

Ordinance No. V(42A)

Master of Technology

(M.Tech.)

(Discipline: RF & Microwave Engineering)



Faculty of Engineering & Technology

**SWAMI VIVEKANAND SUBHARTI UNIVERSITY,
MEERUT**

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT
SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING

ORDINANCE No. V (42A) RELATING TO

MASTER OF TECHNOLOGY (M.Tech.)

PROGRAMME (As per AICTE)

(Effective from the Session – 2018-19)

- This ordinance may be called “**Ordinance Relating to Master of Technology(M.Tech)**” Programme.
- It shall come enforced with immediate effect session 2018-19.
- This supersedes the previous Ordinance from the relating to Master of Technology(M.Tech).
- The degree “Master of Technology” acronym as M.Tech. shall be of two years (foursemesters) in the branches of Engineering.

CHAPTER - 1

Introduction

Chhatrapati Shahuji Subharti Institute of Technology and Engineering is a constituent Institute of Swami Vivekanand Subharti University, Meerut has been established in 2005 with the vision we make every decision to support the career and personal development of our learners. Our curriculum, teaching and services demonstrate that we value the diverse profiles of our learners. The University boasts of highly qualified, dedicated and competent faculty from all walks of life, world class infrastructure, fully equipped Laboratories with latest state-of-the-art equipment and a huge library with recent knowledge resources including e-resources. Swami Vivekanand Subharti University is providing a safe and healthy working environment for teaching and non-teaching employees, students, and visitors etc.

Vision

To become a dynamic, demand driven, quality conscious, efficient and innovative institute capable of becoming active partner in the techno-economic growth of the Nation and to provide world class technological education and research inputs to the society.

Mission

Strive to create centre of excellence in specialized areas of technology and enable its academic beneficiaries to become competent professionals capable of providing sustainable solutions to challenging problems of the society and industry.

Programme Educational Objectives (PEOs):

The Programme Educational Objectives of M.Tech. programmes are:

PEO1. To prepare graduates who will be successful professionals in industry, government, academia, research, entrepreneurial pursuit and consulting firms

PEO2. To prepare graduates who will contribute to society as broadly educated, expressive, ethical and responsible citizens with proven expertise

PEO3. To prepare graduates who will achieve peer-recognition; as an individual or in a team; through demonstration of good analytical, design and implementation skills

PEO4. To prepare graduates who will thrive to pursue life-long learning to fulfill their goals

Programme Outcomes (POs):

Engineering programmes are designed to prepare graduates to attain the following program outcomes:

PO1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and team work: Function effectively as an individual, and as a member or

leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

CHAPTER – 2

General

The M.Tech. programme is available in the following discipline:

1) Computer Science & Engineering Department

- Computer Science &
- Engineering Cyber Security

2) Electrical & Electronics Engineering Department

- Power Electronics & Drives

3) Electronics & Communication Engineering Department

- Radiofrequency & Microwave

4) Mechanical Engineering Department

- Production Engineering

5) Environmental Engineering Department

- Environmental Engineering & Management

Modification/ addition/ deletion in the of specialties offered in the above list can be made by the faculty from time to time in accordance with the direction of the Academic Council which shall be subject to fulfillment of statutory norms, prescribed condition and approval by the Statutory Authorities.

The eligibility qualification for admission to the M.Tech. programmes in Swami Vivekanand Subharti University, Meerut in different specialties shall be as given below in the Table of Eligibility Qualification for M.Tech. admission:

Eligibility Qualification for M.Tech. Admission:

Electronics & Communication Engineering	Radio Frequency & Microwaves	B.Tech/BE/B.Sc (Engg) (EC, EI). Or Associate Membership of Professional Bodies Approved by the Competent Authority. Or M.Sc. (Electronics, Physics with specialization in) or Equivalent Degree
---	------------------------------	--

Categories for M.Tech. Admission

Admission to M.Tech. in each specially shall be approved in any one of the following categories:-

M.Tech. (Regular): It shall be a Regular, Four Semester, Full Time Programme (24 month duration) in which the student will be expected to fulfill the complete requirement relating to the theory/Lab Work/Practical Training/Dissertation etc. while performing full time studies in the University and the Industries/institute/R&D Organization assigned to him/her by the university for completing the dissertation/Project Work.

M.Tech. (2nd Shift): with a view to allow opportunity for higher technical education to the engineering graduate employed in the field and teaching organizations, the university shall run M.Tech classes in the 2nd shift with identical curriculum and syllabi in the evening shift with class timing from 05:00 PM to 09:00 PM.

Provided further that the Vice Chancellor may exercise special powers to allow such 2nd shift classes to be conducted on *Saturday, Sunday and Holidays* to ensure complete and effective coverage of the syllabi and completing teaching hours as per requirement laid down by the statutory authorities/UGC

CHAPTER - 3

Teaching Courses

The programme will be two years duration, divided into four semesters (for M.Tech. Regular).

Annual Academic calendar shall be published by the university.

I , III Semester (Odd)	Session - 1st Aug. to 30th Nov Exam - 1st Dec. to 20th Dec.
II, IV Semester (Even)	Session - 1st Jan. to 10th May Exam - 1st May to 20th May

The documentation relating to the „**Study & Evaluation Scheme**“, „**Syllabus**“ and „**Credits Approved**“ for each subjects/course in the categories mentioned in each of the specialties stated in clause 2.1 above is provided in **Annexure-B1-B10** of the relevant programme in the Academic Ordinance.

Dissertation topics should be allotted to students in the third semester.

4

CHAPTER-4

Curriculum/Structure

The programme shall be spread over two academic years, spread over four semesters comprising actual teaching for a minimum of 90 days in each semester.

The programme focuses on the following aspects:

- (a) Competency
- (b) Entrepreneurship
- (c) Skill Enhancement
- (d) Value Added Courses
- (e) Extracurricular activities

Choice Based Credit System (CBCS):

The CBCS provides an opportunity for the students to choose courses from the prescribed courses comprising Professional/Program Core Courses (PCC), Professional/Program Elective Courses (PEC), Mandatory Courses (MC) and Open Elective Courses (OEC). The courses can be evaluated following the grading system, which is considered to be better than the conventional marks system. Therefore, it is necessary to introduce uniform grading system in the entire higher education in India. This will benefit the students to move across institutions within India to begin with and across countries. The uniform grading system will also enable potential employers in assessing the performance of the candidates. In order to bring uniformity in evaluation system and computation of the Cumulative Grade Point Average (CGPA) based on student's performance in examinations, the UGC has formulated the guidelines to be followed.

Professional/Program Core Courses (PCC)

The departmental core consists of courses considered essential for a chosen engineering/science discipline including, engineering design, seminar, industrial training and project (PROJ).

Professional/Program Elective Courses (PEC)

The students are required to complete a specific number of elective courses. Every department offers a wide variety of elective courses to students providing them opportunity to discover their academic interest and enhancing their engagement in learning process.

Open Elective Courses (OEC)

The Open Electives courses are offered by different academic departments to the students of all disciplines. A wide range of elective courses is available with each branch. When a student opts elective courses offered in his/her program it will be termed as OEC.

Mandatory Courses (MC)

The mandatory courses considered essential for a B.Tech. programme to inculcate the essence of Environmental Sciences, Induction Program, Indian Constitution, Essence of Indian Knowledge Tradition etc.

CHAPTER-5

Attendance

The students are expected to attend all the classes and should not have less than 75 % attendance in theory as well as in practical classes, wherever held, to become eligible to appear for the university examination. Short fall in attendance can, however be condoned in deserving cases to the extent of 10 % by the principal. If the short fall is more than 10 % but not more than 15 %, the Principal may

recommend deserving cases to the Vice Chancellor for condonation. The order of the Vice Chancellor in this regard shall be final.

CHAPTER-6

Examination

All Courses offered by SITE will have an evaluation system within two components as:

1. Continuous Comprehensive Assessment (CCA) accounting for 30% of the final grade that a student gets in a course, and
2. End-Semester Examination (ESE) accounting for the remaining 70% of the final grade that the student gets in a course.

A student will have to pass both the components i.e. CCA and ESE separately to become eligible to be declared successful in a course.

Continuous Comprehensive Assessment (CCA)

Award of Sessional Marks:

Sessional marks for theory subjects, practicals and projects shall be awarded as per the breakup of sessional marks given below:-

- (i) Theory Subjects :**
 - a) Class test will comprise two mid-term tests of equal weightage .- **20 Marks**
 - b) Marks for regular class attendance **- 10 Marks**
- (ii) Practical :**
 - a) Two mid-term viva-voce tests of equal weightage. **- 5 Marks**
 - b) Teacher's assessment (including 5 marks for regular attendance) based on lab record. **-10 Marks**
- (iii) Make-up test** may be held for those students who fail to appear in any one of the mid-term class tests due to genuine unavoidable reasons, provided prior permission was consented from the Principal.

- (iv) A maximum of 10 marks in each subject shall be awarded for attending classes (theory/practical) as per the following norms:

85 % or more attendance	- 10 Marks
80 % or more but less than 85 % attendance	- 09 Marks
75 % or more but less than 80 % attendance	- 08 Marks
70 % or more but less than 75 % attendance	- 07 Marks
65 % or more but less than 70 % attendance	- 06 Marks
60 % or more but less than 65 % attendance	- 05 Marks
51 % or more but less than 60 % attendance	- 04 Marks
50 % attendance	- 01 Marks
Less than 50 % attendance	- 0 Marks

END SEMESTER EXAMINATION (ESE)

The remaining 70% of the final grade of the student in a course will be assessed on the basis of an End Semester Examination (ESE) that will be for three hours duration and will cover the entire syllabus of the course. The question papers for the ESE will be got set by the Controller of Examinations (COE) of the Swami Vivekanand Subharti University (SVSU) by a selected faculty panel.

The entire programme has to be completed within a maximum of four years from the date of original admission in the programme.

CHAPTER-7

Paper Setting

The work of setting the end semester examination papers and evaluation of scripts and conduct of the end semester practical examination shall be assigned to the course teachers as well as to outsiders, ordinarily in the ratio of 50:50 for internal and external valuation respectively.

Results

The result shall be prepared at the end of each academic year of the programme by aggregating the marks obtained in the theory and practical examinations in all the semesters of the programme till date.

- (a) The minimum passing marks in each theory subject (including sessional marks) shall be 40% and 50% in aggregate. The minimum pass marks in a project/ Practical subject (including sessional marks if any), Seminars,

Industrial Training and Educational Tour, Viva-Voce etc. shall be 50%.

- (b) If a student obtained 40% marks in at least 50% of the papers (ignoring fractions) including project report, he/she will be provisionally promoted to the next year with carryover papers and will have to appear & obtain pass marks in carryover papers along with the subsequent regular examinations for the relevant semester.
- (c) If a candidate fails in only one head/subject and having passed in all other head/subject of the given examination of the year than his/her deficiency of maximum five (05) marks may be fulfilled by grace marks after fulfilling the conditions given below:

If a candidate fails in only one head/subject and having passed in all other heads/subjects of the given examination of a **semester*/year**, then his/her deficiency of marks may be fulfilled by grace marks under the following conditions:-

- (a) Grace marks is not a matter of right of the student but is the discretion of the University.
- (b) Provided that the candidate has appeared in the main examination of the concerned programme and falls short of pass marks by not more than five (05) marks in theory paper only. Benefit of above mentioned shall not be given to the candidate who had appeared in supplementary/special examination/carry over examination.
- (c) Further, benefit of grace marks may be given only to the candidate who will pass the entire concerned examination of the **semester*/year** after awarding the grace marks and not for the purpose of promoting the student to next year with back papers or for improvement of division or percentage.
- (d) If in a head/subject of an examination passing in Theory, Practical or sessional exams separately is mandatory, then the benefit of grace marks shall be given only in Theory examination of the University examination.
- (e) The award of grace marks permissible shall be on the basis of 1 grace mark for every 05 marks secured by an examinee over and above the minimum passing aggregate marks of all subjects of the year.

Awarding of Grace Marks shall be done as given below:-

Aggregate Marks Obtained over & above minimum passing marks	Permissible Grace Marks
1-5	1
6-10	2
11-15	3

16-20	4
21-25	5

Total number of Grace Marks given to the student will be marked with astrick (*)at the bottom of the mark sheet.

* Grace Mark in semester examination will be considered hereinafter.

A student not covered by clause 7.2 (a) to (c) above shall have the following options to complete his/her programme –

- (i) He/ she may take admission on payment of full annual programme fee and repeat the entire year of study. He /She shall be treated as a regular student. Or
- (ii) He /She may pay only University exam fee for the End Semester Examination and appear in the End Semester University exams directly. He /She shall not be allowed to attend classes and the Sessional marks obtained earlier shall be retained. Or
- (iii) He /She may pay half of the annual programme fee and attend classes. The sessional marks obtained by him/her earlier shall be retained. There will not be any requirement of minimum attendance for appearing in the University examination.

A student will not be promoted to the next academic year if the carryover papers are more than 50% at one point of time.

Evaluation under Grading Assessment

The minimum Grade/ Grade Point required to pass each paper in a semester examination under CBCS shall be Grade D/ Grade Point 4 in each theory paper/ Practical/Project (wherever applicable) in External Examination and Internal Assessment separately.

Calculation Criteria

To implement the following grading system, the colleges/campuses shall use the following UGC recommended 10 point grading system:

Marks (%)	Letter Grades	Grade Points (G)
85-100	A++ (Outstanding)	10
75 to < 85	A+ (Excellent)	9
70 to <75	A (Very Good)	8
65 to <70	B+ (Good)	7
60 to <65	B (Above Average)	6

50 to <60	C (Average)	5
40 to <50	D (Pass)	4
0 to <40	F (Fail)	0
	AB (Absent)	0

Computation of Semester Grade Point average (SGPA) and Cumulative Grade Point Average (CGPA)

$$(S_i) = \frac{\sum (C_i \times G_i)}{\sum C_i}$$

where C_i is the number of credits of the i^{th} programme and G_i is the grade point scored by the student in the i^{th} programme.

$$CGPA = \frac{\sum (C_i \times S_i)}{\sum C_i}$$

where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

CHAPTER-8
Power to Modify

- 8.1** In the event of any emergent situation, if any deviation is considered necessary, the Vice-Chancellor is authorized to modify the ordinance. Subjected to subsequent ratification by the executive council.
-

SWAMI VIVEKANAND SUBHARTI UNIVERSITY, MEERUT



EVALUATION SCHEME & SYLLABUS

M.TECH. (RF & MICROWAVE ENGG.)

W.E.F. SESSION 2018-19

SUBHARTI INSTITUTE OF TECHNOLOGY AND ENGINEERING
Subhartipuram, NH-58 Delhi- Haridwar Bypass Road,
Meerut -250005 (UP)
www.subharti.org



Department of Electronic & Communication Engineering
Course Structure
M. Tech.
(RF & Microwave Engineering)

YEAR 1ST, SEMESTER-I

S. No.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS				TOTAL MARKS	CREDIT
				L	T	P	CCA			ESE		
							CT	AT	TOTAL			
THEORY SUBJECTS												
1	MMW-101	RF and Microwave Circuit Design	PCC-1	3	0	0	20	10	30	70	100	3
2	MMW-102	Fiber Optic Communication Networks	PCC-2	3	0	0	20	10	30	70	100	3
3	MMW-111-116	Cognitive Radio (Elective-I)	PEC-2	3	0	0	20	10	30	70	100	3
4	MMW-111-116	Wireless & Mobile Communication (Elective-II)	PEC-3	3	0	0	20	10	30	70	100	3
5	METC-101	Research Methodology & IPR	MC-1	2	0	0	20	10	30	70	100	2
6	MMW-151	Advance Microwave Lab	PCC-9	0	0	2	10	5	15	35	50	2
7	MMW-152	Optical and Fiber Communication Lab	PCC-10	0	0	2	10	5	15	35	50	2
8	METC-111-118	Audit Course-I	AC-1	2	0	0	20	10	30	70	100	0
		TOTAL									700	18

L- Lecture

T- Tutorial

P- Practical

CT- Cumulative Test

AT- Attendance

CCA- Continuation Comprehensive Assessment

ESE- End Semester Examination



Subharti Institute of Technology & Engineering

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

Subhartipuram, NH-58 Delhi-Haridwar-Meerut Bypass Road, Meerut -250 005
Ph: +91-121-243 9157, 243 9043 / 52, Ext 2222, 2221, Fax: +91-121-243 108
E-Mail: principle.site@gmail.com; principal.engg@gmail.com; www.subharti.org



Department of Electronic & Communication Engineering
Course Structure
M. Tech.
(RF & Microwave Engineering)

YEAR 1ST, SEMESTER-II

S. No.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS				TOTAL MARKS	CREDIT
				L	T	P	CCA			ESE		
							CT	AT	TOTAL			
THEORY SUBJECTS												
1	MMW-201	Antenna and Radiating System	PCC-5	3	0	0	20	10	30	70	100	3
2	MMW-202	Communication System	PCC-6	3	0	0	20	10	30	70	100	3
3	MMW-213	Optical Networks (Elective-III)	PEC-7	3	0	0	20	10	30	70	100	3
4	MMW-211	CAD of RF and Microwave Circuit (Elective-IV)	PEC-8	3	0	0	20	10	30	70	100	3
5	MMW-251	Project Based Lab	PCC-11	0	0	2	10	5	15	35	50	2
6	MMW-252	Microwave Engineering Lab	PCC-12	0	0	2	10	5	15	35	50	2
7	MMW-253	Mini Project	PCC-13	0	0	4	--	--	100	--	100	2
8	METC-215	Constitution of India (Audit Course-II)	AC-2	2	0	0	20	10	30	70	100	0
TOTAL											700	18

L- Lecture

T- Tutorial

P- Practical

CT- Cumulative Test

AT- Attendance

CCA- Continuation Comprehensive Assessment

ESE- End Semester Examination



Subharti Institute of Technology & Engineering

SWAMI VIVEKANAND SUBHARTI UNIVERSITY

Subhartipuram, NH-58 Delhi-Haridwar-Meerut Bypass Road, Meerut -250 005
Ph: +91-121-243 9157, 243 9043 / 52, Ext 2222, 2221, Fax: +91-121-243 108
E-Mail: principle.site@gmail.com; principal.engg@gmail.com; www.subharti.org



Department of Electronic & Communication Engineering Course Structure M. Tech. (RF & Microwave Engineering)

YEAR 2ND, SEMESTER-III

S. No.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS			TOTAL MARKS	CREDIT	
				L	T	P	CCA		ESE			
							CT	AT				TOTAL
THEORY SUBJECTS												
1	MMW-301	Computational Electromagnetics (Elective-V)	PEC-13	3	0	0	20	10	30	70	100	3
2	MMW-001-004	Radar & Sonar System Engineering (Open Elective)	OEC	3	0	0	20	10	30	70	100	3
3	MMW-351	Dissertation (Phase-I)	PCC-14	0	0	20	--	--	100	200	300	10
		TOTAL									500	16

YEAR 2ND, SEMESTER-IV

S. No.	COURSE CODE	COURSE TITLE	COURSE TYPE	TEACHING LOAD PER WEEK			MARKS			TOTAL MARKS	CREDIT	
				L	T	P	CCA		ESE			
							CT	AT				TOTAL
THEORY SUBJECTS												
1	MMW-451	Dissertation (Phase-II)	PCC-15	0	0	32	--	--	150	350	500	16
		TOTAL									500	16

L- Lecture
T- Tutorial
P- Practical
CT- Cumulative Test
AT- Attendance
CCA- Continuation Comprehensive Assessment
ESE- End Semester Examination

COURSE TYPE NOMENCLATURE :

Course Code	Definitions
PCC	Program Core Courses
PEC	Program Elective Courses
OEC	Open Elective Courses
MC	Mandatory Courses
CCA	Continuation Comprehensive Assessment
ESE	End Semester Examination
AC	Audit Courses

PROGRAM CORE COURSE:-

S. No.	Course Code	Course Name	L	T	P	Credits
1.	MMW-101	RF and Microwave Circuit Design	3	0	0	3
2.	MMW-102	Fiber Optic Communication Networks	3	0	0	3
3.	MMW-103	Applied Electromagnetics & Applications	3	0	0	3
4.	MMW-104	RF & Microwave Elements	3	0	0	3
5.	MMW-201	Antenna and Radiating System	3	0	0	3
6.	MMW-202	Communication System	3	0	0	3
7.	MMW-203	Antenna Theory and Design	3	0	0	3
8.	MMW-204	Microwave Measurement & Material Characterization	3	0	0	3
9.	MMW-151	Advance Microwave Lab	0	0	2	2
10.	MMW-152	Optical and Fiber Communication Lab	0	0	2	2
11.	MMW-251	Project Based Lab	0	0	2	2
12.	MMW-252	Microwave Engineering Lab	0	0	2	2
13.	MMW-253	Mini Project	0	0	4	2
14.	MMW-351	Dissertation (Phase-I)	0	0	20	10
15.	MMW-451	Dissertation (Phase-II)	0	0	32	16

PROGRAM ELECTIVE COURSES-I & II

S. No.	Course Code	Course Name	L	T	P	Credits
1.	MMW-111	RFID System Design	3	0	0	3
2.	MMW-112	Cognitive Radio	3	0	0	3
3.	MMW-113	Wireless & Mobile Communication	3	0	0	3
4.	MMW-114	RF MEMS Design & Technology	3	0	0	3
5.	MMW-115	Spread Spectrum Techniques	3	0	0	3
6.	MMW-116	Advance Sensor array Signal Processing	3	0	0	3

PROGRAM ELECTIVE COURSES-III & IV

S. No.	Course Code	Course Name	L	T	P	Credits
7.	MMW-211	CAD of RF and Microwave Circuit	3	0	0	3
8.	MMW-212	Advanced Digital Signal Processing	3	0	0	3
9.	MMW-213	Optical Networks	3	0	0	3
10.	MMW-214	RF and Electronic System Design Techniques	3	0	0	3
11.	MMW-215	Analog/RF IC Modeling and Design	3	0	0	3
12.	MMW-216	Surface Acoustic Wave Devices and Applications	3	0	0	3

PROGRAM ELECTIVE COURSES-V

S. No.	Course Code	Course Name	L	T	P	Credits
13.	MMW-301	Computational Electromagnetics	3	0	0	3
14.	MMW-302	Architectures and Algorithm for DSP	3	0	0	3
15.	MMW-303	Embedded System	3	0	0	3
16.	MMW-304	Modelling and Simulation Techniques	3	0	0	3

MANDATORY COURSE:-

S. No.	Course Code	Course Name	L	T	P	Credits
1.	METC-101	Research Methodology & IPR	2	0	0	2

OPEN ELECTIVE COURSES:-

S.No.	Course No.	Course Title	L	T	P	Credits
1.	MMW-001	Management Information System	3	0	0	3
2.	MMW-002	Energy Management	3	0	0	3
3.	MMW-003	Radar & Sonar System Engineering	3	0	0	3
4.	MMW-004	Environmental Pollution and Its Control	3	0	0	3

LIST OF AUDIT COURSE-I & II

S. No.	Course Code	Course Title	L	T	P	Credits
1.	METC-111/211	English for Research Paper Writing	2	0	0	0
2.	METC-112/212	Disaster Management	2	0	0	0
3.	METC-113/213	Sanskrit for Technical Knowledge	2	0	0	0
4.	METC-114/214	Value Education	2	0	0	0
5.	METC-115/215	Constitution of India	2	0	0	0
6.	METC-116/216	Pedagogy Studies	2	0	0	0
7.	METC-117/217	Stress Management by Yoga	2	0	0	0
8.	METC-118/218	Personality Development through Life Enlightenment Skills	2	0	0	0

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-101

Course Title: RF and Microwave Circuit Design

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. This is a course on the design and applications of microwave devices and amplifiers and RF filter circuits. This course introduces basic principles of microwave amplifiers such as klystron, reflex klystron and magnetron applications. Much attention is given to basic microwave amplifiers, oscillators and measurement of power, VSWR and impedance. Introduction of basic RF concepts and design of basic filters. It also deals with RF basic oscillators, mixers.

Unit No.	Particulars	Contact Hours
1	Transmission Line Theory:Lumped element circuit model for transmission line, field analysis, Smith chart, quarter wave transformer, generator and load mismatch, impedance matching and tuning.	8
2	Microwave Network Analysis:Impedance and equivalent voltage and current, Impedance and admittance matrix, The scattering matrix, transmission matrix, Signal flow graph.	8
3	Microwave Components: Microwave resonators, Microwave filters, power dividers and directional couplers, Ferromagnetic devices and components.	7
4	Nonlinearity And Time VarianceInter-symbol interference, random process & noise, definition of sensitivity and dynamic range, conversion gain and distortion.	9
5	Microwave Semiconductor Devices And Modeling: PIN diode, Tunnel diodes, Varactor diode, Schottky diode, IMPATT and TRAPATT devices, transferred electron devices, Microwave BJTs, GaAs FETs, low noise and power GaAs FETs, MESFET, MOSFET, HEMT.	8
6	Amplifiers Design: Power gain equations, stability, impedance matching, constant gain and noise figure circles, small signal, low noise, high power and broadband amplifier, oscillators, Mixers design.	6

Course Outcomes:

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

1. Understand the behaviour of RF passive components and model active components.
2. Perform transmission line analysis.
3. Demonstrate use of Smith Chart for high frequency circuit design.
4. Justify the choice/selection of components from the design aspects.
5. Contribute in the areas of RF circuit design.

References:

1. Matthew M. Radmanesh, "Advanced RF & Microwave Circuit Design: The Ultimate Guide to Superior Design", AuthorHouse, 2009.

2. D.M.Pozar, "Microwave engineering", Wiley, 4th edition, 2011.
3. R.Ludwig and P.Bretchko, "R. F. Circuit Design", Pearson Education Inc, 2009.
4. G.D. Vendelin, A.M. Pavoι, U. L. Rohde, "Microwave Circuit Design Using Linear And Non Linear Techniques", John Wiley 1990.
5. S.Y. Liao, "Microwave circuit Analysis and Amplifier Design", Prentice Hall 1987.
Radmanesh, "RF and Microwave Electronics Illustrated", Pearson Education, 2004.

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-102

Course Title: Fiber Optic Communication Networks

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. To learn the basic elements of optical fiber transmission link, fiber modes configurations and structures
2. To understand the different kind of losses, signal distortion in optical wave guides and other signal degradation factors
3. To learn the various optical source materials, LED structures, quantum efficiency, Laser diodes
4. To learn the fiber optical receivers such as PIN APD diodes, noise performance in photo detector, receiver operation and configuration
5. To learn the fiber optical network components, variety of networking aspects, FDDI, SONET/SDH and operational principles WDM

Unit No.	Particulars	Contact Hours
1	<p>Network Elements: Optical and Photonic Device Technology: Attenuation and dispersion, Chirp, Dispersion Management, Couplers, Isolators, Circulators, Multiplexers and Filters, EDFA, Raman Amplifier, SOA, SRA, Active and Passive Optical Switches, Optical Cross Connects, Wavelength Selective Cross Connects, Wavelength Converters, Optical Time Domain Reflectometry (OTDR), Optical Spectrum Analysers (OSA), WDM and Filters: dielectric, AWG and Fiber Bragg Grating (FBG) devices, Nonlinear optical fibers.</p>	10
2	<p>Optical Modulators: Phenomenological theory of nonlinearities. Optics of anisotropic media. Harmonic generation, mixing and parametric effects. Two-photon absorption, saturated absorption and nonlinear refraction. Rayleigh, Brillouin and Raman scattering. Self-focusing and self-phase-modulation. Self-induced transparency Solitons. Optical switching, Electro-Optic Effect and Acousto-Optic effects. EO and AO modulators.</p>	9
3	<p>Detection and receiver design: Receiver Sensitivity – Bit-Error Rate, Eye Pattern, and Minimum received power, Quantum limit of photo detection; Receiver Design – Front End, Linear channel, Decision circuit, Integrated Receivers; Noise in detection Circuit – Shot Noise, Thermal noise; Concept of Carrier to Noise Analysis.</p>	8
4	<p>Network Architectures and Topologies: The End To End Transmission Path, Loss And Dispersion Budgets in Network Designing, Optical Signal Flow And Constraints, Design of STAR, BUS, MESH and RING Topologies, Static Multipoint Networks: The Broadcast Star, Multiplexing and Multiple Access Schemes: TWDM/MA, Sub carriers, CDMA, Capacity Allocation for Dedicated Connections, Demand Assigned Connections.</p>	9
5	<p>Optical Networks: Optical Networks Architecture, SONET/SDH Optical Network, WDM Optical Networks, Wavelength Routed Optical Network, Routing Algorithms, Network Monitoring and Management, Fault and Security Management, Routing Protocols, Intelligent Optical Network (ION), FDDI, FTTH, Business Drivers for Next Generation-Optical Networks, Coherent Optical Communication Systems and Design Requirements, Dispersion Compensating Network Designs, Optical Heterodyne Systems.</p>	9

Course Outcomes:

1. Graduate will demonstrate the ability to design conduct experiment analyze and interpret dat
2. Graduate will demonstrate the ability to design a system, component or process as per needs and specification
3. Graduate will develop confidence for self education and ability for life long learning

References:

1. Govind P. Agrawal, "Fiber-Optic Communication Systems" , 3rd Ed., John Wiley & Sons 2003.
2. Gerd Keiser, "Optical Fiber Communications" McGraw-Hill, 3rd Edition, 2000.
3. John M. Senior "Optical Fiber Communications principles and practice" 2nd Edition, PHI, 2003

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-112

Course Title: Cognitive Radio

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. Study the fundamental limits of communication in cognitive radio networks from information theoretic frameworks.
2. Development of efficient spectrum sensing techniques for mobile users.
3. Interference analysis, avoidance and mitigation, by network coding/ cognitive beam forming/ interference alignment.
4. Compressed sensing for achieving higher detection sensitivity, especially in view of wide-band spectrum sensing

Unit No.	Particulars	Contact Hours
1	Introduction to Cognitive Radios: Digital dividend, cognitive radio (CR) architecture, functions of cognitive radio, dynamic spectrum access (DSA), components of cognitive radio, spectrum sensing, spectrum analysis and decision, potential applications of cognitive radio.	9
2	Spectrum Sensing: Spectrum sensing, detection of spectrum holes (TVWS), collaborative sensing, geo-location database and spectrum sharing business models (spectrum commons, real time secondary spectrum market).	8
3	Optimization Techniques of Dynamic Spectrum Allocation: Linear programming, convex programming, non-linear programming, integer programming, dynamic programming, stochastic programming..	9
4	Dynamic Spectrum Access and Management: Spectrum broker, cognitive radio architectures, centralized dynamic spectrum access, distributed dynamic spectrum access, learning algorithms and protocols	9
5	Spectrum Trading: Introduction to spectrum trading, classification of spectrum trading, radio resource pricing, brief discussion on economics theories in DSA (utility, auction theory), classification of auctions (single auctions, double auctions, concurrent, sequential).	10
6	Research Challenges in Cognitive Radio: Network layer and transport layer issues, cross-layer design for cognitive radio networks	6

Course Outcomes:

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

1. Understand the fundamental concepts of cognitive radio networks.
2. Develop the cognitive radio, as well as techniques for spectrum holes detection that cognitive radio takes advantages in order to exploit it.
3. Understand technologies to allow an efficient use of TVWS for radio communications based on two spectrum sharing business models/policies.
4. Understand fundamental issues regarding dynamic spectrum access, the radio-resource management and trading, as well as a number of optimisation techniques for better

References:

1. Ekram Hossain, Dusit Niyato, Zhu Han, "Dynamic Spectrum Access and Management in Cognitive Radio Networks", Cambridge University Press, 2009.

2. Kwang-Cheng Chen, Ramjee Prasad, "Cognitive radio networks", John Wiley & Sons Ltd., 2009.
3. Bruce Fette, "Cognitive radio technology", Elsevier, 2nd edition, 2009.
4. Huseyin Arslan, "Cognitive Radio, Software Defined Radio, and Adaptive Wireless Systems", Springer, 2007.
5. Francisco Rodrigo Porto Cavalcanti, Soren Andersson, "Optimizing Wireless Communication Systems" Springer, 2009.
6. Linda Doyle, "Essentials of Cognitive Radio", Cambridge University Press, 2009.

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-113

Course Title: Wireless & Mobile Communication

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. By the end of the course, the student will be able to analyze and design wireless and mobile cellular systems.
2. By the end of the course, the student will have the ability to work in advanced research wireless and mobile cellular programs.

Unit No.	Particulars	Contact Hours
1	Cellular Communication Fundamentals:Cellular system design, Frequency reuse, cell splitting, handover concepts, Co channel and adjacent channel interference, interference reduction techniques and methods to improve cell coverage, Frequency management and channel assignment.GSM architecture and interfaces, GSM architecture details, GSM subsystems, GSM Logical Channels, Data Encryption in GSM, Mobility Management, Call Flows in GSM.2.5 G Standards: High speed Circuit Switched Data (HSCSD), General Packet Radio Service (GPRS), 2.75 G Standards: EDGE.	8
2	Spectral efficiency analysis based on calculations for Multiple access technologies:TDMA, FDMA and CDMA,Comparison of these technologies based on their signal separation techniques, advantages, disadvantages and application areas.Wireless network planning (Link budget and power spectrum calculations)	6
3	Mobile Radio Propagation:Large Scale Path Loss, Free Space Propagation Model, Reflection, Ground Reflection (Two-Ray) Model, Diffraction, Scattering, Practical Link Budget Design using Path Loss Models, Outdoor Propagation Models, Indoor Propagation Models, Signal Penetration into Buildings. Small Scale Fading and Multipath Propagation, Impulse Response Model, Multipath Measurements, Parameters of Multipath channels, Types of Small Scale Fading: Time Delay Spread; Flat, Frequency selective, Doppler Spread; Fast and Slow fading..	8
4	Equalization, Diversity:Equalizers in a communications receiver, Algorithms for adaptive equalization, diversity techniques, space, polarization, frequency diversity, Interleaving.	5
5	Code Division Multiple Access:Introduction to CDMA technology, IS 95 system Architecture, Air Interface, Physical and logical channels of IS 95, Forward Link and Reverse link operation, Physical and Logical channels of IS 95 CDMA, IS 95 CDMA Call Processing, soft Handoff, Evolution of IS 95 (CDMA One) to CDMA 2000, CDMA 2000 layering structure and channels.	8
6	Higher Generation Cellular Standards:3G Standards: evolved EDGE, enhancements in 4G standard, Architecture and representative protocols, call flow for LTE, VoLTE, UMTS, introduction to 5G	4

Course Outcomes:

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

1. Design appropriate mobile communication systems.
2. Apply frequency-reuse concept in mobile communications, and to analyze its effects on interference, system capacity, handoff techniques

3. Distinguish various multiple-access techniques for mobile communications e.g. FDMA, TDMA, CDMA, and their advantages and disadvantages .
4. Analyze path loss and interference for wireless telephony and their influences on a mobile-communication system's performance.
5. Analyze and design CDMA system functioning with knowledge of forward and reverse channel details, advantages and disadvantages of using the technology.
6. Understanding upcoming technologies like 3G, 4G etc

Text Books:

1. K.Feher, Wireless digital communications, PHI, New Delhi, 1999.
2. T.S.Rappaport, Wireless digital communications; Principles and practice, Prentice Hall, NJ, 1996.

Reference Books:

1. W.C.Y.Lee, Mobile communications Engineering: Theory And Applications, Second Edition, McGraw Hill, New York.1998.
2. Schiller, Mobile Communications; Pearson Education Asia Ltd., 2000.

Department Of Electronics & Communication Engineering

1-Subject Code: METC-101

Course Title: Research Methodology & IPR

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Understand some basic concepts of research and its methodologies
2. Identify appropriate research topics
3. Select and define appropriate research problem and parameters
4. Prepare a project proposal (to undertake a project)
5. Organize and conduct research (advanced project) in a more appropriate manner \
6. Write a research report and thesis
7. Write a research proposal (grants)

Unit No.	Particulars	Contact Hours
1	Meaning of research problem, Sources of research problem, Criteria Characteristics of a good research problem, Errors in selecting a research problem, Scope and objectives of research problem. Approaches of investigation of solutions for research problem, data collection, analysis, interpretation, Necessary instrumentations	5
2	Effective literature studies approaches, analysis Plagiarism, Research ethics	6
3	Effective technical writing, how to write report, Paper Developing a Research Proposal, Format of research proposal, a presentation and assessment by a review committee	7
4	Nature of Intellectual Property: Patents, Designs, Trade and Copyright. Process of Patenting and Development: technological research, innovation, patenting, development. International Scenario: International cooperation on Intellectual Property. Procedure for grants of patents, Patenting under PCT	7
5	Patent Rights: Scope of Patent Rights. Licensing and transfer of technology. Patent information and databases. Geographical Indications	9
6	New Developments in IPR: Administration of Patent System. New developments in IPR; IPR of Biological Systems, Computer Software etc. Traditional knowledge Case Studies, IPR and IITs	4

Course Outcomes:

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

1. Understand research problem formulation. Analyze research related information
2. Follow research ethics
3. Understand that today's world is controlled by Computer, Information Technology, but tomorrow world will be ruled by ideas, concept, and creativity.
4. Understanding that when IPR would take such important place in growth of individuals & nation, it is needless to emphasis the need of information about Intellectual Property Right to be promoted among students in general & engineering in particular.

5. Understand that IPR protection provides an incentive to inventors for further research work and investment in R & D, which leads to creation of new and better products, and in turn brings about, economic growth and social benefits.

References:

1. Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"
2. Wayne Goddard and Stuart Melville, "Research Methodology: An Introduction"
3. Ranjit Kumar, 2nd Edition, "Research Methodology: A Step by Step Guide for beginners"
4. Halbert, "Resisting Intellectual Property", Taylor & Francis Ltd ,2007. Mayall, "Industrial Design", McGraw Hill, 1992.
5. Niebel, "Product Design", McGraw Hill, 1974.
6. Asimov, "Introduction to Design", Prentice Hall, 1962.
7. Robert P. Merges, Peter S. Menell, Mark A. Lemley, " Intellectual Property in New Technological Age", 2016.
8. T. Ramappa, "Intellectual Property Rights Under WTO", S. Chand, 2008

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-151

Lab Title: Advance Microwave Lab

2-Contact Hours: L: 0 T: 0 P: 2

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 2

Students will have to complete **Any Five** experiments from the following list during the first Semester Using HFSS 14.

Objective:

1. To study the characteristics and various optical fiber parameters using different types of optical cables in single and multi-mode.
2. To study about various optical sources and optical detectors and their use in both analog and digital in the optical communication system.
3. To facilitate the student to become familiar with active & passive microwave devices & components used in Microwave communication systems.

List Of Experiments:

- 1 – UHF Probe
- 2 – Circular Waveguide Horn
- 3 – Probe Feed Patch
- 4 – Slot Coupled Patch
- 5 – Specific Absorption Rate
- 6 – CPW Feed Bowtie Antenna
- 7 – End-fire Array

Course Outcome:

1. Students can identify the type of fiber optic cable and test their parameters.
2. Students will have the awareness to select appropriate optical source and detector for different applications.
3. Students can operate and modify the setting in any kind of microwave equipment

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-152

Lab Title: Optical and Fiber Communication Lab

2-Contact Hours: L: 0 T: 0 P: 2

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 2

Students will have to complete **Any Five** experiments from the following list during the first Semester.

Objective:

1. Fiber optic communication design, measurements and simulations. This includes numerical aperture, fiber attenuation, power distribution in single mode fibers, mode distribution in multimode fibers, fiber coupling efficiency and Connectors/ splices losses. Also design, construction and simulation of WDM communication system components are covered

List Of Experiments:

1. Measurement of Numerical Aperture
2. Measurement of Attenuation and Bending Loss
3. Study of Analog Link
4. Study of BER and Q-factor estimation in the optical system simulation
5. EDFA design for DWDM link
6. Study the Characteristics of a Communication channels AWGN BSC
7. Analog and Digital Modulation
 - Frequency Modulation and Demodulation
 - QPSK Modulation and Demodulation
8. Conventional Encoder and Decoder

Course Outcome:

1. Couple light in and out of fibers and connect them • Measure loss and dispersion in fibers
2. Measure the performance of analog and digital fiber links
3. Relate an integrated view of engineering by explaining the fundamental analogies between electrical and optical communication systems.

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-201

Course Title: Antenna and Radiating System

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Antenna radiation mechanism, field and polarization analysis.
2. Antenna tuning and optimization.
3. Frequency and pattern reconfigurability
4. Antenna array mechanism

Unit No.	Particulars	Contact Hours
1	Types of Antennas: Wire antennas, Aperture antennas, Micro strip antennas, Array antennas Reflector antennas, Lens antennas, Radiation Mechanism, Current distribution on thin wire antenna. Fundamental Parameters of Antennas: Radiation Pattern, Radiation Power Density, Radiation Intensity, Directivity, Gain, Antenna efficiency, Beam efficiency, Bandwidth, Polarization, Input Impedance, radiation efficiency, Antenna Vector effective length, Friis Transmission equation, Antenna Temperature.	9
2	Linear Wire Antennas: Infinitesimal dipole, Small dipole, Region separation, Finite length dipole, half wave dipole, Ground effects. Loop Antennas: Small Circular loop, Circular Loop of constant current, Circular loop with non uniform current..	8
3	Linear Arrays: Two element array, N Element array: Uniform Amplitude and spacing, Broadside and End fire array, Super directivity, Planar array, Design consideration.	8
4	Aperture Antennas: Huygen's Field Equivalence principle, radiation equations, Rectangular Aperture, Circular Aperture. Horn Antennas: E-Plane, H-plane Sectoral horns, Pyramidal and Conical horns.	8
5	Micro strip Antennas: Basic Characteristics, Feeding mechanisms, Method of analysis, Rectangular Patch, Circular Patch.	9
6	Reflector Antennas: Plane reflector, parabolic reflector, Cassegrain reflectors, Introduction to MIMO.	6

Course Outcomes:

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

1. Compute the far field distance, radiation pattern and gain of an antenna for given current distribution
2. Estimate the input impedance, efficiency and ease of match for antennas.
3. Compute the array factor for an array of identical antennas.
4. Design antennas and antenna arrays for various desired radiation pattern characteristics.

References:

1. Constantine A. Balanis, "Antenna Theory Analysis and Design", John Wiley & Sons, 4th edition, 2016.
2. John D Kraus, Ronald J Marhefka, Ahmad S Khan, "Antennas for All Applications", Tata McGraw-Hill, 2002.
3. R.C.Johnson and H.Jasik, "Antenna Engineering hand book", Mc-Graw Hill, 1984. I.J.Bhal and P.Bhartia, "Micro-strip antennas", Artech house, 1980:

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-202

Course Title: Communication System

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To understand basic analog and digital communication system theory and design, with an emphasis on wireless communications methods.

Unit No.	Particulars	Contact Hours
1	COMMUNICATION SYSTEMS AND SIGNALS: Elements of a communication system, Transmitter, receiver and channel, Mathematical models of communication channels, The layered approach, Communication signals -Time and frequency domain representation using Fourier series, Fourier Transform and Inverse Fourier transform. Transmission of signals through linear systems, Filters, Low pass and band pass signals, Band pass systems, Phase and group delay, sources of information, Numerical computation of the Fourier Transform	8
2	ANALOG COMMUNICATION SYSTEMS: Review of amplitude modulation techniques-Double side band suppressed carrier AM, Single sideband, Vestigial sideband, Implementation of modulation and Demodulation circuits, Frequency modulation, PLL, Non linear effects in FM systems, Super heterodyne receiver, Mobile Radio system.	7
3	RANDOM VARIABLES, PROCESSES AND NOISE THEORY: Probability, Random variables, Statistical averages, random processes, Mean, correlation and covariance functions, Transmission of a random process through a Linear spectral density, Power spectral density, Gaussian Process, noise, narrowband noise. Receiver Model, Calculation of Noise in DSB-SC, AM and FM receivers, Pre-emphasis and De-emphasis	7
4	DIGITAL COMMUNICATION SYSTEMS: Sampling – PAM, TDM, PPM, Quantization-PCM and Delta Modulation, Baseband Transmission of Digital Signals-matched filter detection, probability of error due to noise, inter symbol interference, Nyquist criterion for distortionless transmission, Baseband and M-ary PAM Transmission, Tapped delay equalization, Bandpass Transmission of Digital Signals-Bandpass Transmission Model, M-ary Data Transmission systems, Transmission of Binary PSK and FSK	9
5	INFORMATION THEORY, SOURCE CODING AND ERROR CONTROL CODING: Information content, entropy and information rate of independent sources, data compression, sources with dependent messages, Still and moving images compression, ERROR CONTROL CODING TECHNIQUES: Channel capacity, Field theory and modulo-2 operators, Hamming codes, Geometric interpretation of error control coding, cyclic codes, Hybrid FEC/ARQ codes, Correcting Burst errors, Convolutional errors and viterbi decoding.	10

Course Outcomes:

1. Understand the basic concept of information
2. Understand how information is put into electronic for storage and delivery.
3. Have detailed understanding of amplitude and frequency modulation and demodulation methods including synchronous demodulation, nonlinear demodulation and phase-locked loops.
4. Have an understanding of design considerations for multiple access/use spectrum and multiplexing
5. Have detailed understanding of digital communication basics including matched filters, signal space methods and optimal receiver design
6. Understand basic principles of Gaussian noise processes and their use/utility in communication system design.

References:

1. Harold P.E.Stern, Samy A.Mahmoud; Communication Systems-Analysis and Design
2. John G. Proakis, Masoud Salehi, Communication Systems Engineering.
3. Haykin, Moher; Communication Systems, Wiley, India

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-211

Course Title: CAD of RF & Microwave Circuit

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Analyze transmission-line circuits at RF and microwave frequencies
2. Use the Smith chart for solving transmission-line problems
3. Perform Scattering parameter analysis of RF networks.
4. Describe the operation and analyze the performance of basic microwave components

Unit No.	Particulars	Contact Hours
1	Microwave Tubes: Limitation of conventional tubes, microwave tubes, velocity modulation, method of producing the velocity modulation. Velocity modulation in reflex klystron, Applegate diagram with gap voltage for a reflex klystron. Principle of operation of magnetron, hull cutoff condition, advantages of slow wave devices.	9
2	Microwave oscillator design. One – port and two – port negative resistance oscillators. Oscillator design using large – signal measurements.	7
3	Planar transmission lines; characteristics, properties; design parameters and applications. Design of mixers.	7
4	Microwave Networks and Component: Wave guide components like attenuator, Phase shifters and couplers, Flanges, Bends, Irises, Posts, Loads, Principle of operation and properties of E-plane, H-plane Tee junctions of wave guides, Hybrid T, Multi-hole directional coupler, Directional couplers, Microwave resonators- rectangular. Principles of operation of nonreciprocal devices, properties of ferrites, Isolators and phase shifters.	9
5	Microwave-Measurements: Square law detection, Broadband and tuned detectors. Wave-guide probes, Probe and detector mounts, Slotted line arrangement and VSWR meter, Microwave bench components and source modulation. High, Medium and low-level power measurement techniques, Network Analyzer and its use in measurements.	10

Course Outcomes:

1. Design basic microwave components to meet certain specifications
2. Analyze microwave systems and assess the impact of microwave component performances on overall system performance
3. Assess qualitatively and quantitatively the role of microwave components in the application areas of MIC, MEMS, wireless systems and UWB systems

References:

1. “Microwave Engineering” by Prof. GSN Raju, IK International Publishers, 2007

2. "Microwave Engineering" by P.A. Rizzi, PHI, 1999.
3. "Microwave Transistors and Amplifiers" by G.Gonzalez, Prentice- Hall
4. "Microwave Amplifier and Oscillator Design" by S.Y.Liao, Prentice – Hal
5. R. E. Collins: Foundations of Microwave Engineering, 2nd Edition, Wiley Publications.
6. D. M. Pozar: Microwave Engineering, 3rd Edition, Wiley Publications

Department Of Electronics & Communication Engineering

- 1- Subject Code: MMW-212 Course Title: Advanced Digital Signal Processing
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4- Credits: 3

Objectives:

1. To provide an understanding of the principles and concepts digital signal processing.
2. To introduce compressive sensing and its application to automatic target recognition.
3. To provide an understanding of current research in advanced digital signal processing.

Unit No.	Particulars	Contact Hours
1	Overview of DSP, Characterization in time and frequency, FFT Algorithms, Digital filter design and structures: Basic FIR/IIR filter design & structures, design techniques of linear phase FIR filters, IIR filters by impulse invariance, bilinear transformation, FIR/IIR Cascaded lattice structures, parallel realization of IIR.	9
2	Multi rate DSP, Decimators and Interpolators, Sampling rate conversion, multistage decimator & interpolator, poly phase filters, QMF, digital filter banks, Applications in sub-band coding.	8
3	Linear prediction & optimum linear filters, stationary random process, forward-backward linear prediction filters, solution of normal equations, AR Lattice and ARMA Lattice-Ladder Filters, Wiener Filters for Filtering and Prediction.	8
4	Adaptive Filters, Applications, Gradient Adaptive Lattice, Minimum mean square criterion, LMS algorithm, Recursive Least Square algorithm.	9
5	Estimation of Spectra from Finite-Duration Observations of Signals. Nonparametric Methods for Power Spectrum Estimation, Parametric Methods for Power Spectrum Estimation, Minimum-Variance Spectral Estimation, Eigen analysis Algorithms for Spectrum Estimation.	9
6	Application of DSP & Multi rate DSP, Application to Radar, introduction to wavelets, application to image processing, design of phase shifters, DSP in speech processing & other applications.	7

Course Outcomes:

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

1. To understand theory of different filters and algorithms.
2. To understand theory of multirate DSP, solve numerical problems and write algorithms.
3. To understand theory of prediction and solution of normal equations.
4. To know applications of DSP at block level.

References:

1. J.G.Proakis and D.G.Manolakis“Digital signal processing: Principles, Algorithm and Applications”, 4th Edition, Prentice Hall, 2007.
2. N. J. Fliege, “Multirate Digital Signal Processing: Multirate Systems -Filter Banks – Wavelets”, 1st Edition, John Wiley and Sons Ltd, 1999.
3. Bruce W. Suter, “Multirate and Wavelet Signal Processing”,1st Edition, Academic Press, 1997.
4. M. H. Hayes, “Statistical Digital Signal Processing and Modeling”, John Wiley & Sons Inc., 2002.
5. S.Haykin, “Adaptive Filter Theory”, 4th Edition, Prentice Hall, 2001.
6. D.G.Manolakis, V.K. Ingle and S.M.Kogon, “Statistical and Adaptive Signal Processing”, McGraw Hill, 2000

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-251

Lab Title: Project Based Lab

2-Contact Hours: L: 0 T: 0 P: 2

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 2

Students will have to complete **Any Five** experiments from the following list during the second semester using HFSS 14.

List Of Experiments:

1 – Magic T

2 – Coax Bend

3 – Ring Hybrid

4 – Coax Stub Includes Optimetrics.

5 – Microstrip - Wave Ports Includes Optimetrics.

6 – Dielectric Resonator

7 – Band-pass Filter

8 – Band-stop Filter

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-252

Lab Title: Microwave Engineering Lab

2-Contact Hours: L: 0 T: 0 P: 2

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 2

Students will have to complete **Any Six** experiments from the following list during the second semester.

Objective:

1. Know about the behavior of microwave components.
2. Understand the radiation pattern of horn antenna

List Of Experiments:

1. Measurement of guide wavelength and frequency of the signal in a rectangular waveguide.
2. Measurement of VSWR using slotted line.
3. Study of mode characteristics of reflex Klystron and determination of mode number, transit time & electronic tuning sensitivity.
4. Study of characteristics of Gunn oscillator.
5. Study of Gunn diode as modulated source (PIN modulation) and determination of modulation depth.
6. Measurement of coupling coefficient and directivity of a directional coupler.
7. Study of insulation & coupling coefficient of a magic T.
8. Measurement of attenuation using substitution method and plot of attenuation versus frequency characteristics.
9. Study of waveguide horn and its radiation pattern and determination of the beam width.
10. Study of a ferrite circulator and measurement of isolation, insertion loss, cross coupling and input VSWR.
11. Measurement of microwave power using power meter

Course Outcome:

1. Demonstrate the characteristics of Microwave sources
2. Demonstrate the characteristics of directional Couplers
3. To test the characteristics of microwave components
4. To analyze the radiation pattern of antenna
5. To measure antenna gain
6. Practice microwave measurement procedures

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-253

Lab Title: Mini Project

2-Contact Hours: L: 0 T: 0 P: 4

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 2

The student will have to submit a synopsis at the beginning of the semester for the approval to the departmental project committee in a specified format. The student will have to present the progress of the work through seminars and progress report. A report must be submitted to the department for evaluation purpose at the end of the semester in a specified format.

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-301

Course Title: Computational Electromagnetics

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. Introduce the subject of computational techniques and numerical methods to the EE graduate students. Utilize the computer power at KFUPM and strengthen the use of computers in design and education.
2. Develop expertise in the field of computational electromagnetics in particular and numerical methods in general.
3. Complement the shortage in the EE graduate (and undergraduate in the future) curriculum which improves the image of the EE department within the KFUPM community and at large.
4. Offer EE graduate students opportunities to pursue their MS and PhD research in this field, through solving real-life technological problems.

Unit No.	Particulars	Contact Hours
1	Review: Maxwell's Equations, Boundary Conditions, Wave Equation Vector Potential Theory, Wave Polarization, and Solutions to Maxwell's Equations.	8
2	Introduction to the Finite Element Method (FEM) – Ritz and Galerkin methods Example: Static Solution via the FEM method.	8
3	1D FEM – Dynamic Solution – Deriving the Boundary Value Problem Linear Shape Functions, Simplex Coordinates, and Assembly, 1D Example in Cartesian Coordinate, Higher-Order shape functions	7
4	2D FEM – Reactional Form of the Wave Equation 2D Shape Functions on triangles 2D Finite Element Analysis 2D Applications – Static & Dynamic Absorbing Boundary Conditions Higher-order elements on a 2D triangle Numerical Integration on 2D triangles Isoparametric 2D Triangular Elements	9
5	3D Finite Elements Shape Functions – Tetrahedron, Hexahedron, and Prisms Numerical Integration – 3D Cubature Rules Applications of 3D FEM.	8

Course Outcomes:

1. Build a background in numerical methods to be used in their research work and future studies and careers.
2. Understand the concept of modeling and the treatment of numerical solutions.
3. Explore an ever-increasing area of research with state-of-the-art techniques and methods.
4. Be exposed to the recent (and hot) technological developments in the field of electromagnetics, especially in photonics and telecommunications.

References:

1. The Finite Element Method in Electromagnetics , J.-M. Jin, Wiley-IEEE Press; 2 edition (May 27, 2002).
2. Finite Element Method for Eigenvalue Problems in Electromagnetics by C. J. Reddy, Manohar D. Deshpande, C. R. Cockrell, and Fred B. Beck NASA Technical Paper.

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-003

Course Title: RADAR and SONAR System Engineering

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To understand the Radar Signal acquisition and sampling in multiple domains
2. To provide clear instruction in radar DSP basics
3. To equip the skills needed in both design and analysis of common radar algorithms
4. To understand the basics of synthetic aperture imaging and adaptive array processing
5. To illustrate how theoretical results are derived and applied in practice

Unit No.	Particulars	Contact Hours
1	<u>INTRODUCTION:</u> Radar Block Diagram & operation, Radar Frequencies, Radar development, Application of Radar. <u>RADAR EQUATION:-</u> Simple form of Radar Equation, Prediction of Range performance, Minimum detectable signal, Receiver noise, Signal to Noise ratio, Transmitter Power, Pulse repetition frequency & range ambiguities, System losses, Propagation effects.	8
2	CW & FREQUENCY MODULATED RADAR:- The Doppler effect, CW Radar, Frequency-modulated CW Radar, Multiple Frequency CW Radar. MTI & PULSE DOPPLER RADAR:- Introduction, Delay Line Cancellers, Multiple or staggered, Pulse repetition frequencies, range-Gated Doppler Filters, Digital Signal Processing, Other MTI delay line, Limitation of MTI performance, Noncoherent MTI, Pulse Doppler Radar, MTI from a moving platform.	7
3	TRACKING RADAR: Tracking with Radar, Sequential Lobbing, Conical Scan, Monopulse Tracking Radar, Tracking in range, Acquisition. RECEIVERS, DISPLAYS & DUPLEXERS:- Radar Receivers, Noise Figure, Mixer, Low-noise Front ends, Displays, Duplexer, Receiver protectors.	7
4	Sonar System: Propagation, the sea surface reflection and scattering from boundaries, effects of an inhomogeneous medium. Description of sources of noise. Reverberation. Probability correlation analysis. Spectral analysis.	9
5	Review of active/passive sonar system concepts. Basic design considerations. Review of spatial and temporal processors for search and track applications for active/passive sonars. Sonar displays. Physics of CRT displays. Psycho-physical aspects. Display format and detection criteria. Modern software format display. Miscellaneous sonar concepts including frequency scanning side scan, parametric array, coastal surveillance systems.	10

Course Outcomes:

1. Graduates will demonstrate the ability to identify, formulate and solve engineering problems
2. Graduates will demonstrate the ability to design a system, component or process as per needs and specifications
3. Graduates will show the ability to participate and try to succeed in competitive examinations

References:

1. Introduction to Radar Systems Third Edition—Merrill I. Skolnik
2. Sonar for Practising Engineers Third Edition—A. D. Waite ,Wiley Publications.
3. Electronic Communication Systems : Kennedy; TMH
4. Microwaves and Radar : A.K. Maini; Khanna
5. Peyton Z. Peebles;, "Radar Principles", Johnwiley, 2004
6. J.C Toomay, " Principles of Radar", 2nd Edition –PHI, 2004

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-351

Lab Title: Dissertation (Phase – I)

2-Contact Hours: L: 0 T: 0 P: 20

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 10

Syllabus Contents:

The dissertation / project topic should be selected / chosen to ensure the satisfaction of the urgent need to establish a direct link between education, national development and productivity and thus reduce the gap between the world of work and the world of study. The dissertation should have the following

1. Relevance to social needs of society
2. Relevance to value addition to existing facilities in the institute
relevance to industry need
3. Problems of national importance
4. Research and development in various domain

The student should complete the following:

1. Literature survey Problem Definition
2. Motivation for study and Objectives
3. Preliminary design / feasibility / modular approaches
4. Implementation and Verification
5. Report and presentation

Guidelines for Dissertation Phase – I and II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator.

After multiple interactions with guide and based on comprehensive literature survey, the student shall identify the domain and define dissertation objectives. The referred literature should preferably include IEEE/IET/IETE/Springer/Science Direct/ACM journals in the areas of Computing and Processing (Hardware and Software), Circuits-Devices and Systems, Communication-Networking and Security, Robotics and Control Systems, Signal Processing and Analysis and any other related domain. In case of Industry sponsored projects, the relevant application notes, while papers, product catalogues should be referred and reported.

Student is expected to detail out specifications, methodology, resources required, critical issues involved in design and implementation and phase wise work distribution, and submit the proposal within a month from the date of registration.

Phase – I deliverables: A document report comprising of summary of literature survey, detailed objectives, project specifications, paper and/or computer aided design, proof of concept/functionality, part results, A record of continuous progress.

Phase – I evaluation: A committee comprising of guides of respective specialization shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend repeating the Phase-I work.

Course Outcome:

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

1. Ability to synthesize knowledge and skills previously gained and applied to an in-depth study and execution of new technical problem.
2. Capable to select from different methodologies, methods and forms of analysis to produce a suitable research design, and justify their design.
3. Ability to present the findings of their technical solution in a written report.
Presenting the work in International/ National conference or reputed journals.

Department Of Electronics & Communication Engineering

1-Lab Code: MMW-451

Lab Title: Dissertation (Phase – II)

2-Contact Hours: L: 0 T: 0 P: 32

3-Examination Duration (Hrs.): Presentation/Practical 03

4-Credits: 16

The dissertation stage II is based on a report prepared by the students on dissertation allotted to them. It may be based on:

1. Experimental verification / Proof of concept.
2. Design, fabrication, testing of Communication System.
3. The viva-voce examination will be based on the above report and work.

Guidelines for Dissertation Phase – I and II

As per the AICTE directives, the dissertation is a yearlong activity, to be carried out and evaluated in two phases i.e. Phase – I: July to December and Phase – II: January to June.

The dissertation may be carried out preferably in-house i.e. department's laboratories and centers OR in industry allotted through department's T & P coordinator

During phase – II, student is expected to exert on design, development and testing of the proposed work as per the schedule. Accomplished results/contributions/innovations should be published in terms of research papers in reputed journals and reviewed focused conferences OR IP/Patents.

Phase – II deliverables: A dissertation report as per the specified format, developed system in the form of hardware and/or software, A record of continuous progress.

Phase – II evaluation: Guide along with appointed external examiner shall assess the progress/performance of the student based on report, presentation and Q & A. In case of unsatisfactory performance, committee may recommend for extension or repeating the work

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-103 Course Title: Applied Electromagnetics & Applications

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. An introduction to the general field of electromagnetism.
2. An understanding of basic electromagnetic concepts and parameters necessary for the analysis and design of electromagnetic systems.
3. Mathematical and scientific skills relevant to electromagnetic systems.
4. Basic analysis techniques needed when formulating and solving electromagnetic problems.
5. A broad outlook and appreciation of the contribution of electromagnetics to the fields of electrical, computer, and communication engineering.
6. The technical foundation required for more advanced future courses in applied electromagnetics engineering.
7. An understanding of how to bridge between the concepts of electric circuits and the concepts of electromagnetics as presented.

Unit No.	Particulars	Contact Hours
1	Electromagnetic Field & Waves: Physical interpretation of gradient divergence & curl, Gauss Law & Stokes theorem, Time varying field & Maxwell's equations, Boundary conditions, wave equations & its solution, Energy & power.	8
2	Transmission Line Theory: General Transmission Line (TL) equations, Wave Characteristics on finite TL, Transients on TL, TL Impedance matching, Some application of TL.	8
3	Waveguide & Resonators: General Solutions for TEM, TE & TM waves, parallel-plate waveguide, rectangular waveguides, circular waveguides, surface wave on a ground dielectric slab, strip line, transverse resonance technique, wave velocities dispersion, series & parallel resonant circuits, TL resonators, Rectangular Circular waveguide cavities, dielectric resonators, excitation of resonators	7
4	Electromechanical Dynamics (Field, Forces & Motion): Field & moving media, magnetic diffusion & charge relaxation, force densities & stress tensor including magnetization, polarization, propagation & stability of electromechanical waves and charge transport phenomenon.	9
5	Biological Effects of EM Field: Clinical utilization of electromagnetic field effect, medical application of micro wave technique, microwave hyperthermia, biomedical application of electromagnetic fields, Measurement techniques for the characterization of biological materials.	8

Course Outcomes:

1. Are knowledgeable in static electric and magnetic fields.
2. Demonstrate an ability to apply Gauss' law, Ampere's Law, Biot-Savart law, Faraday's law and Maxwell's equations in the analysis of electromagnetic systems.
3. Are familiar with the different vector operators used in Maxwells' equations and plane wave analysis.
4. Are familiar with the four Maxwell's equations used to study timevarying EM or dynamic fields.
5. Are familiar with Lenz's law and the concept of induced emf.
6. Understand the concept of uniform TEM plane-wave propagation.
7. Understand the concept of plane-wave polarization.
8. Understand the concept of electromagnetic power density flow in lossless medium.
9. Are able to apply Electromagnetics boundary conditions to solve for fields at interface between two different charge-free mediums.
10. Understand the concept of plane wave reflection and transmission at normal incidence.
11. Are able to come up with a basic transmission line analogue for the case of a plane wave incident at multiple dielectric interfaces
12. Understand the voltage and current wave equations along a transmission line.
13. Understand the concepts of incident and reflected waves, reflection coefficient, and Standing-Wave Ratio along a transmission line.
14. Understand the concepts of power flow, power loss, and maximum power transfer along a transmission line.
15. Understand basic concepts of matched line and quarter-wave transformer.
16. Have been exposed to at least one electromagnetic system application.

References:

1. D. M. Pozar: Microwave Engineering, 3rd Edition, Wiley Publications.

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-104

Course Title: RF and Microwave Elements

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. Microwave devices such as Amplifiers, Oscillators
2. Microwave measurements
3. RF basic concepts
4. RF filter
5. RF amplifier design

Unit No.	Particulars	Contact Hours
1	Microwave semiconductor Materials & Devices: Study of different semiconductor material for RF & Microwave material, Gas microwave diodes. Varactor diode, millimeter wave varactor diode, P-I-N diode, Tunnel diodes, Microwave Klystrons, Reflex Klystron, TWT.	8
2	Design of Microwave Active Circuits and Network Analysis: Equivalent models of microwave diode and transistor, S-parameter description of active devices, Representation of two port RF /Microwave Networks, impedance & equivalent voltages & circuit, impedance & admittance matrices, Scattering matrix, Transmission matrix, Signal Flow graphs and its applications.	8
3	Microwave filters & Amplifier Design: Microwave filter: Periodic structures, Filter design by image parameter method, Filter design by insertion loss method, Filter transformation, MW Amplifiers, Two port power gain, stability, single stage transistor amplifier design, broad band transistor amplifier design, and power amplifiers.	7
4	Noise & Active RF components: Noise in MW circuits, Dynamic range & intermeditation dissipation, RF transistor's characteristics, MW Integrated Circuits (MMIC).	9
5	Oscillators & Mixers: RF Oscillators, MW Oscillators, Oscillator Phase Noise, Frequency Multipliers, Mixer Characteristics, single ended diode mixers, single ended FET mixers, Balanced Mixer.	8

Course Outcomes:

1. Graduates will demonstrate the ability to identify, formulate and solve engineering problems
2. Graduates will demonstrate the ability to design and conduct experiments, analyze and interpret data.
3. Graduates will demonstrate the ability to design a system, component or process as per needs and specifications
4. Graduate will develop confidence for self education and ability for life-long learning.
5. Graduates will show the ability to participate and try to succeed in competitive examinations

References:

1. "Microwave Engineering" by Prof. GSN Raju, IK International Publishers, 2007
2. "Microwave Engineering" by P.A. Rizzi, PHI, 1999.

References:

1. "Microwave Transistors and Amplifiers" by G.Gonzalez, Prentice- Hall
2. "Microwave Amplifier and Oscillator Design" by S.Y.Liao, Prentice – Hal
3. R. E. Collins: Foundations of Microwave Engineering, 2nd Edition, Wiley Publications.
4. D. M. Pozar: Microwave Engineering, 3rd Edition, Wiley Publications

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-203

Course Title: Antenna Theory & Design

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. To understand the applications of the electromagnetic waves in free space.

Unit No.	Particulars	Contact Hours
1	Antenna Fundamentals and Definitions: Antenna: Definition and Operating principle, Isotropic and non-isotropic radiators, Antenna properties and functions, Antenna parameters, Solid angle, HPBW, BWFN, HPPD, Radiation resistance, Antenna temperature. Retarded vector Potential. Basics of current element. The Radio Communication Link.	9
2	Arrays: Linear arrays and their analysis, Pattern Multiplication. Resonant Antennas: Dipole antennas, Folded Dipole antennas Yagi-Uda antennas, Corner Reflector Antennas, Loop antennas, Microstrip antennas.	8
3	Broadband Antennas: Travelling-Wave wire antennas, Helical Antennas, Sleeve Antennas, Principles of Frequency-Independent Antennas, Log-Periodic Antennas.	8
4	Aperture Antennas: Radiation from Apertures and Huygen's Principle, Rectangular Apertures, Rectangular Horn Antennas, Circular Apertures, Reflector antennas.	8
5	Antenna Synthesis & Measurements: The Synthesis Problem: Formulation of Synthesis Problem, Synthesis Principles, Woodward-Lawson Sampling Method, Dolph-Chebyshev Linear array Method. Antenna Measurements: Drawbacks in Measurements of Antenna Parameters, Methods to Overcome Drawbacks in Measurements, Measurements Ranges. Antenna Pattern Measurements, Radiation Resistance Measurements, Gain Measurements, Directivity Measurement, Measurement of RI, Measurement of Efficiency, Polarisation and Phase.	9

Course Outcomes:

1. The students will be able to apply the fundamentals to design different types of antennas.

References:

1. Kraus.J.D., "Antennas" 2nd edition, John wiley and Sons, 2002.
2. Balanis.A, "Antenna Theory Analysis and Design", John Wiley and Sons, New York, 2005
3. Collin.R.E. and Zucker.F., "Antenna Theory"Part I,Mc Graw Hill,New York,1996.
4. R..C.Hansen, "Phased Array Antennas", John Wiley & Sons, 1998

Department Of Electronics & Communication Engineering

- 1- Subject Code: MMW-204 Course Title: Microwave Measurement & Material Characterization
2- Contact Hours: L: 3 T: 0 P: 0
3- Examination Duration (Hrs.): Theory 03
4-Credits: 3

Objectives:

1. Understand Microwave devices, components, their characteristics, their working , and their applications.

Unit No.	Particulars	Contact Hours
1	Electromagnetic Properties of Materials: Materials Research and Engineering at Microwave Frequencies, Physics for Electromagnetic Materials, Microscopic scale, Macroscopic scale. Microwave Theory and Techniques for Materials Characterization: Overview of the Microwave Methods for the Characterization of Electromagnetic Materials, Nonresonant methods, and Resonant methods.	9
2	Reflection Methods: Introduction, Open-circuited reflection, Short-circuited reflection, Coaxial-line Reflection Method, Open-ended apertures, Coaxial probes terminated into layered materials, Coaxial-line-excited monopole probes, Coaxial lines open into circular waveguides, Shielded coaxial lines.	8
3	Free-space Reflection Method: Requirements for free-space measurements, Short-circuited reflection method, Movable metal-backing method, Bistatic reflection method. Measurement of Both Permittivity and Permeability Using Reflection Methods: Two-thickness method, Different-position method, Combination method, Different backing method. Frequency-variation method.	8
4	Resonator Methods: Introduction, Dielectric Resonator Methods, Courtney resonators, Cohn resonators, Circular-radial resonators, Sheet resonators, Dielectric resonators in closed metal shields. Dielectric Resonator Methods for Surface-impedance Measurement: Measurement of surface resistance, Measurement of surface impedance.	9
5	Planar-circuit Methods: Introduction, Stripline Methods-Nonresonant methods and Resonant methods, Microstrip Methods-Nonresonant methods And Resonant methods, Coplanar-line Methods-Nonresonant methods and Resonant methods.	9

Course Outcomes:

1. Acknowledge about the microwave frequencies and the waveguides that are used to carry them.
2. Study the various parameters and characteristics of the various waveguide components.
3. Implement waveguide components for various applications.
4. Analyze the difference between the conventional tubes and the microwave tubes for the transmission of the EM waves.

References:

1. Microwave Electronics 'Measurement and Materials Characterization' L. F. Chen, C. K. Ong and C. P. Neo, V. V. Varadan and V. K. Varadan 'John Wiley & Sons, Ltd.

References:

2. Microwave Amplifier and Oscillator Design" by S.Y.Liao, Prentice – Hall
3. R. E. Collins: Foundations of Microwave Engineering, 2nd Edition, Wiley Publications.

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-111

Course Title: RFID System Design

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. It is intended to give readers who are unfamiliar with RFID or just need a brief refresher, a thumbnail sketch of the technology's basic functionality and its intended markets, as well as, an understanding of its relevant implementation and political issues.

Unit No.	Particulars	Contact Hours
1	RFID Standards, Laws, Regulations, Policies, and Guidelines: EPC global, ISO/IEC Item Management, Contactless Smart Cards, Animal Identification, FCC Rules for ISM Band, Identity Standards, and Guidelines for Securing RFID Systems	8
2	Understand the basic components and applications of RFID systems, modulation techniques used in RFID systems, RFID reader architectures Design & Principle.	7
3	RFID Security, Confidentiality, Integrity, Availability, Threats, Cryptography, and Threat Modeling	7
4	Frequency Bands, Electromagnetic, Antennas, Nominal Read Range, Modulation, Encoding, Data Rates, Fast Fourier Transform, Simulation, Regulations, Threats, Risks, and Mitigation	9
5	basic concepts of error correcting coding techniques in RFID systems, Understand and analyze theoretical and practical effects of tag interference and inter-reader interference in RFID systems, basic anti-collision procedures, Understand basic data security techniques for RFID systems.	7

Course Outcomes:

1. RFID used today it most commonly refers to the burgeoning business application for managing and tracking supply chains, especially in the materials, manufacturing, and retail industries.
2. The supply chain business objective is to use RFID technology to not only take the just-in-time inventory concept to its next performance level but to support additional information functions ... from streamlining the product recall process and reducing theft and fraud, to further improving the type and quantity of product marketing information.

References:

1. Finkenzeller, RFID Handbook: Fundamentals and Applications, 2nd Ed., Wiley, 2003.
2. Curty, Declercq, Dehollain and Joehl, Design and Optimization of passive UHF RFID Systems, Springer, 2007.
3. Thornton and Lathem, RFID Security, Syngress, 2006.
4. Daniel M. Dobkin, the RF in RFID: passive UHF RFID in practice, Oxford, UK: Elsevier, 2008

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-114

Course Title: RF MEMS Design & Technology

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4- Credits: 3

Objectives:

1. An understanding of simple linear and non-linear mechanical, electromagnetic and electromechanical models of RF MEMS structures
2. An ability to design practical RF MEMS devices using analytical and numerical techniques
3. An ability to design high-performance circuits and sub-systems using RF MEMS components..
4. An understanding of the limitations of the RF MEMS technology for wireless applications.

Unit No.	Particulars	Contact Hours
1	Evolution of Microsystems: Benefits of micro systems, concept of micro machines/ micro systems, Scaling laws, nano machines.	6
2	Introduction to Sensors, Actuators and Mathematical Models: Various domains and classification of transducers: electrostatic, piezoelectric, thermal sensing principles: electrostatic, resistive, chemical etc. SAW devices.	8
3	Surface Bulk Micro Machining: Overview of silicon processes techniques, micro machining techniques and special processes for MEMS, polymer MEMS, Recent advances in MEMS fabrication.	10
4	RF MEMS – enabled circuit elements and models – RF/Microwave substrate properties, Micro machined – enhanced elements – capacitors, inductors, varactors, MEM switch – shunt MEM switch, low voltage hinged MEM switch approaches, push-pull series switch, folded – beam – springs suspension series switch, Resonators – transmission line planar resonators, cavity resonators, micromechanical resonators, film bulk acoustics wave resonators, MEMS modeling – mechanical modeling, electromagnetic modeling.	4
5	Novel RF MEMS – Enabled circuits – reconfigurable circuits – the resonant MEMS switch, capacitors, inductors, tunable CPW resonator, MEMS microswitch arrays, Reconfigurable circuits – double – stub tuner, Nth-stub tuner, filters, resonator tuning system, massively parallel switchable RF front ends, true delay digital phase shifters, reconfigurable antennas – tunable dipole antennas, tunable microstrip patch-array antenna.	10

Course Outcomes:

1. This course focuses on the modeling, design, technology and applications of RF Micro-Electro-Mechanical Systems (MEMS).
2. Students will develop a strong understanding of RF MEMS technology and its applications on the future generation of communication systems, radars and sensors.
3. The class begins by introducing linear and non-linear electromechanical models for RF MEMS devices through analytical and numerical techniques.
4. The high potential of RF MEMS on building a variety of reconfigurable high-frequency components and systems is subsequently presented in detail.
5. Finally, several research topics including reliability, packaging and novel architectures are introduced

References:

1. Hector J. De Los Santos, "RF MEMS Circuit Design for Wireless Communications", Artech House, 2002.
2. Vijay K. Varadan, K.J. Vinoy, K.A. Jose, "RF MEMS and their Applications", John Wiley and Sons, Ltd., 2002.
3. Gabriel M. Rebeiz, "RF MEMS Theory, Design & Technology", Wiley Interscience, 2002

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-115

Course Title: Spread Spectrum Technology

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Describe the types and advantages of spread spectrum modulation formats.
2. Perform analysis on the performance of spread spectrum modulation formats.
3. Describe the differences and benefits of different types of spreading codes.
4. Describe the differences between standard narrowband communication systems and spread spectrum systems.
5. Analyze the performance of spread spectrum systems in the presence of interference.

Unit No.	Particulars	Contact Hours
1	Introduction to spread spectrum systems: Introduction to Spread Spectrum Technique – Direct Sequence Spread Spectrum Systems, Frequency hopping Spread Spectrum Systems and Hybrid Spread Spectrum Systems-Time hopping Spread Spectrum Signals-Common Problems faced in Spread Spectrum Systems- Introduction to OFDM - Introduction to UWB communication.	12
2	Jamming performance of Uncoded Spread Spectrum Systems: Introduction-Jammer types-BER performance in Broadband noise jamming, Partial band noise jamming and Pulsed jamming (DS/PSK, SFH/DPSK, SFH/PSK, JFH/MFSK, FFH/BFSK, Hybrid DS-SFS SFS) BER performance in single tone and multi tone jamming.	10
3	Jamming performance of Coded Spread Spectrum Systems: Interleaver structures for coded systems- Jamming Performance analysis using Linear Block codes, Convolutional codes, Iteratively decode codes	10
4	Introduction to W-CDMA Introduction to W-CDMA – Basic W-CDMA transmission technologies, Link capacity Expansion Technologies – WCDMA Characteristics and Specifications- W-CDMA system architecture- Radio Access Interface Standard – Design of W-CDMA Radio system – Quality of Service in W-CDMA systems	12

Course Outcomes:

1. Analyze the performance of spread spectrum signals in the presence of multiple access interference (CDMA context).
2. Describe techniques for reducing the impact of interference on spread spectrum signals.
3. Analyze the performance of spreading code acquisition and tracking circuits.
4. Analyze the performance of multiple access techniques based on spread spectrum (i.e., CDMA).
5. Describe the major factors influencing the capacity of CDMA wireless networks

References:

1. "Spread Spectrum Systems for GNSS and wireless communication" by Jack K Holmes, Artech house, London.
2. "Introduction to Spread Spectrum Communications "by Roger L Peterson, Rodger E. Ziemer, David E. Borth, prentice Hall.
3. "W-CDMA mobile communication systems " by Kiji Tachikawa, John Wiley & Sons.

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-116 Course Title: Advance Sensor array Signal Processing

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To develop the skills in abstract algebra
2. To develop the skills to identify linear transformation and transforms and its role in linear systems
3. To develop the skills to formulate linear transformation problems in matrix form

Unit No.	Particulars	Contact Hours
1	Spatial Signals: Signals in space and time. Spatial frequency, Direction vs. frequency. Wave fields. Far field and Near field signals	8
2	Sensor Arrays: Spatial sampling, Nyquist criterion. Sensor arrays. Uniform linear arrays, planar and random arrays. Array transfer (steering) vector. Array steering vector for ULA. Broadband arrays	8
3	Spatial Frequency: Aliasing in spatial frequency domain. Spatial Frequency Transform, Spatial spectrum. Spatial Domain Filtering. Beam Forming. Spatially white signal	8
4	Direction of Arrival Estimation: Non parametric methods - Beam forming and Capon methods. Resolution of Beam forming method. Subspace methods - MUSIC, Minimum Norm and ESPRIT techniques. Spatial Smoothing	10
5	Higher order statistics in Signal Processing: Moments, Cumulants and poly spectra, Higher order moments and LTI systems	8

Course Outcomes:

1. Understand the formulation of problems in abstract algebra framework
2. Understand and represent linear transformations
3. Understand the role of matrices in linear transformation representations

References:

1. Array Signal Processing: Concepts and Techniques., Dan E. Dudgeon and Don H. Johnson. (1993) Prentice Hall.
2. Statistical and Adaptive signal processing- Manalokis, Ingle and Kogon, Artech House INC., 2005.
3. Spectral Analysis of Signals. Petre Stoica and Randolph L. Moses. (2005, 1997) Prentice Hall.
4. Array Signal Processing.

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-207

Course Title: Optical Networks

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. The course will give the student in-depth understanding of the functionality of optical networks and how they may be implemented. How an optical network can work together with an IP-based network infrastructure for ensuring both high reliability and performance in access, metro and transport networks, is paid special attention. Protocols.

Unit No.	Particulars	Contact Hours
1	SONET/SDH: optical transport network, IP, routing and forwarding, multiprotocol label switching.	8
2	WDM network elements: optical line terminals and amplifiers, optical add/drop multiplexers, OADM architectures, reconfigurable OADM, optical cross connects.	7
3	Control and management: network management functions, optical layer services and interfacing, performance and fault management, configuration management, optical safety.	7
4	Network Survivability: protection in SONET/SDH & client layer, optical layer protection schemes.	9
5	WDM network design: LTD and RWA problems, dimensioning wavelength routing networks, statistical dimensioning models.	7
6	Access networks: Optical time division multiplexing, synchronization, header processing, buffering, burst switching, test beds, Introduction to PON, GPON, AON.	6

Course Outcomes:

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

1. Contribute in the areas of optical network and WDM network design.
2. Implement simple optical network and understand further technology developments for future enhanced network.

References:

1. Rajiv Ramaswami, Sivarajan, Sasaki, "Optical Networks: A Practical Perspective", MK, Elsevier, 3rd edition, 2010.
2. Siva Ram Murthy and Mohan Gurusamy, "WDM Optical Networks: Concepts Design, and Algorithms", PHI, EEE, 2001

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-214 Course Title: RF & Electronic System Design Techniques

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To educate students fundamental RF circuit and system design skills
2. To introduce students the basic RF electronics utilized in the industry and how to build up a complex RF system from basis
3. To offer students experience on designing and simulating RF circuits in computer

Unit No.	Particulars	Contact Hours
1	Programmable Logic Devices & FPGAs Introduction to FPGAs –FPGA technologies –FPGA Architectures –FPGA Design Flow Prototyping with Xilinx FPGAs –FPGA based Testing	13
2	Applications on FPGA DSP Algorithms on FPGAs –Wireless applications -FPGAs for automotive applications -Use of Lab view for real time simulations	13
3	PCB design Signal integrity - High speed PCB design -EMI/EMC analysis -System level design of electronic hardware for automotive applications -System level testing and validation of automotive electronics systems for reliability	15

Course Outcomes:

1. This course primarily contributes to ECE program outcomes that develop students abilities to:
2. Ability to apply knowledge of mathematics, science and engineering.
3. Ability to identify, formulate and solve engineering problems.
4. Ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

References:

1. Stephen Brown and Zvonko Vranesic, “Fundamentals of Digital Logic with Verilog Design”, TATA McGraw Hill, 2002
2. Charles Roth, “Digital Systems Design using VHDL”, Thomson Books, 1998.
3. J Bhasker, “A Verilog Premier”, 2001
4. Lionel Bening, Harry Foster, “Principles of Verifiable RTL Design, Computers”, 2001
5. Howard. W. Johnson & Martin Graham, “High speed Digital Design”, Prentice Hall, 2004.
6. Gajski, “Principles of Digital Design”, Prentice- Hall International, 1997.
7. Samir Palnitker, “A guide to Digital Design and Synthesis”, Pearson Education, 2003.

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-215

Course Title: Analog/RF IC Modeling and Design

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. The participants will after the course have a basic knowledge on the transistor-level integrated circuits with emphasis on CMOS technology.
2. The participants should understand the motivation and background of using integrated electronics, and their ubiquitous application and impact on the modern society.
3. The goal is to achieve a basic understanding and knowledge of the driving and limiting factors in circuit performance, of circuit design techniques, and of technology issues important to integrated amplifier circuits.
4. The participants are expected to be able to design basic analog integrated circuits in a standard flow with consideration of performance and powers. The course also serves as a preparation for advanced topics in analog, mixed-signal, VLSI, RF and biomedical related circuits.

Unit No.	Particulars	Contact Hours
1	Introduction to RF IC design Gain, decibels, impedance, levels. Nonlinearities and harmonic distortions. Intermediation, dynamic range.	8
2	Introduction to random processes and noises Review of thermal noise. Noise models and circuit noise calculations. Introduction to low-noise amplifiers, Low-noise RF amplifiers Structure. Relationship between power consumption, gain, Linearity and noise figure.	10
3	Transceivers architectures. Transceivers functions and characteristics. Direct conversion and super heterodyne receivers. Phase-locked loops: Phase-locked loops and frequency synthesis. Basic building blocks of the PLL. PLL synthesizers for radio applications.	10
4	Telecommunication ICs PCM, CVSD codec, filters MODEMS, LAN chip sets, ISDN Codecs, Telephone subscriber circuits, line interface, switched capacitor, DSP chips. High speed decision circuits. MIC and MMIC.	12

Course Outcomes:

1. understand the operation of CMOS devices
2. familiar with the small- and large-signal models of CMOS transistors
3. analyze the basic current mirrors
4. understanding the voltage references
5. analyze and design basic operational amplifiers
6. understand the concept of gain, power, and bandwidth
7. design basic circuits using EDA tools

References:

1. D.M. Pozar. Microwave Engineering. 3rd Ed., N.Y., John Wiley & Sons, Inc., 2005.
2. Leon W. Couch. Digital and Analog Communication Systems . 6th Ed, Prentice Hall PTR, New Jersey, 2001.
3. B. Sklar. Digital Communications. Fundamentals and Applications. 2nd Ed., Prentice Hall PTR, New Jersey, 2001.

Department Of Electronics & Communication Engineering

- 1-Subject Code: MMW-216 Course Title: Surface Acoustic Wave Devices and applications
2-Contact Hours: L: 3 T: 0 P: 0
3-Examination Duration (Hrs.): Theory 03
4-Credits: 3

Objectives:

1. Get acquainted with acoustic wave devices and design of surface acoustic wave (SAW) filters

Unit No.	Particulars	Contact Hours
1	Physical Characterization: Thin Film Thickness- Measurements- ellipsometry, surface profiling, spectrophotometer, FTIR	10
2	Critical Dimension Measurements: Optical microscope, Scanning Electron Microscope, Transmission Electron Microscope	10
3	Material and Impurity Characterization: SIMS, XRD, EDAX • Electrical Characterization	10
4	Our-probe technique, Hall effect, sheet resistance C-V measurements, DLTS, Carrier lifetime, impurity profiling, I-V measurements	9

Course Outcomes:

1. Many (at present – to 10^8) elements. At the same time it is important that ICs contain only transistors, diodes, resistors and capacitors. Practically inductive elements cannot be integrated in monolithic ICs.
2. When small ICs appeared the problem of miniaturisation of filters, delay lines and other components that included inductive elements arose. As a result of search of ways to miniaturise mentioned components, surface acoustic wave devices were created.
3. Principles of SAW devices design are revealed in this laboratory test by an example of a SAW filter consisting of input transducer, SAW waveguide, output transducer and absorbers

References:

1. W.R. Reunyan, “Semiconductor Measurements And Instrumentation”, Mc-Graw Hill.
2. Schroder, “Semiconductor Material and Device Characterization”
3. Philips F. Kare and Greydon B. Lauabee, “Characterization of semiconductor Materials”, Mc-Graw Hill., K.V. Ravi, “Imperfections and Impurities In Semiconductor Silicon”, John Wiley And Sons

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-302 Course Title: Architectures and Algorithms for DSP

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To provide sound foundation of digital signal processing (DSP) architectures and designing efficient VLSI architectures for DSP systems

Unit No.	Particulars	Contact Hours
1	Discrete Time Signal & System: Discrete time signal- sequences, Discrete time systems, LT1 system, Frequency domain representation of discrete time signal, constant coefficients difference equation.	8
2	Orientation of DSP: Introduction of programmable signal system (DSP tasks; DSP processors and embodiments), Numeric Representation and Arithmetic Operation format (Fixed point and floating point representation), Extended precision, floating point emulation, Q-notation, Fixed point and floating point arithmetic operations.	8
3	Digital Signal Processing: Architecture of Programmable Digital Signal Processors (CPU-Data and program memory features Peripheral interfacing/Execution control), Digital signal processor specific assembly language programming (Instruction types; addressing modes, assembly language programming for specific fixed/floating point points DSP processor, pipelining)	7
4	Transform and Advanced DSP Algorithm: Z-Transform and properties, RCO, Inverse Z- Transform, Recursive and non-recursive system, Algorithm for Convolution and FFT, DFT & IDFT Algorithm, Method for generation of elementary fuctions, pseudorandom number generation software.	9
5	Low Power DSP Processor Design: Design for Low power DSP processor, sources of power consumption in a programmable DSP/Software power estimation, Software techniques for low power.	8

Course Outcomes:

1. Understand DSP architectures
2. Analyze DSP architectures
3. Understand pipelining, parallel processing and retiming
4. Understand and analyze folding and unfolding architectures
5. Understand systolic architecture design
6. Understand and analyze fast convolution algorithms and algorithmic strength reduction techniques
7. Understand and analyze pipelined and parallel recursive adaptive filters
8. Understand and analyze general purpose digital signal processors

References:

1. John G. Proakis, "Digital Signal Processing Principles, Algorithms and Applications", 4th edition, PHI 2007.

2. Lawrence R. Rabiner, Bernard Gold, "Theory and Application of Digital Signal Processing", PHI 2001.
3. Roberto Cristi "Modern Digital Signal Processing", Thomson Brooks/Cole, 2000
4. Steven W. Smith, "Digital Signal Processing: A Practical Guide for Engineers and Scientists", Elsevier, 2003.

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-303

Course Title: Embedded System

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Graduates of the program are expected to understand the societal impact of embedded systems and technological solutions.
2. Graduates of the program are expected to do hardware/software co-design for embedded systems. Graduates will continue to develop skills in analysis, approach, optimization, and implementation of embedded systems.
3. Graduates of the program are expected to obtain the knowledge, skills and capabilities necessary for immediate employment in embedded systems. Embedded systems is a profession increasingly driven by advances in technology; therefore graduates are expected to obtain the necessary life-long learning skills to enable them to be able to adapt to a changing environment.
4. Graduates of the program are expected to develop a broad base of skills. These skills will prepare them for professional practice: 1) as embedded engineers, 2) as participants in embedded development teams, and 3) as effective communicators within a multidisciplinary team.
5. Graduates of the program are expected to acquire knowledge of management and marketing of embedded projects and products and to prepare for series production

Unit No.	Particulars	Contact Hours
1	Introduction to embedded systems: Background and History of Embedded Systems, definition and Classification, Programming languages for embedded systems: desirable characteristics of programming languages for embedded systems, low-level versus high-level languages, main language implementation issues: control, typing. Major programming languages for embedded systems. Embedded Systems on a Chip (SoC) and the use of VLSI designed circuits	8
2	Microcontroller: Introduction to Microcontrollers, Evolution, Microprocessors vs. Microcontrollers, MCS-51 Family Overview, Important Features, Architecture. 8051 Pin Functions, Architecture, Addressing Modes, Instruction Set, Instruction Types.	7
3	Programming: Assembly Programming. Timer Registers, Timer Modes, Overflow Flags, Clocking Sources, Timer Counter Interrupts, Baud Rate Generation. Serial Port Register, Modes of Operation, Initialization, Accessing, Multiprocessor Communications, Serial Port Baud Rate.	7
4	Interrupts: Interrupt Organization, Processing Interrupts, Serial Port Interrupts, External Interrupts, Interrupt Service Routines. Microcontroller Specification, Microcontroller Design, Testing, Timing Subroutines, Look-up Tables, Serial Data Transmission.	9

5	<p>Applications: Interfacing Keyboards, Interfacing Displays, Interfacing A/D and D/A Converters, Pulse Measurement, Loudspeaker Interface, Memory Interface.</p> <p>Serial Communications - Examples of Internal Serial-Communication Devices–UART, SPI, I2C</p> <p>Laboratory Work: Assembly Language for 8051 on KEIL</p>	10
---	---	----

Course Outcomes:

1. an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;
2. an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;
3. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;
4. an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;
5. an ability to function effectively as a member or leader on a technical team;
6. an ability to identify, analyze, and solve broadly-defined engineering technology problems;
7. an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;
8. an understanding of the need for and an ability to engage in self-directed continuing professional development;
9. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;
10. a knowledge of the impact of engineering technology solutions in a societal and global context; and a commitment to quality, timeliness, and continuous improvement

References:

1. Frank Vahid and Tony Givargis, "Embedded System Design: A Unified Hardware / Software Approach, John Wiley, 2002.
2. Steve Heath, "Embedded Systems Design", EDN Series, 2003.
3. David E simon, "An Embedded Software Primer", 1st edition, Addison Wesley 1999.
4. Wayne Wolf "Computers as components: Principles of Embedded Computing System Design", The Morgan Kaufmann Series in Computer Architecture and Design, 2008

Department Of Electronics & Communication Engineering

1- Subject Code: MMW-304

Course Title: Modelling and Simulation Techniques

2- Contact Hours: L: 3 T: 0 P: 0

3- Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Introduce students to the simulation and modeling techniques ; and
2. Provide students with opportunities to develop basic simulation and modeling skills with respect to carrying out research projects using any simulation method on the computer

Unit No.	Particulars	Contact Hours
1	Introduction Circuits as dynamic systems, Transfer functions, poles and zeroes, State space, Deterministic Systems, Difference and Differential Equations, Solution of Linear Difference and Differential Equations, Numerical Simulation Methods for ODEs, System Identification, Stability and Sensitivity Analysis.	8
2	Statistical methods, Description of data, Data-fitting methods, Regression analysis, Least Squares Method, Analysis of Variance, Goodness of fit.	7
3	Probability and Random Processes, Discrete and Continuous Distribution, Central Limit theorem, Measure of Randomness, Monte Carlo Methods.	7
4	Stochastic Processes and Markov Chains, Time Series Models.	5
5	Modeling and simulation concepts, Discrete-event simulation, Event scheduling/Time advance algorithms, Verification and validation of simulation models.	6
6	Continuous simulation: Modeling with differential equations, Example models, Bond Graph Modeling, Population Dynamics Modeling, System dynamics.	7

Course Outcomes:

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

3. Identify and model discrete systems (deterministic and random) Identify and model discrete signals (deterministic and random)
4. Understand modelling and simulation techniques to characterize systems/processes

References:

1. R. L. Woods and K. L. Lawrence, "Modeling and Simulation of Dynamic Systems", Prentice-Hall, 1997.
2. Z. Navalih, "VHDL Analysis and Modelling of Digital Systems", McGraw-Hill, 1993. J. Banks, JS. Carson and B. Nelson, "Discrete-Event System Simulation", 2nd Edition, Prentice-Hall of India, 1996.

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-001

Course Title: Management Information System

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

5. At the end of the course, it is expected that students are able to understand the usage of Information Systems in management. The students also would understand the activities that are undertaken in acquiring an Information System in an organization. Further the student would be aware of various Information System solutions like ERP, CRM, Data warehouses and the issues in successful implementation of these technology solutions in any organization.

Unit No.	Particulars	Contact Hours
1	Organizations in the Information Age: The Role of Information Technology. Building and Managing the Information Age Organization	8
2	The Virtual Organization. Electronic Commerce and the Internet	7
3	The Role of the IT Architecture. Management Support Technologies	7
4	Outsourcing the IT Function. Managing Technology-Driven Change	9

Course Outcomes:

1. Students would be able to understand the usage of MIS in organizations and the constituents of the MIS.
2. The student would understand the classifications of MIS, understanding of functional MIS and the different functionalities of these MIS. This would be followed by case study on Knowledge management.
3. Planning for Information Systems: Identification of Applications, Business Application Planning, Systems and Critical Success Factors, Method of Identifying Applications, Nolan Stage Model in MIS.

References:

1. Laudon, KC and Laudon, JP, Management Information Systems: Managing the Digital Firm 10th Ed., Pearson/Prentice-Hall, New Jersey, 2007. ISBN 0-13-153841-1

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-002

Course Title: Energy Management

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To prepare the students for successful career in the energy industry; energy regulation and management agencies; and in the academic and R&D institutions.
2. To produce graduates strong in energy resources, technologies and management fundamentals, and capable in addressing the present and potential future energy problems.
3. To produce energy professionals, who are sensitive to, and well aware of, the energy issues and concerns, and who can apply their specialized knowledge for the sustainable energy management.

Unit No.	Particulars	Contact Hours
1	1 Ecological principles and energy flow 1.1 Ecological principle of nature 1.2 Concept of ecosystems 1.3 Different types of ecosystems; ecosystem theories 1.4 Energy flow in the ecosystems; biodiversity	8
2	Energy scenario and development 2.1 Overview of world energy scenario 2.2 Overview of India's energy scenario 2.3 Overview of Energy Scenario of North East India and in particular to Assam 2.4 Energy and development linkage 2.5 Energy Sources: classification of energy sources 2.6 Quality and concentration of energy sources	7
3	Major energy resources 3.1 Units of various Energy sources, Conversion, calorific value 3.2 Coal-sources, formation, important properties & conversion 3.3 Petroleum-sources, genesis, important properties & uses 3.4 Natural gas- sources, genesis, important properties & uses	7
4	Environment concerns of energy extraction 4.1 Environment effects of energy extraction, conversion and use 4.2 Sources of pollution; primary and secondary pollutants. 4.3 Consequences of pollution growth; air, water, soil, thermal, noise pollution-cause and effect 4.4 Pollution control methods 4.5 Environmental laws on pollution control	9
5	Energy use & climate change 5.1 Global warming 5.2 Green house gas emission, impacts, mitigation. 5.3 Causes of global, regional and local climate change	10

Course Outcomes:

1. Understood and acquired fundamental knowledge on the science of energy and on both the conventional and non-conventional energy technologies
2. Acquired the expertise and skills needed for the energy monitoring, auditing and management, and for the development, implementation, maintenance and auditing of Energy Management Systems
3. Become capable of analysis and design of energy conversion systems
4. Acquired skills in the scientific and technological communications, and in the preparation, planning and implementation of energy projects

References:

1. Ristinen RA. Kraushaar JJ. Energy and the Environment, 2nd edition, John Willey & Sons, 2006
2. Banerjee BP. Handbook of Energy and Environment in India, Oxford University Press, 2005, India

3. MC Dass, Fundamentals of Ecology, Tata McGraw Hill, 1994
4. Kaushik ND. Kaushik K. Energy, Ecology & Environment, Capital Publishing, 2004
5. De AK. Environmental Chemistry, New Age International Publishers, 2005

Department Of Electronics & Communication Engineering

1-Subject Code: MMW-004

Course Title: Environment Pollution and Its Control

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To assess air pollution: sources and effects.
2. To assess sources and classification of water pollutants.
3. To assess sources of soil contamination source.

Unit No.	Particulars	Contact Hours
1	<u>Public Health</u> Communicable diseases. Non-communicable diseases caused by pollution.	5
2	<u>Water Pollution</u> Classification of sources of pollution. Heat pollution and its effects. Soil erosion and its effects. Erosion control. The process of self-cleaning. Mass balance. Dissolved oxygen profile. Eutrophication process. Sources of water pollution. Sea pollution	6
3	<u>Air Pollution</u> This topic introduces basic aspects of air pollution including the definition of air pollution, composition of air and types of pollutants. History of air pollution in Malaysia and other countries will be covered. Awareness of air pollution will be developed in this topic. Environmental Quality Act 1974. The types of pollution and the effects. Green house phenomena. Indoor air pollution. Air pollution control. Explains sources of indoor and outdoor pollution. Guidelines and standard of this pollution will be discussed. Air Pollution Index will be calculated	7
4	<u>Noise Pollution</u> This topic will explain the scope of noise including definition of noise, noise standard, level of noise pollution in the environment, definition of noise pollution and noise pollution criteria. The effects of noise pollution. The method of insulating noise pollution	7
5	<u>Solid Waste Management</u> This topic is to help students understand the process of generation and handling of Municipal solid waste (MSW). This topic covers storage, collection, and transport of municipal solid waste (MSW). It exposes the student to the various kinds of MSW disposal methods such as landfill, incineration and organic MSW composting. Discuss waste reduction, reuses, recovery and recycling concepts and also analyze the impact of reuse/recycle/reduction on landfill design and operation	9
6	<u>HAZARDOUS WASTE MANAGEMENT</u> The characteristics of hazardous waste. Environment Quality Act 1974. Processing of hazardous waste. Methods of disposal	4

Course Outcomes:

1. Ability to distinguish between various methods of air pollution analysis.
2. To understand air pollution sampling and measurement.
3. Water quality analysis and measurement of soil contamination.

References:

1. Ristinen RA. Kraushaar JJ. Energy and the Environment, 2nd edition, John Willey & Sons, 2006
2. Banerjee BP. Handbook of Energy and Environment in India, Oxford University Press, 2005, India

3. MC Dass, Fundamentals of Ecology, Tata McGraw Hill, 1994
4. Kaushik ND. Kaushik K. Energy, Ecology & Environment, Capital Publishing, 2004
5. De AK. Environmental Chemistry, New Age International Publishers, 2005

Department Of Electronics & Communication Engineering

1-Subject Code: METC-111/211

Course Title: English for Research Paper Writing

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Understand that how to improve your writing skills and level of readability
2. Learn about what to write in each section
3. Understand the skills needed when writing a Title
4. Ensure the good quality of paper at very first-time submission

Unit No.	Particulars	Contact Hours
1	Planning and Preparation, Word Order, Breaking up long, sentences, Structuring Paragraphs and Sentences, Being Concise and Removing Redundancy, Avoiding Ambiguity and Vagueness	4
2	Clarifying Who Did What, Highlighting Your Findings, Hedging and Criticising, Paraphrasing and Plagiarism, Sections of a Paper, Abstracts. Introduction	4
3	Review of the Literature, Methods, Results, Discussion, Conclusions, The Final Check.	4
4	key skills are needed when writing a Title, key skills are needed when writing an Abstract, key skills are needed when writing an Introduction, skills needed when writing a Review of the Literature, skills are needed when writing the Methods, skills needed when writing the Results, skills are needed when writing the Discussion, skills are needed when writing the Conclusions	4
5	useful phrases, how to ensure paper is as good as it could possibly be the first- time submission	4

Course Outcomes:

1. Participate actively in writing activities (individually and in collaboration) that model effective scientific and technical communication in the workplace.
2. Understand how to apply technical information and knowledge in practical documents for a variety of a.) professional audiences (including peers and colleagues or management) and b) public audiences.
3. Practice the unique qualities of professional writing style, including sentence conciseness, readability, clarity, accuracy, honesty, avoiding wordiness or ambiguity, previewing, using direct order organization, objectivity, unbiased analyzing, summarizing, coherence and transitional devices.
4. Recognize, explain, and use the rhetorical strategies and the formal elements of these specific genres of technical communication: technical abstracts, data based research reports, instructional manuals, technical descriptions, web pages, wikis, and correspondence.
5. Collect, analyze, document, and report research clearly, concisely, logically, and ethically; understand the standards for legitimate interpretations of research data within scientific and technical communities.

References:

1. Goldbort R (2006) Writing for Science, Yale University Press (available on Google Books)
2. Day R (2006) How to Write and Publish a Scientific Paper, Cambridge University Press
3. Highman N (1998), Handbook of Writing for the Mathematical Sciences, SIAM. Highman's book .

4. Adrian Wallwork , English for Writing Research Papers, Springer New York Dordrecht Heidelberg London, 2011

Department Of Electronics & Communication Engineering

1-Subject Code: METC-112/212

Course Title: Disaster Management

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Learn to demonstrate a critical understanding of key concepts in disaster risk reduction and humanitarian response.
2. Critically evaluate disaster risk reduction and humanitarian response policy and practice from multiple perspectives.
3. Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
4. Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in.

Unit No.	Particulars	Contact Hours
1	Introduction Disaster: Definition, Factors And Significance; Difference Between Hazard And Disaster; Natural And Manmade Disasters: Difference, Nature, Types And Magnitude.	4
2	Repercussions Of Disasters And Hazards: Economic Damage, Loss Of 4 Human And Animal Life, Destruction Of Ecosystem. Natural Disasters: Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts And Famines, Landslides And Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks And Spills, Outbreaks Of Disease And Epidemics, War And Conflicts.	4
3	Disaster Prone Areas In India Study Of Seismic Zones; Areas Prone To Floods And Droughts, Landslides And Avalanches; Areas Prone To Cyclonic And Coastal Hazards With Special Reference To Tsunami; Post-Disaster Diseases And Epidemics	4
4	Disaster Preparedness And Management Preparedness: Monitoring Of Phenomena Triggering A Disaster Or Hazard; Evaluation Of Risk: Application Of Remote Sensing, Data From Meteorological And Other Agencies, Media Reports: Governmental And Community Preparedness.	4
5	Risk Assessment Disaster Risk: Concept And Elements, Disaster Risk Reduction, Global And National Disaster Risk Situation. Techniques Of Risk Assessment, Global Co-Operation In Risk Assessment And Warning, People's Participation In Risk Assessment. Strategies for Survival.	4
6	Disaster Mitigation Meaning, Concept And Strategies Of Disaster Mitigation, Emerging Trends In Mitigation. Structural Mitigation And Non-Structural Mitigation, Programs Of Disaster Mitigation In India.	4

Course Outcomes:

1. Capacity to integrate knowledge and to analyse, evaluate and manage the different public health aspects of disaster events at a local and global levels, even when limited information is available.
2. Capacity to describe, analyse and evaluate the environmental, social, cultural, economic, legal and organisational aspects influencing vulnerabilities and capacities to face disasters.

3. Capacity to work theoretically and practically in the processes of disaster management (disaster risk reduction, response, and recovery) and relate their interconnections, particularly in the field of the Public Health aspects of the disasters.
4. Capacity to manage the Public Health aspects of the disasters.

References:

1. R. Nishith, Singh AK, “Disaster Management in India: Perspectives, issues and strategies “New Royal book Company
2. Sahni, Pardeep Et.Al. (Eds.),” Disaster Mitigation Experiences And Reflections”, Prentice Hall Of India, New Delhi.
3. Goel S. L. , Disaster Administration And Management Text And Case Studies” ,Deep & Deep Publication Pvt. Ltd., New Delhi.

Department Of Electronics & Communication Engineering

1-Subject Code: METC-113/213

Course Title: Sanskrit for Technical Knowledge

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To get a working knowledge in illustrious Sanskrit, the scientific language in the world
2. Learning of Sanskrit to improve brain functioning
3. Learning of Sanskrit to develop the logic in mathematics, science & other subjects enhancing the memory power
4. The engineering scholars equipped with Sanskrit will be able to explore the huge knowledge from ancient literature

Unit No.	Particulars	Contact Hours
1	Alphabets in Sanskrit, Past/Present/Future Tense, Simple Sentences	8
2	Order Introduction of roots Technical information about Sanskrit Literature	8
3	Technical concepts of Engineering-Electrical, Mechanical, Architecture, Mathematics	8

Course Outcomes:

Students will be able to

1. Understanding basic Sanskrit language
2. Ancient Sanskrit literature about science & technology can be understood
3. Being a logical language will help to develop logic in students

References:

1. "Abhyaspustakam" – Dr.Vishwas, Samskrita-Bharti Publication, New Delhi
2. "Teach Yourself Sanskrit" Prathama Deeksha-Vempati Kutumbshastri, Rashtriya Sanskrit Sansthanam, New Delhi Publication
3. "India's Glorious Scientific Tradition" Suresh Soni, Ocean books (P) Ltd., New Delhi

Department Of Electronics & Communication Engineering

1-Subject Code: METC-114/214

Course Title: Value Education

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Understand value of education and self- development
2. Imbibe good values in students
3. Let the should know about the importance of character

Unit No.	Particulars	Contact Hours
1	Values and self-development –Social values and individual attitudes. Work ethics, Indian vision of humanism. Moral and non- moral valuation. Standards and principles. Value judgements.	4
2	Importance of cultivation of values. Sense of duty. Devotion, Self-reliance. Confidence, Concentration, Truthfulness, Cleanliness. Honesty, Humanity. Power of faith, National Unity. Patriotism.Love for nature ,Discipline	6
3	Personality and Behavior Development - Soul and Scientific attitude. Positive Thinking. Integrity and discipline. Punctuality, Love and Kindness. Avoid fault Thinking. Free from anger, Dignity of labour. True friendship. Universal brotherhood and religious tolerance. Happiness Vs suffering, love for truth. Aware of self-destructive habits. Association and Cooperation Doing best for saving nature	6
4	Character and Competence –Holy books vs Blind faith. Self-management and Good health. Science of reincarnation. Equality, Nonviolence ,Humility, Role of Women. All religions and same message. Mind your Mind, Self-control. Honesty, Studying effectively	6

Course Outcomes:

Students will be able to

1. Knowledge of self-development
2. Learn the importance of Human values
3. Developing the overall personality

References:

1. Chakroborty, S.K. “Values and Ethics for organizations Theory and practice”, Oxford University Press, New Delhi

Department Of Electronics & Communication Engineering

1-Subject Code: METC-115/215

Course Title: Constitution of India

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
2. To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
3. To address the role of socialism in India after the commencement of the Bolshevik Revolution in 1917 and its impact on the initial drafting of the Indian Constitution

Unit No.	Particulars	Contact Hours
1	History of Making of the Constitution:Indian History Drafting Committee, (Composition & Working), Preamble, The Union and its territory, Citizenship	4
2	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	4
3	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	4
4	Sate Legislation: Function and formation of state legislative, legislative council, Power of chief minister, union state relationship Local Administration: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative, CEO o Municipal Corporation. Pachayati raj: Introduction, PRI: ZilaPachayat. Elected officials and their roles, CEO ZilaPachayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy	4
5	Commission: Election Commission: Role and Functioning.	4

	Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.	
--	---	--

Course Outcomes:

Students will be able to:

1. Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
2. Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
3. Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
4. Discuss the passage of the Hindu Code Bill of 1956

References:

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

Department Of Electronics & Communication Engineering

1-Subject Code: METC-116/216

Course Title: Pedagogy Studies

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. Review existing evidence on the review topic to inform programme design and policy making undertaken by the DfID, other agencies and researchers.
2. Identify critical evidence gaps to guide the development

Unit No.	Particulars	Contact Hours
1	Introduction and Methodology: Aims and rationale, Policy background, Conceptual framework and terminology .Theories of learning, Curriculum, Teacher education. Conceptual framework, Research questions. Overview of methodology and Searching	4
2	Thematic overview: Pedagogical practices are being used by teachers in formal and informal clasMMWoms in developing countries. Curriculum, Teacher education.	2
3	Evidence on the effectiveness of pedagogical practices. Methodology for the in depth stage: quality assessment of included studies. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy? Theory of change. Strength and nature of the body of evidence for effective pedagogical practices. Pedagogic theory and pedagogical approaches. Teachers' attitudes and beliefs and Pedagogic strategies.	4
4	Professional development: alignment with clasMMWom practices and follow- up support Peer support Support from the head teacher and the community. Curriculum and assessment Barriers to learning: limited resources and large class sizes	4
5	Research gaps and future directions Research design Contexts Pedagogy Teacher education Curriculum and assessment Dissemination and research impact.	2

Course Outcomes:

Students will be able to understand:

1. What pedagogical practices are being used by teachers in formal and informal clasMMWoms in developing countries?
2. What is the evidence on the effectiveness of these pedagogical practices, in what conditions, and with what population of learners?
3. How can teacher education (curriculum and practicum) and the school curriculum and guidance materials best support effective pedagogy?

References:

1. Ackers J, Hardman F (2001) Classroom interaction in Kenyan primary schools, *Compare*, 31 (2): 245-261.
2. Agrawal M (2004) Curricular reform in schools: The importance of evaluation, *Journal of Curriculum Studies*, 36 (3): 361-379.
3. Akyeampong K (2003) Teacher training in Ghana - does it count? Multi-site teacher education research project (MUSTER) country report 1. London: DFID.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J (2013) Improving teaching and learning of basic maths and reading in Africa: Does teacher preparation count? *International Journal Educational Development*, 33 (3): 272–282.
5. Alexander RJ (2001) *Culture and pedagogy: International comparisons in primary education*. Oxford and Boston: Blackwell.
6. Chavan M (2003) Read India: A mass scale, rapid, 'learning to read' campaign.
7. www.pratham.org/images/resource%20working%20paper%202.pdf.

Department Of Electronics & Communication Engineering

1-Subject Code: METC-117/217

Course Title: Stress Management by Yoga

2-Contact Hours: L: 3 T: 0 P: 0

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To achieve overall health of body and mind
2. To overcome stress

Unit No.	Particulars	Contact Hours
1	Definitions of Eight parts of yog. (Ashtanga)	8
2	Yam and Niyam. Do`s and Don`t`s in life. 1. Ahinsa, satya, astheya, bramhacharya and aparigraha 2. Shaucha, santosh, tapa, swadhyay, ishwarpranidhan	8
3	Asan and Pranayam. 1. Various yog poses and their benefits for mind & body. 2. Regularization of breathing techniques and its effects-Types of pranayam	8

Course Outcomes:

Students will be able to:

1. Develop healthy mind in a healthy body thus improving social health also.
2. Improve efficiency.

References:

1. "Yogic Asanas for Group Training-Part-I" :Janardan Swami Yogabhyasi Mandal, Nagpur
2. "Rajayoga or conquering the Internal Nature" by Swami Vivekananda, AdvaitaAshrama (Publication Department), Kolkata

Department Of Electronics & Communication Engineering

1-Subject Code: METC-118/218

Course Title: Personality Development through Life

2-Contact Hours: L: 3 T: 0 P: 0

Enlightenment Skills

3-Examination Duration (Hrs.): Theory 03

4-Credits: 3

Objectives:

1. To learn to achieve the highest goal happily
2. To become a person with stable mind, pleasing personality and determination
3. To awaken wisdom in students

Unit No.	Particulars	Contact Hours
1	Neetisatakam-Holistic development of personality Verses- 19,20,21,22 (wisdom) Verses- 29,31,32 (pride & heroism) Verses- 26,28,63,65 (virtue) Verses- 52,53,59 (don't's) Verses- 71,73,75,78 (do's)	8
2	Approach to day to day work and duties. Shrimad BhagwadGeeta: Chapter 2-Verses 41, 47,48, Chapter 3-Verses 13, 21, 27, 35, Chapter 6-Verses 5,13,17, 23, 35 Chapter 18-Verses 45, 46, 48.	8
3	Statements of basic knowledge. Shrimad BhagwadGeeta: Chapter2-Verses 56, 62, 68 Chapter 12 -Verses 13, 14, 15, 16,17, 18 Personality of Role model. Shrimad BhagwadGeeta: Chapter2-Verses 17, Chapter 3-Verses 36,37,42, Chapter 4-Verses 18, 38,39 Chapter18 – Verses 37,38,63	8

Course Outcomes:

Students will be able to

1. Study of Shrimad-Bhagwad-Geeta will help the student in developing his personality and achieve the highest goal in life
2. The person who has studied Geeta will lead the nation and mankind to peace and prosperity
3. Study of Neetishatakam will help in developing versatile personality of students

References:

1. "Srimad Bhagavad Gita" by Swami SwarupanandaAdvaita Ashram (Publication Department), Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya) by P.Gopinath,
3. Rashtriya Sanskrit Sansthanam, New Delhi.