlled rectifiers & evaluate their performance parameter
5. To study various types of inverters.
6. To study various AC & DC motor control techniques.
7. To study fundamentals of PLC, UPS, SMPS, SCADA.

Course Learning Outcomes:

Course Outcomes: Upon successful completion of this course, the student will be able to:		**Descriptor**	**Level**
1	Demonstrate characteristics of various power devices	Demonstrate	Understanding
2	Demonstrate operation of firing circuits for SCR	Demonstrate	Understanding
3	Demonstrate operation of controlled rectifiers	Demonstrate	Understanding
4	Make use of controlled rectifiers for speed control of DC motor.	Make use of	Applying
5	Compile report of workshop on PLC	Compile	Creating

CO-PO Mapping:

Strength of Correlation: High: 3 Medium: 2 Low: 1

	Program Outcomes											
Course Outcomes	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
CO-1	1			2						1		
CO-2				2						1		
CO-3	1		2	2								
CO-4				2						1		
CO-5			1	2								1
SUM	3		3	10						3		1
AVG	1		1.5	2						1		1

Assessments :
Teacher Assessment:
One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	25
ESE-O.E.	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.
ESE: Assessment is based on oral examination

Course Contents:

Experiment No. 1:--- **Aim and Objectives:** Study of V-I Characteristics of SCR **Outcomes:** Students will be able to explain V-I Characteristics of SCR **Theoretical Background:** Principle of operation of SCR **Experimentation:** Study V-I Characteristics of SCR **Results and Discussions:** Plot graph of V_{AK} v/s I_A **Conclusion:** SCR starts conducting when sufficient gate current flows through its gate terminal	2 **Hrs.**
Experiment No. 2:--- **Aim and Objectives:** Study of V-I Characteristics of MOSFET. **Outcomes:** Students will be able to explain operation of MOSFET **Theoretical Background:** Principle of operation of MOSFET **Experimentation:** Measure the V_{DS} & I_D **Results and Discussions:** Plot graph of V_{DS} & I_D **Conclusion:** MOSFET conducts when sufficient gate current is available	2 **Hrs.**
Experiment No. 3:--- **Aim and Objectives:** Study of Firing circuits using R & RC triggering **Outcomes:** students will be able to explain operation of R & RC triggering circuit to turn on SCR **Theoretical Background:** Principle of operation of R & RC triggering **Experimentation:** Vary the gate current & measure the firing angle. **Results and Discussions:** Plot a graph of o/p voltage waveforms. **Conclusion:** It is observed that as gate current varies firing of SCR is delayed	2 **Hrs.**
Experiment No. 4:--- **Aim and Objectives:** Study of Firing circuits using UJT as relaxation oscillator **Outcomes:** Students will be able to explain operation of operation of UJT as relaxation oscillator circuit to turn on SCR **Theoretical Background:** Operating principle of UJT as relaxation oscillator **Experimentation:** Vary the gate current & measure the firing angle. **Results and Discussions:** Plot o/p voltage waveforms **Conclusion:** SCR can be turned on by applying gate current to its gate terminal which depends charging & discharging of capacitor which turns on UJT	2 **Hrs.**
Experiment No. 5:--- **Aim and Objectives:** Study of single phase half wave controlled rectifier **Outcomes:** Students will be able to explain operation of operation of single phase half wave controlled rectifier & evaluate various performance parameters **Theoretical Background:** Operating principle of single phase half wave controlled rectifier **Experimentation:** Vary the gate current & measure the firing angle.	2 **Hrs.**

Results and Discussions: Calculate performance parameters. Plot o/p voltage waveforms **Conclusion:** SCR can be implemented as a half wave rectifier. Power delivered to the load can be controlled by changing firing angle of SCR. Because of Free wheeling diode the average o/p voltage is improved.	
Experiment No. 6:--- **Aim and Objectives:** Study of single phase full wave controlled rectifier **Outcomes:** Students will be able to explain operation of operation of single phase full wave controlled rectifier & evaluate various performance parameters **Theoretical Background:** Operating principle of single phase full wave controlled rectifier **Experimentation:** Vary the gate current & measure the firing angle. **Results and Discussions:** Calculate performance parameters. Plot o/p voltage waveforms **Conclusion:** SCR can be implemented as a full wave rectifier. Power delivered to the load can be controlled by changing firing angle of SCR. Because of Free wheeling diode the average o/p voltage is improved.	2 **Hrs.**
Experiment No. 7:- **Aim and Objectives:** Study of single phase semi converter **Outcomes:** Students will be able to explain operation of operation of single phase semi converter & evaluate various performance parameters **Theoretical Background:** Operating principle of single phase semi converter **Experimentation:** Vary the gate current & measure the firing angle. **Results and Discussions:** Calculate performance parameters. Plot o/p voltage waveforms **Conclusion:** SCR can be implemented as a semi converter. Power delivered to the load can be controlled by changing firing angle of SCR. Because of Free wheeling diode the average o/p voltage is improved.	
Experiment No. 8:- **Aim and Objectives:** Study of Three phase full wave controlled rectifier **Outcomes:** Students will be able to explain operation of operation of Three phase full wave controlled rectifier & evaluate various performance parameters **Theoretical Background:** Operating principle of Three phase full wave controlled rectifier **Experimentation:** Vary the gate current & measure the firing angle. **Results and Discussions:** Calculate performance parameters. Plot o/p voltage waveforms **Conclusion:** SCR can be implemented as a full wave rectifier. Power delivered to the load can be controlled by changing firing angle of SCR. Because of Free wheeling diode the average o/p voltage is improved.	2 Hrs
Experiment No.9:- **Aim and Objectives:** Study of Three phase semi converter **Outcomes:** Students will be able to explain operation of operation of Three phase semi converter & evaluate various performance parameters **Theoretical Background:** Operating principle of Three phase semi converter **Experimentation:** Vary the gate current & measure the firing angle. **Results and Discussions:** Calculate performance parameters. Plot o/p voltage waveforms	2 Hrs

Conclusion: SCR can be implemented as a semi converter. Power delivered to the load can be controlled by changing firing angle of SCR. Because of Free wheeling diode the average o/p voltage is improved.	
Experiment No. 10:- **Aim and Objectives:** Study of PLC **Outcomes:** Students will be able to Describe operation of PLC & its programming **Theoretical Background:** Fundamentals of PLC **Experimentation:** 1 to 3 days Workshop on PLC **Results and Discussions:** Discuss PLC programming. **Conclusion:** The programmable logic controller is used not only for industrial purpose but also in civil applications such as washing machine, elevators working and traffic signals control.	2 Hrs

Textbooks:

1 P.S.Bhimbra :Power Electronics
2. P.C.Sen: Power electronics; MGH publication
3. M.D. Singh & Khanchandani : Power Electronics McGraw Hill publication
4. FederickD.Hackworth:ProgrammableLogicControllers; PearsonEducation

References:

1 Ned Mohan: Powerelectronics; WileyPub. 3rd Edition
2. Dr. Ramachandran: Mechatronics; Wiley Pub. (For SCADA)
3. Frank D.Petruzella : ProgrammableLogicControllers MGH publication

Experiment wise Measurable students Learning Outcomes:

1) Students will be able to explain V-I Characteristics of SCR
2) Students will be able to explain operation of MOSFET
3) Students will be able to explain operation of R & RC triggering circuit to turn on SCR
4) Students will be able to explain operation of operation of UJT as relaxation oscillator circuit to turn on SCR

5) Students will be able to explain operation of operation of Single phase Half wave controlled rectifier & evaluate various performance parameters
6) Students will be able to explain operation of operation of Single phase Full wave controlled rectifier & evaluate various performance parameters
7) Students will be able to explain operation of operation of Single phase semi converter & evaluate various performance parameters
8) Students will be able to explain operation of operation of Three phase semi converter & evaluate various performance parameters
9) Students will be able to explain operation of operation of Three phase semi converter & evaluate various performance parameters
10) Students will be able to Describe operation of PLC & its programming

Title of the Course: Digital TV & Multimedia Lab	**L**	**T**	**P**	**Credit**
Course Code: UETC0732	**-**	**--**	**2**	**1**

Course Pre-Requisite: Basic knowledge of Analog & Digital Communication etc.

Course Description: Digital TV lab course introduces the practical on colour composite video signal, DTH, fault finding of LCD/LED, demonstration of satellite receiver, installation of CCTV etc.

Course Objectives:

1. After learning Digital TV lab course, students will get benefit to learn and understand the of real-life fault finding of LCD/LED,
2. Students will get benefit to learn and understand Demonstration of satellite receiver.
3. students will get benefit to learn and understand how to install of CCTV etc

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive level	Descriptor
CO1	**Apply** the fundamental knowledge to understand how to troubleshoot LCD/LED.	**III**	**Applying**
CO2	**Demonstrate** how to connect satellite receiver with Television to receive various programs.	**II**	**Understanding**
CO3	**Demonstrate** how to install CCTV.	**II**	**Understanding**

CO-PO Mapping:

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

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE	50
ESE (POE)	50

ISE are based on practical performed/ Quiz/ Lab assignments/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on practical and oral examination.

Experiment No. 1:--- **Aim and Objectives:** Study of Pattern Generator / CCVS. **Outcomes:** Students should be able to explain and perform Pattern Generator / CCVS. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to perform experiment based Pattern Generator / CCVS. **Results and Discussions:**	02 Hrs.

Conclusion:	
Experiment No. 2:--- **Aim and Objectives:** Study of Pattern Generator / CCVS. **Outcomes:** Students should be able to explain and perform Pattern Generator / CCVS. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to perform experiment based on Pattern Generator / CCVS. **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No. 3:--- **Aim and Objectives:** Demonstration of DTH. **Outcomes:** Students should be able to explain and Demonstrate of DTH. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to perform experiment based on DTH. **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No.4:--- **Aim and Objectives:** Demonstration of CCTV. **Outcomes:** Students should be able to explain and Demonstrate of CCTV. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to perform experiment based on CCTV. **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No.5:--- **Aim and Objectives:** Demonstration of IPTV. **Outcomes:** Students should be able to explain and Demonstrate of IPTV. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to perform experiment based on IPTV. **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No.6:--- **Aim and Objectives:** Installation of LCD/LED TV. **Outcomes:** Students should be able to explain and install of LCD/LED TV. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to install of LCD/LED TV. **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No.7:--- **Aim and Objectives:** Fault finding of LCD/LED TV: how to trace live circuit for fault No colour in component video **Outcomes:** Students should be able to find fault of LCD/LED TV: how to trace live	02 Hrs.

circuit for fault No colour in component video**.** **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to find fault of LCD/LED TV: how to trace live circuit for fault No sound in right channel**.** **Results and Discussions:** **Conclusion:**	
Experiment No.8:--- **Aim and Objectives:** Fault finding of LCD/LED TV: how to trace live circuit for fault No picture in component video **Outcomes:** Students should be able to find fault of LCD/LED TV: how to trace live circuit for fault No picture in component video**.** **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to find fault of LCD/LED TV: how to trace live circuit for fault No sound in right channel**.** **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No.9:--- **Aim and Objectives:** Fault finding of LCD/LED TV: how to trace live circuit for fault No sound in left channel. **Outcomes:** Students should be able to find fault of LCD/LED TV: how to trace live circuit for fault No sound in left channel**.**. **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to find fault of LCD/LED TV: how to trace live circuit for fault No sound in right channel. **Results and Discussions:** **Conclusion:**	02 Hrs.
Experiment No.10:--- **Aim and Objectives:** Fault finding of LCD/LED TV: how to trace live circuit for fault No sound in right channel. **Outcomes:** Students should be able to find fault of LCD/LED TV: how to trace live circuit for fault No sound in right channel**.** **Theoretical Background:** Knowledge of Analog & Digital Communication etc. **Experimentation:** Students are able to find fault of LCD/LED TV: how to trace live circuit for fault No sound in right channel**.** **Results and Discussions:** **Conclusion:**	02 Hrs.
Textbooks: 1. Television and video Engineering, A. M. Dhake, TMH Publication. 2. R. R. Gulati, ―Monochrome and colour television. 3. Fundamentals of Electronics-LCD/LED TV Practical version 1.0 by Funfirst Funtronic Pvt.Ltd. 4. "Audio Video Engineering" by Dr. R. C. Jaiswal, Nirali Prakashan; First edition (2019)	
References: 1. Television Engineering -Audio and Video Systems, D. S. Bormane, P.B. Mane, Wiley publication. 2. S. P. Bali, ―Color TV Theory and Practice. 3. Bernard Grobb, Charles E, ―Basic TV and Video Systems.	

4. Video Demystified, Kelth jack, Penram International Publication.
5. Audio Video Systems, R.G. Gupta, TMH Publication.

Experiment wise Measurable students Learning Outcomes: Students should able to

1. Students are able to explain and perform Pattern Generator / CCVS.
2. Students are able to explain and perform DTH.
3. Students are able to explain and perform CCTV.
4. Students are able to explain and perform IPTV.
5. Students are able to find faults of LCD/LED TV.

Title of the Course: RF & Microwave Engineering Lab	**L**	**T**	**P**	**Credit**
Course Code: UETC0733	**-**	**-**	**2**	**1**

Course Pre-Requisite: Basic knowledge of Maxwell's equations.

Course Description: Course deals with different types of Microwave tubes. Different types of waveguides and modes. Also we discuss different microwave measurements techniques.

Course Objectives:

The course aims to:

1. Introduce the students about various microwave Devices, amplifiers and oscillators to know their applications in various domains.
2. Introduce different microwave junctions and use them to measure some parameters.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy	
		level	Descriptor
CO1	Illustrate different microwave devices.	Understanding	Illustrate
CO2	Select different devices for microwave measurement techniques.	Applying	Select
CO3	Classify microwave component for various applications.	Understanding	Classify

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1		2		2						2		1
CO2		2								2		1
CO3	1	2		2						2		1

Assessments :

Teacher Assessment:

One component of In Semester Evaluation (ISE) and one End Semester Examination (ESE) having 50%, and 50% weights respectively.

Assessment	Marks
ISE(TW)	25
ESE(OE)	50

ISE are based on practical performed/ Quiz/ Mini-Project assigned/ Presentation/ Group Discussion/ Internal oral etc.

ESE: Assessment is based on oral examination

Lab Contents:

Experiment No. 1:--- **Aim: Experiment on studying different microwave components.** **Objectives: Understand analysis and working of each component.** **Outcomes: S- matrix analysis.** **Theoretical Background: Properties of S-matrix.** **Experimentation:** **Results and Discussions:** **Conclusion:** **We discuss different types of components with properties of S-matrix.**	**02 Hrs.**
Experiment No. 2:---	**02 Hrs.**

Aim: Experiment on characteristics of Klystron Tube. **Objectives: Understand working of Klystron tube.** **Outcomes: Plotting characteristics.** **Theoretical Background: Working of Bunching Process.** **Experimentation:** **Results and Discussions:** **We study Applegate diagram.** **Conclusion:** **We understand bunching process.**	
Experiment No. 3:--- **Aim: Experiment on studying E-plane Tee.** **Objectives: Demonstrate working of E-plane Tee.** **Outcomes: Show how it works as Subtractive Tee.** **Theoretical Background: Properties of S-matrix.** **Experimentation:** **Results and Discussions: To see how S-matrix of E-Plane Tee works.** **Conclusion:** **We observed output as in opposite phase.**	**02 Hrs.**
Experiment No. 4:--- **Aim: Experiment on studying H-plane Tee.** **Objectives: Demonstrate working of H-plane Tee.** **Outcomes: Show how it works as Additive Tee.** **Theoretical Background: Properties of S-matrix.** **Experimentation:** **Results and Discussions: To see how S-matrix of H-Plane Tee works.** **Conclusion:** **We observed output as in phase.**	**02Hrs.**
Experiment No. 5:--- **Aim : Experiment on studying Magic Tee.** **Objectives: Demonstrate working of Magic Tee.** **Outcomes: Show how it works as Additive and Subtractive Tee.** **Theoretical Background: Properties of S-matrix.** **Experimentation:** **Results and Discussions: To see how S-matrix of Magic Tee works.** **Conclusion:** **We observed output as in phase and out of opposite phase.**	**02 Hrs.**
Experiment No. 6:--- **Aim: Experiment on char. of Gunn diode.** **Objectives: Demonstrate working of Gunn diode.** **Outcomes: Observed output of Gunn Diode.** **Experimentation:** **Results and Discussions:** **Conclusion:** **In this, by observing output characteristics, we study Gunn Diode.**	**02Hrs.**
Experiment No. 7:---	

Aim: Experiment on HFSS. **Objectives: Demonstrate FSS software.** **Outcomes: Design rectangular waveguide.** **Theoretical Background: Working of Waveguides.** **Experimentation:** **Results and Discussions:** **Conclusion:** **We design rectangular waveguide.**	**02 Hrs**

Textbooks:

1) Microwave Engineering: Sushrut Das, Oxford Publication
2) Microwave Devices and Circuit – Samul Liao (Prentice hall of India)
3) Microwave Engineering-Annapurna Das ,TMH Publication

References:

1) Foundation for Microwave Engg. – R.E.Collin, Wiley Publications
2) Microwave Engineering-David M. Pozer., Wiley Publications
3) Techniques of Microwave Measurement-Carol G. Montgomery
4) Microwave Active Devices vaccum and solid state – M.L. Sisodia
5) Basic laboratory microwave techniques- Manual, Sisodia and Raghuvanshi Wiley
6) Microwave Engineering:Dr.K.T.MathewsWiley Publications

Experiment wise Measurable students Learning Outcomes:

After the completion of Lab, the student should be able to:

1) Study of different microwave components.
2) Working of Klystron Tube.
3) Study how E- Plane Tee works as Subtractive Tee.
4) Study how H- Plane Tee works as Additive Tee.
5) Study how Magic Tee works as Subtractive and Additive Tee.
6) Working of Gunn Diode.
7) Designing of Rectangular Waveguide using H.F.S.S.

Program Elective- III

Program Elective III	
Course Code	**Course Name**
UETC0721	Digital Image Processing
UETC0722	Computer Network
UETC0723	CMOS VLSI

Title of the Course: DIGITAL IMAGE PROCESSING	**L**	**T**	**P**	**Credit**
Course Code: UETC0721	**3**	**1**	**0**	**4**

Course Pre-Requisite:
Matlab programming.

Course Description:
The course introduces fundamentals of a digital image, its acquisition, enhancement, recognition and compression.

Course Objectives:

1) To describe basic concepts of digital image processing.
2) To describe and implement various methods for image enhancement and recognition.
3) To explain concept of image segmentation and compression.
4) To acquaint with MATLAB image processing toolbox to implement image processing techniques.

Course Learning Outcomes:

CO	**After the completion of the course the student should be able to**	Bloom's Cognitive	
		Level	Descriptor
CO1	**Explain** the fundamental concepts in digital image processing.	Understanding	Explain
CO2	**Apply** gray level transformations, spatial filters and histogram processing for image enhancement.	Application	Apply
CO3	**Select** morphological operators for extracting image features.	Application	Select
CO4	**Examine** image segmentation and compression used in digital image processing.	Analyze	Examine

CO-PO Mapping:

CO	**PO**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2											
2	3	2		2	2					1		
3	2	2	2		2	1				1		
4	2	3	2	2	2	1				1		1

Assessments :

Teacher Assessment:
Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with 60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--- Digital Image Fundamentals :	06 Hrs.

Elements of visual perception, fundamentals steps in DIP, Basic concept of sampling and quantization, Representation of binary, Gray level, colour image, Metric & topological properties of digital image , colour model.	
Unit 2:--- Image enhancement in spatial domain : Gray level transformation function: image negation, Log transformation, power law transformation, Piecewise linear transformation functions, Histogram equalization, Enhancement using arithmetic / Logic operation.	06 Hrs.
Unit 3:--- Image filtering : Basics of spatial filtering, smoothening, sharpening, Gradient and laplacian filter, Filtering in frequency domain: basic properties, filtering in frequency domain.	06 Hrs.
Unit 4:--- Morphological image processing : Dilation & erosion, opening and closing operation, Hit- or –miss transformation, Morphological algorithms: Boundary extraction, region filling, thinning and thickening.	06 Hrs.
Unit 5:--- Image segmentation : Detection of discontinuities: Point detection, line detection, edge detection, Sobel, Prewitt, Laplacian mask for edge detection, Thresholding, Region based segmentation: region growing, region splitting and merging.	06 Hrs.
Unit 6:--- Image compression : Fundamentals, coding redundancy, interpixel redundancy, fidelity criteria, lossless predictive coding, Lossy predictive coding, DCT compression.	06 Hrs.
Textbooks: 1) Digital Image Processing - Rafael C Gonzalez, Richard E.Woods: Pearson Publication 2) Fundamentals of Digital Image Processing - Anil K.Jain 3) Digital Image Processing and Analysis- B. Chanda , D. Dutta Majumder	
References: 1) Digital Image Processing - S. Jayraman, S Esakkiarajan, Veerakumar: MGH 2) Digital Image Processing using Matlab - Rafael C Gonzalez. 3) Fundamentals of Digital Image Processing - S.Annadurai, R. Shanmugalaxmi: Pearson Publication 4) Digital Image Processing – Pratt 5) Image Processing Analysis and Machine vision - Milan Sonka, Vaclav Hlavac: Thomson	
Unit wise Measurable students Learning Outcomes: Student will be able to 1. Describe fundamental concepts in digital image processing. 2. Explain various image enhancement techniques of a grey level image. 3. Describe different filters used in image processing. 4. Explain the morphological operators in image processing. 5. Explain various discontinuities and methods for image segmentation. 6. Describe the basics of image compression.	

Title of the Course: Computer Communication Network **Course Code:** UETC0722	**L** **3**	**T** **1**	**P** **-**	**Credit** **4**

Course Pre-Requisite: Basics of Analog & Digital Communication System.

Course Description: Course deals with different types of topologies, Models, Functions of lower four layers, protocols and algorithms at lower 3 layers. It also discusses TCP/IP Protocol suite along with IPV4 and IPV6 addresses.

Course Objectives:

1. Introduce various topologies, types, devices and layered models in computer networking.
2. Expose the students to the design issues, standards and protocols at various layers.
3. Discuss the TCP/IP protocol suite.

Course Learning Outcomes:

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

1. Differentiate types of networks and topologies.
2. Distinguish OSI and TCP/IP Reference models.
3. Summarize various networking devices.
4. Inquire the design issues of the layers.
5. Explain TCP/IP protocols like IP, ARP, RARP, TCP, UDP etc.
6. Describe the protocols at the Application Layer.

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy	
		level	Descriptor
CO1	Distinguish between various network topologies, types, OSI and TCP/IP models.	Cognitive Level 4 -Analyzing	Distinguish
CO2	Summarize guided and unguided transmission media and different networking devices used at physical layer.	Cognitive Level 2- Understanding	Summarize
CO3	Demonstrate error detection, error correctio mechanisms, frame formats, elementary protocols an standards at data link layers.	Cognitive Level 2- Understanding	Demonstrate
CO4	Explain various routing and congestion contro algorithms.	Cognitive level 2- Understanding	Explain
CO5	Illustrate TCP/IP protocols like IP, ARP, RARP, TCP, UDP etc.	Cognitive level 2- Understanding	Illustrate
CO6	List the network security mechanisms.	Cognitive level - 1 Remembering	List

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
2	1								2		1	2
2	1	1							1		1	2
2	1	1	1						2		1	2
1		1	1						1		1	1
1	1	1							1		1	1
1	1	1	1						1		1	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:--Introduction: Introduction, topologies, types, OSI Model, TCP/IP Suite, Addressing, Network Software Issues, Introduction to Cloud Computing	**05Hrs.**
Unit 2:--- Networking components: Guided Transmission Media – Twisted pair, Coaxial, OFC Unguided Transmission Media – Propagation Modes, Radio Waves, Microwave Infrared, Components – Cabling, Connectors, NIC, Repeaters, Hub, Switches, Bridges, Routers, Gateways. Network Switching: circuit switching, packet switching.	**07 Hrs.**
Unit 3:--- Data Link Control: Design issues**,** Noiseless channels and noisy Channels, HDLC Protocol, Error detection (CRC),Multiple access**:** Random access: CSMA, CSMA/CD, CSMA/CA, Controlled access Channelization, Wired LANs- Ethernet, IEEE standard, changes in the standards, Wireless LANs: IEEE 802.11	**07 Hrs.**
Unit 4:--- Network Layer: Design issues, Routing Algorithms- shortest path, distance vector routing, link	**06Hrs.**

state routing, flow based routing, routing for mobile hosts, congestion control-congestion prevention policies- leaky bucket and token bucket algorithm, congestion control in virtual circuit subnet and choke packets.	
Unit 5:--- TCP/IP Protocol Suite: TCP/IP and internet, IP protocol and it's header format, addressing, subnetting, other networks layer protocol – ARP, RARP, ICMP, IGMP, Transport Layer Protocols: TCP,UDP	**07Hrs.**
Unit 6:--- Application Layer: DNS, Electronic Mail, WWW, HTTP, SMTP, TELNET, FTP	**06 Hrs.**

Textbooks:

1) Computer Networks Andrew S. Tanenbaum, Fourth Edition, PEARSON
2) Data Communication and Networking, Fifth Edition, Behrouz A. Forouzan, TMH
3) TCP/IP Protocol Suite, Fourth Edition, Behrouz A. Forouzan, MGH
4) T. Viswanathan, "Telecommunication Switching System and Networks", Prentice Hall

References:

1) Computer Networking with Internet Protocols and Technology, William Stallings, 2008
2) Computer Networking A top down approach, James F. Kurose, Person, Fifth Edition
3) S. Keshav, "An Engineering Approach to Computer Networking" , Pearson Education
4) D. Comer, "Computer Networks and Internet/TCP-IP", Prentice Hall

Unit wise Measurable students Learning Outcomes:

After the completion of the course the student should be able to

1) Differentiate types of networks and topologies.
2) Discuss various networking components.
3) Describe design issues of data link layer.
4) Explain network layers protocols.
5) Explain TCP/IP protocols like IP, ARP, RARP, TCP, UDP etc.
6) Describe the protocols at the Application Layer.

Title of the Course: CMOS VLSI Design	L	T	P	Credit
Course Code: UETC0723	3	1	-	4

Course Pre-Requisite: Digital Electronics.

Course Description:

This course covers design and analysis of CMOS VLSI design including: Modern VLSI design techniques and challenges in nanoscale CMOS technology; Basic circuit designs using CMOS transistors; Proper layout structures; Methods for optimizing the area, speed, and power of circuits; Use of CAD tools for both schematic and layout of complex CMOS circuits; Design of arithmetic logic and memory cells; Large system integration.

Course Objectives:

1. To understand the concepts of MOS transistors operations and their AC, DC characteristics.
2. To know the fabrication process of CMOS technology and its layout design rules.
3. To study the concepts of CMOS invertors and their sizing methods.
4. To understand the concepts of power estimation and delay calculations in CMOS circuits.
5. To understand Elements of Data path and Memory Design.
6. To understand Timing consideration and Testability.

Course Learning Outcomes:

Upon successful completion of this course, the student will be able to:

CO	After the completion of the course the student should be able to	Bloom's Cognitive	
		level	Descriptor
CO1	Understand MOS transistor theory, Characteristics & MOS models.	II	Understand
CO2	Understand CMOS technologies, Design rules & CMOS process enhancements.	II	Understand
CO3	Understand basic circuits concepts and MOS scaling	II	Understand
CO4	Build CMOS circuit layouts using Layout Design Rule.	III	Build
CO5	Understand elements of Data path and Memory Design.	II	Understand
CO6	Understand Timing consideration and Testability	II	Understand

CO-PO Mapping:

CO	PO											
	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
CO1	2			2								
CO2	1		3	3	3							
CO3	1		2	2	3							
CO4	1		2	2	2							
CO5	1					2						
CO6	1		1	1	1	2						

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one End Semester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content

(normally last three modules) covered after MSE.	
Course Contents:	
Unit 1:---MOS Transistor Theory NMOS and PMOS transistors, CMOS logic, MOS transistor theory –Introduction, Enhancement mode transistor action, Ideal I-V Characteristics, DC transfer characteristics, Threshold voltage-Body effect-Design equations-Second order effects. MOS models and small signal AC characteristics, Simple MOS capacitance Models, Detailed MOS gate capacitance model and MOS Diffusion capacitance model.	**6 Hrs.**
Unit 2:--- CMOS TECHNOLOGY AND DESIGN RULE CMOS fabrication and Layout, CMOS technologies, P -Well process, N -Well process, twin -tub process. MOS layers stick diagrams and Layout diagram, Layout design rules, Latch up in CMOS circuits, CMOS process enhancements, Technology –related CAD issues, Fabrication and packaging.	**8 Hrs.**
Unit 3:---CMOS LOGIC STRUCTURES: CMOS Complementary Logic, Bi CMOS Logic, Pseudo -nMOS Logic, Dynamic CMOS Logic, Clocked CMOS Logic, Pass Transistor Logic, CMOS Domino Logic Cascaded Voltage Switch Logic (CVSL).	6 **Hrs.**
Unit 4:---BASIC CIRCUIT CONCEPTS AND MOS SCALING: BASIC CIRCUIT CONCEPTS: Sheet resistance, Area capacitances, Capacitance calculations, The delay unit, Inverter delays, Driving capacitive loads, Propagation delays, Wiring capacitances. SCALING OF MOS CIRCUITS: Scaling models and factors, Limits on scaling, Limits due to current density and noise.	6 **Hrs.**
Unit 5:---CMOS SUBSYSTEM DESIGN AND PROCESSES : CMOS SUBSYSTEM DESIGN: Architectural issues, Switch logic, Gate logic, Design examples – combinational logic, Clocked circuits, Other system considerations. Clocking Strategies. CMOS SUBSYSTEM DESIGN PROCESSES: General considerations, Process illustration, ALU subsystem, Adders, Multipliers.	9 **Hrs.**
Unit 6:--- MEMORY, REGISTERS, CLOCK AND TESTABILITY: MEMORY, REGISTERS & CLOCK: Timing considerations, Memory elements, Memory cell arrays. TESTABILITY: Performance parameters, Layout issues, I/O pads, Real estate, System delays, Ground rules for design, Test and testability.	7 **Hrs.**

Textbooks:

1. **CMOS VLSI Design – A Circuits and Systems Perspective**, 3rd Edition, N.H. Weste and David Harris, Addison-Wesley, 2005, (Refer to http://www.cmosvlsi.com).
2. **Principles of CMOS VLSI Design: A Systems Perspective**, Neil H. E. Weste, K. Eshragian, 3rd edition, Pearson Education (Asia) Pvt. Ltd.
3. **Basic VLSI Design** - Douglas A. Pucknell& Kamran Eshraghian, PHI 3rd Edition (original Edition – 1994), 2005.

References:

1. R. Jacob Baker, **CMOS Circuit Design, Layout and Simulation**, John Wiley India Pvt. Ltd. 2008.
2. **Fundamentals of Semiconductor Devices**, M. K. Achuthan and K.N. Bhat, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007.
3. **CMOS Digital Integrated Circuits: Analysis and Design**, Sung-Mo Kang & Yusuf Leblebici, 3rd Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2007.
4. **Analysis and Design of Digital Integrated Circuits** – D.A Hodges, H.G Jackson and R.A

Saleh, 3rd Edition, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2007

Unit wise Measurable students Learning Outcomes:

UNIT-I:
UO1: Students will understand basic of MOS transistor circuits..

UNIT-II:
UO1: Students will be able to Estimate area and power dissipation for Digital CMOS circuits

UNIT-III:
U01: Students will be able to construct different CMOS logic structures.

UNIT –IV:
U01: Students will be able to do power estimation and delay calculations in CMOS circuits.

UNIT –V:
U01: Students will be able to explain elements of Data path and Memory Design.

UNIT –VI:
U01 :Students will be able to explain Timing consideration and Testability

Open Elective II		Offered by Department
Course Code	**Course Name**	
UOEL0716	Navigation Systems	Electronics & Telecommunication Engineering
UOEL0717	Wireless communication and network	Electronics & Telecommunication Engineering

Title of the Course: Navigation Systems	**L**	**T**	**P**	**Credit**
Course Code: UOEL0716	**3**	**1**	**-**	**4**

Course Pre-Requisite: Nil.

Course Description:

Introduction to Navigation Types and Inertial Sensors used in navigation. Understand different components of inertial navigation systems. Understand different Tracking & Safety Systems, Inertial Sensor Technologies. Understand Principles of Radio and Satellite Navigation and will be able to deploy above skills effectively in the analysis and understanding of navigation systems in a spacecraft.

Course Objectives:

1. To Introduce The Basic Functional Elements Of Navigation Systems
2. To Introduce The Fundamentals Of Inertial Navigation Systems
3. To Educate On The Tracking And Safety Systems Techniques
4. To Introduce Inertial Sensor Technologies.
5. To Introduce Radio and Satellite Navigation.

Course Learning Outcomes:

Upon successful completion of this course, the student will be able to:

CO		Bloom's Taxonomy	
		level	Descriptor
CO1	Understand the Basic Functional Elements Of Navigation Systems	II	Understand
CO2	Understand Principle of operation of Inertial Sensors and Gyro systems.	II	Understand
CO3	Understand Principles of Inertial Navigation and Transformation Techniques.	II	Understand
CO4	Understand Radio and Satellite navigation systems.	II	Understand
CO5	Apply skills effectively in the analysis and understanding of navigation systems.	III	Apply

CO-PO Mapping:

CO	**PO**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	**2**	**2**										
CO2	**2**	**2**	**2**									
CO3	**2**	**2**	**2**									
CO4	**2**	**2**	**2**									
CO5	**1**	**3**	**3**									

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)

ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1:---NAVIGATION CONCEPTS Introduction to navigation –Definition navigation, guidance and control. Types of Navigation, General principles of conventional navigation systems, Geometric concepts of Navigation – Elements - The Earth in inertial space - Earth's Rotation - Revolution of Earth – Different Coordinate Systems – Coordinates Transformation - Euler angle formulations - Direction cosine formulation - Quaternion formulation.	**6 Hrs.**
Unit 2:---GYRO SYSTEM Gyroscopes-Principle of operation-Types–Mechanical - Electromechanical-Optical Gyro - Ring Laser gyro- Fiber optic gyro-Rate Gyro, Rate Integrating Gyro, Free Gyro, Vertical Gyro, Directional Gyro, Analysis & Applications.	**6 Hrs.**
Unit 3:---INERTIAL SENSOR Accelerometers- Principle of operation - Feedback Control Technology, Pendulous servo accelerometer-Vibrating string accelerometer-Transfer function-Accelerometer performance parameters. MEMS devices for aerospace navigation.	**6 Hrs.**
Unit 4:--- INERTIAL NAVIGATION SYSTEMS Basic Principles of Inertial Navigation- INS components: transfer function and errors- Earth in inertial space - coriolis effect – INS Mechanization. Platform and Strap down – Navigation algorithms. INS system block diagram, Different co-ordinate systems – Transformation Techniques - Schuler Tuning - compensation errors - Gimbal lock alignment- Initial calibration and Alignment Algorithms.	**8 Hrs.**
Unit 5:--- RADIO NAVIGATION SYSTEM Short range navigation systems-Basics of VOR, TACAN, DME-Long range navigation-Basics of OMEGA, LORAN-Instrument Landing System. Introduction to radars-Block schematic diagram and Principle of operation-Radar equation-Range and frequencies- Application of radars- Types of radar-Pulse Doppler Radar, MTI, and Tracking Radar.	**7 Hrs.**
Unit 6:--- SATELLITE NAVIGATION, TRACKING AND SAFETY SYSTEMS Global Navigation Satellite Systems - Basic concepts of GPS. Space segment, Control segment, user segment, GPS constellation, GPS measurement characteristics, selective availability (AS), Anti spoofing (AS). Applications of Satellites and GPS for 3D position, Velocity, determination as function of time, Interdisciplinary applications. Regional Navigation Systems- Distress and Safety-COSPAS-SARSAT-INMARSAT Distress System- Location-Based service.	**9 Hrs.**

Textbooks:

1. Myron Kyton, Walfred Fried, _Avionics Navigation Systems‘, John Wiley & Sons,2nd edition, 1997 Global Navigation Satellite Systems, Inertial Navigation, and Integration, 3rd EditionMohinder S. Grewal, Angus P. Andrews, Chris G. Bartone
2. George M Siouris, _Aerospace Avionics System; A Modern Synthesis‘, Academic Press Inc., 1993.
3. Albert Helfrick, _Practical Aircraft Electronic Systems‘, Prentice Hall Education, Career & Technology, 1995.
4. Albert D. Helfrick, _Modern Aviation Electronics‘, Second Edition, Prentice Hall Career & Technology, 1994.
5. Sen, A.K. & Bhattacharya, A.B. —Radar System and Radar Aids to Navigation‖, Khanna Publishers, 1988.
6. Slater, J.M. Donnel, C.F.O and others, —Inertial Navigation Analysis and Design‖, McGraw-Hill.

REFERENCES:

1. Maxwell Noton, ”Spacecraft navigation and guidance”, Springer (London, New York), 1998
2. Slater, J.M. Donnel, C.F.O and others, “Inertial Navigation Analysis and Design”, McGraw-Hill Book Company, New York, 1964.

3. Albert D. Helfrick, 'Modern Aviation Electronics', Second Edition, Prentice Hall Career & Technology, 1994
4. George M Siouris, 'Aerospace Avionics System; A Modern Synthesis', Academic Press Inc., 1993.
5. Myron Kyton, Walfred Fried, 'Avionics Navigation Systems', John Wiley & Sons, 1997
6. Tsui. J. B.Y, "Fundamentals of Global Positioning System Receiver", John Wiley an Sons Inc.

Title of the Course: Wireless Communication and Network	**L**	**T**	**P**	**Credit**
Course Code:UOEL0717	**3**	**-**	**-**	**3**

Course Pre-Requisite: Basics of communication Systems.

Course Description:

This Course is to expose the students to the most recent technological developments in wireless communication systems. The Course considers the basic concepts of cellular system. The Course provides various multiple access techniques and Standards in Cellular mobile Communication.

The course aims to:

1. Focus on basic fundamentals of wireless communication.
2. Explain large & small scale radio wave propagation
3. Understand basic mobile communication and its multiple access techniques.
4. Understand mobile network and its connectivity.

Course Learning Outcomes:

Upon successful completion of this course, a student will be able to:

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy	
		level	Descriptor
CO1	List the basic fundamentals of wireless communication.	**List**	**Remembering**
CO2	Explain multiple access techniques to mobile communication	**Apply**	**Applying**
CO3	Explain mobile network.	**Explain**	**Understanding**

CO-PO Mapping:

CO	**PO**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2		-	-	-	-	-	-	-	-	-	1
2	2	2	-	-	-	-	-	-	-	-	-	1
3	2	2	-	-	-	-	-	-	-	-	-	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.

MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	**Hr.**
UNIT I : INTRODUCTION OF WIRELESS COMMUNICATION. Challenges in wireless networking, Wireless communications standards Overview, evolution of cellular system, Cellular system architecture & operation, Performance criteria. Multiple access schemes for wireless communication -TDMA, FDMA, CDMA, SDMA	6
UNIT II : WIRELESS NETWORK PLANNING AND OPERATION frequencies management, channel assignments, frequency reuse, System capacity& its improvement, Handoffs & its types, roaming, co channel & adjacent channel interference .	7
UNIT III : DIGITAL CELLULAR NETWORKS GSM architecture& interfaces, signal processing in GSM, frame structure of GSM, Channels used in GSM.	5
UNIT IV : WIRELESS LAN TECHNOLOGY Overview, WLAN technologies, infrared LANs, Spread Spectrum LANs Narrowband Microwave LANs IEEE 802.11- Architecture, protocols, MAC layer .MAC frame, MAC management	5
UNIT V : BLUETOOTH Overview, Radio specification, Base band specification, Link manager specification, logical link control & adaptation protocol.	4
UNIT VI : MOBILE DATA NETWORKS Introduction, Data oriented CDPD networks, GPRS, Wireless Access Protocol : WAP architecture , Wireless Datagram ,Wireless Transport layer security, wireless transaction ,Wireless Session ,Wireless Application Environment,WML	**7**

TEXT BOOKS:

1.William C.Y.Lee,” **Mobile communication Engg”** , Tata Mc-Grraw Hill Publications
2.T.S.Rappaport,” **Wireless Communication, principles & practice”** Pearson Education
3. Schiller,”**Mobile communication**”, IInd Edition, Pearson Education

REFERENCE BOOKS:

1. William Stalling,**” Wireless Communication & Networking”**
2. Rampantly,” Mobile communication”
3. Kamilo Feher,**” Wireless digital communication”, PHI, 1999**
4. Kavesh pahlavan & P.Krishna Murthy,**” Principles of Wireless networks”**

Audit Course-V

Title of the Course: Intellectual Property Rights	L	T	P	Credit
Course Code: UETC0761	2	-	-	-

Course Pre-Requisite: Electronics System Design-Lab

- **Course Description:** In modern age of technology, to introduce fundamental aspects of Intellectual property Rights to students who are going to play a major role in development and management of innovative projects in industries.

- Course Objectives :
  - To disseminate knowledge on patents, patent regime in India and abroad and registration aspects.
  - To disseminate knowledge on copyrights and its related rights and registration aspects.
  - To disseminate knowledge on trademarks and registration aspects.
  - To disseminate knowledge on Design, Geographical Indication (GI), Plant Variety and Layout Design Protection and their registration aspects
  - To aware about current trends in IPR and Govt. steps in fostering IPR.

Course Learning Outcomes:

CO	After the completion of the course the student should be able to	Bloom's Taxonomy	
		Level	Descriptor
CO1	To describe basic of intellectual property right (IPR)	Cognitive	Describing
CO2	To Know Elements of Patentability	Psychomotor	Applying
CO3	To provide Knowledge of Copyrights and Trademarks	Cognitive	Knowing
CO4	To analyze the IP Design and Geographical Indication (GI)	Cognitive	Analyzing

CO-PO Mapping:

CO	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	-	-	-	3	-	-	-	-	3	-
CO2	3	3	-	-	-	3	-	-	-	-	3	-
CO3	3	3	-	-	-	3	-	-	-	-	3	-
CO4	3	3	-	-	-	2	-	-	-	-	3	-

Assessments :

Teacher Assessment:

End Semester Examination (ESE) 100% weights.

Assessment	Marks
ESE	100

ESE: Assessment is based on 100% course content.

Course Contents:

Unit 1: Overview of Intellectual Property: **6Hrs**

Introduction and the need for intellectual property right (IPR) - Kinds of Intellectual Property Rights: Patent, Copyright, Trade Mark, Design, Geographical Indication, Plant Varieties and Layout Design – Genetic Resources and Traditional Knowledge – Trade Secret - IPR in India : Genesis and development – IPR in abroad - Major International Instruments concerning Intellectual Property Rights: Paris Convention, 1883, the Berne

Convention, 1886, the Universal Copyright Convention, 1952, the WIPO Convention, 1967,the Patent Co-operation Treaty, 1970, the TRIPS Agreement, 1994	
Unit 2: Patents: Patents - Elements of Patentability: Novelty , Non Obviousness (Inventive Steps), Industrial Application - Non - Patentable Subject Matter - Registration Procedure, Rights and Duties of Patentee, Assignment and licence , Restoration of lapsed Patents, Surrender and Revocation of Patents, Infringement, Remedies & Penalties - Patent office and Appellate Board	**6Hrs**
Unit 3: Copyrights: Nature of Copyright - Subject matter of copyright: original literary, dramatic, musical, artistic works; cinematograph films and sound recordings - Registration Procedure, Term of protection, Ownership of copyright, Assignment and licence of copyright - Infringement, Remedies & Penalties – Related Rights - Distinction between related rights and copyrights	**6Hrs**
Unit 4: Trademarks: Concept of Trademarks - Different kinds of marks (brand names, logos, signatures, symbols, well known marks, certification marks and service marks) - Non Registrable Trademarks - Registration of Trademarks - Rights of holder and assignment and licensing of marks-Infringement, Remedies & Penalties - Trademarks registry and appellate board	**6Hrs**
Unit 5: Other forms of IP: Design Design: meaning and concept of novel and original - Procedure for registration, effect of registration and term of protection. **Geographical Indication (GI)** Geographical indication: meaning, and difference between GI and trademarks - Procedure for registration, effect of registration and term of protection.	**6Hrs**
Textbooks: 1. Nithyananda, K V. (2019). Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited. 2. Neeraj, P., & Khusdeep, D. (2014). Intellectual Property Rights. India, IN: PHI learning Private Limited.	
References: 1. Ahuja, V K. (2017). Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.	
E-resources: 1. Subramanian, N., & Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf 2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf	

Final Year B. Tech. Semester VIII

Title of the Course: Satellite Communication	**L**	**T**	**P**	**Credit**
Course Code: UETC0801	**3**	**-**		**3**

Course Pre-Requisite: Analog Communication Systems, Digital Communication, Electromagnetic Engineering, Antenna & Wave Propagation.

Course Description: NGSO satellite systems, and Internet access by satellite There have been many changes in the thirty three years since the first edition of Satellite Communications was published. There has been a complete transition from analog to digital communication systems, with analog techniques replaced by digital modulation and digital signal processing. While distribution of television programming remains the largest sector of commercial satellite communications, low earth orbit constellations.

Course Objectives:

The course aims :

1. To introduce the fundamental concept in the field of satellite communication.
2. To enable the student know how to place satellite in orbit.
3. To know the concept of space subsystem.
4. To analyze, design and evaluate satellite communication subsystem its networking.

Course Learning Outcomes:

Student will able to:

1. Understand Orbital aspects involved in satellite communication.
2. Understand Power budget calculation.
3. Understand Satellite system and services provided.
4. Analyze the performance satellite communication system.

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy level	Descriptor
CO1	Understand Orbital aspects involved in satellite communication.	**Understand**	**Understand**
CO2	Understand Power budget calculation.	**Understand**	**Understand**
CO3	Understand Satellite system and services provided.	**Understand**	**Understand**
CO4	Analyze the performance satellite communication system.	**Analyze**	**Analyze**

CO-PO Mapping:

CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	1		2	3								
CO2	1		2	3								
CO3	1		2	3								
CO4	1		2	3								

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10
ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:

Unit 1: Introduction of Satellite Communication: Introduction, basic concept of satellite communication, Orbital Mechanics, Look angle determination, Orbital perturbation, Orbital determination, Launchers and Launch vehicles, Orbital effects in communication system performance.	07 **Hrs.**
Unit 2: Satellite subsystem: Satellite Subsystem, Attitude and control system(AOCS), Telemetry, Tracking, Command and Monitoring, Power systems, Communication subsystem, Satellite antennas, Equipment reliability and space qualification	07 **Hrs.**
Unit 3: Satellite Link Design: Introduction, Basic transmission Theory, System Noise Temperature and G/T Ration, Design of Downlinks, Satellite System using Small Earth Stations, Uplink Design, Design of specified C/N : Combining C/N and C/I values in Satellite Links	06 **Hrs.**
Unit 4: Satellite Networks: Reference architecture for satellite networks, basic characteristics of satellite networks, Onboard connectivity with transparent processing, analogue transparent switching, Frame organization, Window organization, On board connectivity with beam scanning	06 **Hrs.**
Unit 5: Low Earth Orbit and Non Geo-Stationary satellite system: Introduction, Orbit considerations, Coverage and Frequency Consideration, Delay and Throughput Consideration, Operational NGSO constellation design: Iridium, Teledesic.	5 **Hrs.**
Unit 6: Satellite Radio and GPS: C-Band and Ku- Band Home satellite TV, Digital DBS TV, Satellite Radio Broadcasting, Radio and Satellite Navigation, GPS Position Location Principles, GPS Receivers and codes.	5 **Hrs.**

Textbooks:

1. Satellite Communications-Timothy Pratt, Charles Bostian, Jeremy Allnut John Wiley & Sons (II Edition)(For chapters I,II,III,IV,VI)
2. Satellite Communications-Anil k. Maine and Varsha Agaraval, Wiley Publications (All chapters)

References:

1. Satellite Communications- Dennis Roody McGraw Hill(All Chapters)
2. Satellite Communications- Gerard Maral and Michel Bousquet, Wiley Publication (5th Edition For chapter IV)
3. Satellite Communications systems Engineering, 2nd edition- Wilbur L. Pritchard, Henri G.

Unit wise Measurable students Learning Outcomes: Student will be able to

1. Understand Orbital aspects involved in satellite communication.
2. Understand Satellite Subsystems.
3. Understand Power budget calculation.
4. Understand Satellite system and services provided.
5. Analyze the performance satellite communication system.
6. Understand applications of Satellite like GPS, Satellite Radio & DBS TV.

Title of the Course: Wireless Mobile Communication	**L**	**T**	**P**	**Credit**
Course Code: UETC0802	**3**	**-**	**-**	**3**

Course Pre-Requisite: Antenna Wave Propagation.

Course Description: The course has been designed to expose the students to the most recent technological developments in Mobile communication systems.. The Course considers the basic concepts of cellular system. Following this, various propagation effects and propagation models used in mobile communication are included in the course. The Course provides various multiple access techniques and Standards in Cellular mobile Communication.

The course aims to:

1. Focus on basic fundamentals of wireless communication.
2. Explain large & small scale radio wave propagation
3. Understand basic mobile communication and its multiple access techniques.
4. Understand mobile network and its connectivity.

Course Learning Outcomes:

Upon successful completion of this course, a student will be able to:

CO	**After the completion of the course the student should be able to**	Bloom's Taxonomy	
		level	Descriptor
CO1	List the basic fundamentals of wireless communication.	List	Remembering
CO2	Explain large and small scale radio wave propagation	Explain	Understanding
CO3	Explain multiple access techniques to mobile communication	Explain	Understanding
CO4	Explain mobile network.	Explain	Understanding

CO-PO Mapping:

CO	**PO**											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	2		-	-	-	-	-	-	-	-	-	1
2	2	2	-	-	-	-	-	-	-	-	-	1
3	2	2	-	-	-	-	-	-	-	-	-	1
4	2	1	-	-	-	-	-	-	-	-	-	1

Assessments :

Teacher Assessment:

Two components of In Semester Evaluation (ISE), One Mid Semester Examination (MSE) and one EndSemester Examination (ESE) having 20%, 30% and 50% weights respectively.

Assessment	Marks
ISE 1	10
MSE	30
ISE 2	10

ESE	50

ISE 1 and ISE 2 are based on assignment/declared test/quiz/seminar/Group Discussions etc.
MSE: Assessment is based on 50% of course content (Normally first three modules)
ESE: Assessment is based on 100% course content with60-70% weightage for course content (normally last three modules) covered after MSE.

Course Contents:	**Hr.**
Unit I :Introduction of Wireless Communication 2G, 3G wireless networks, WLL, Cellular Concept	4
Unit II : Mobile Radio Propagation. Large Scale Path Loss: Introduction to Radio Wave propagation, The three Basic Propagation Mechanisms, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Outdoor Propagation Models, Indoor Propagation Models Small-Scale Fading and Multipath : Small-Scale Multipath Measurements, Parameters of Mobile Multipath Channels, Types of small-Scale Fading	7
Unit III : Wireless Networking: Introduction to wireless Networks Difference Between Wireless and Fixed Telephone Networks, Development of Wireless Networks, Fixed Network Transmission Hierarchy, Traffic Routing in Wireless Networks,Wireless Data Services, Common Channel Signaling (CCS), Architecture of B-ISDN & services, Signaling System No. 7 (SS7), An Example of SS7-Global Cellular Network Interoperability,	5
Unit IV : Introduction to Mobile Communication & Multiple Access Technique Mobile and Personal Communication, mobile and wireless devices, Specialized packet and mobile radio networks, circuit switched data services on cellular networks, packet switched data services on cellular networks, Multiple Access Technique- FDMA, TDMA, SDMA, CDMA, spread spectrum multiple access	6
Unit V : WIRELESS LAN TECHNOLOGY Overview, WLAN technologies, infrared LANs, Spread Spectrum LANs Narrowband Microwave LANs IEEE 802.11- Architecture, protocols, MAC layer .MAC frame, MAC management.	5
Unit VI : Mobile Network & Transport Layer Mobile IP, DHCP (Dynamic Host Control Protocol), Mobile ad hoc networks, Bluetooth & Wi-Fi network	5

Text Books:

1 Wireless Communications Principals & Practice- Theodore S. Rappaport, (P.E.)
2 Mobile Communications: Jachen Schiller (Addison Westy)

Reference Books:

1 Wireless Networks by P. Nicopolitidis, M. S. Obaidat, G. I. Papadimitriou, A. S. Pomportsis; Wiley Pub.

2 Wireless Communication & Networks by William Stallings(Pearson Edition)
3 Wireless communication and Networks by Upena Dalal(Oxford)
4 Wireless and Mobile network by Manvi (Wiley India)