RV COLLEGE OF ENGINEERING®

(Autonomous Institution Affiliated to VTU, Belagavi)
R.V. Vidyaniketan Post, Mysore Road
Bengaluru – 560 059

Scheme and Syllabus of III & IV Semesters

(Autonomous System of 2018 Scheme)

Master of Technology (M.Tech)

in

RADIO FREQUENCY AND MICROWAVE ENGINEERING

DEPARTMENT OF

TELECOMMUNICATION ENGINEERING

Vision

Leadership in Quality Technical Education, Interdisciplinary Research & Innovation, with a Focus on Sustainable and Inclusive Technology.

Mission

- To deliver outcome based Quality education, emphasizing on experiential learning with the state of the art infrastructure.
- To create a conducive environment for interdisciplinary research and innovation.
- To develop professionals through holistic education focusing on individual growth, discipline, integrity, ethics and social sensitivity.
- To nurture industry-institution collaboration leading to competency enhancement and entrepreneurship.
- To focus on technologies that are sustainable and inclusive, benefiting all sections of the society.

Quality Policy

Achieving Excellence in Technical Education, Research and Consulting through an Outcome Based Curriculum focusing on Continuous Improvement and Innovation by Benchmarking against the global Best Practices.

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DEPARTMENT OF

TELECOMMUNICATION ENGINEERING

Department Vision

Imparting quality education in Electronics and Telecommunication Engineering through focus on fundamentals, research and innovation for sustainable development

Department Mission

- Provide comprehensive education that prepares students to contribute effectively to the profession and society in the field of Telecommunication.
- Create state-of-the–art infrastructure to integrate a culture of research with a focus on Telecommunication Engineering Education
- Encourage students to be innovators to meet local and global needs with ethical practice
- Create an environment for faculty to carry out research and contribute in their field of specialization, leading to Centre of Excellence with focus on affordable innovation.
- Establish a strong and wide base linkage with industries, R&D organization and academic Institutions.

PROGRAM OUTCOMES (POs)

PO	Description
PO1:	Acquire in-depth knowledge of RF &Microwave Engineering with an ability to analyze, synthesize, evaluate existing and new technologies.
PO2:	Learn and apply modern engineering tools to solve complex engineering problems.
PO3:	Engage in life-long learning independently, to contribute for multidisciplinary research work.
PO4:	Independently carry out research /investigation and development work to solve practical problems.
PO5:	Write and present a substantial technical report/document.
PO6:	Demonstrate a degree of mastery over the area Radio Frequency and Microwave Engineering. The mastery would be at a level higher than the requirements in the appropriate bachelor program.

Lead Society: Institute of Electrical and Electronics Engineers (IEEE)

ABBREVIATIONS

Sl. No.	Abbreviation	Meaning
1.	VTU	Visvesvaraya Technological University
2.	BS	Basic Sciences
3.	CIE	Continuous Internal Evaluation
4.	SEE	Semester End Examination
5.	CE	Professional Core Elective
6.	GE	Global Elective
7.	HSS	Humanities and Social Sciences
8.	CV	Civil Engineering
9.	ME	Mechanical Engineering
10.	EE	Electrical & Electronics Engineering
11.	EC	Electronics & Communication Engineering
12.	IM	Industrial Engineering & Management
13.	EI	Electronics & Instrumentation Engineering
14.	CH	Chemical Engineering
15.	CS	Computer Science & Engineering
16.	TE	Telecommunication Engineering
17.	IS	Information Science & Engineering
18.	BT	Biotechnology
19.	AS	Aerospace Engineering
20.	PHY	Physics
21.	CHY	Chemistry
22.	MAT	Mathematics

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RV COLLEGE OF ENGINEERNG®, BENGALURU-560 059
(Autonomous Institution Affiliated to VTU, Belagavi)
DEPARTMENT OF TELECOMMUNICATION ENGINEERING

M.Tech in RADIO FREQUENCY AND MICROWAVE ENGINEERIGN

THIRD SEMESTER							
Sl. No.	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**			**Total Credits**
				Lecture L	**Tutorial T**	**Practical P**	
1	18MDC31	Wireless Communication	TE	4	1	0	5
2	18MDC3EX	Elective -E	TE	4	0	0	4
3	18 MRM34	Internship	TE	0	0	5	5
4	18 MRM35	Dissertation Phase I	TE	0	0	5	5
Total Credits				**8**	**1**	**10**	**19**
Total Hours				**8**	**2**	**20**	**30**

LIST OF ELECTIVE COURSES

III Semester				
GROUP E: CORE ELECTIVES				
Sl. No.	**Course Code**	**Host Dept**	**Course Title**	**Credits**
1.	18 MDC3E1	TE	Short Range Wireless Communication	04
2.	18 MDC3E2	TE	Software Defined Networks.	04
3.	18 MDC3E3	TE	Network Security	04

FOURTH SEMSESTER							
Sl. No	**Course Code**	**Course Title**	**BoS**	**CREDIT ALLOCATION**			**Credits**
				L	**T**	**P**	
1	18 MRM 41	Dissertation Phase II	TE	0	0	20	20
2	18 MRM 42	Technical Seminar	TE	0	0	2	2
		Total Credits		**0**	**0**	**22**	**22**
		Total Hours		**--**	**--**	**44**	**44**

III SEMESTER		
WIRELESS COMMUNICATION (Theory)		
Course Code: 18MDC31		**CIE Marks: 100**
L:T:P: 4:1:0		**SEE Marks: 100**
Hours: 40L		**SEE Duration: 03Hrs**

UNIT-I	
Wireless channel: physical modeling for wireless channels, input/output model of wireless channel, time and frequency response.	**08 Hrs**
UNIT-II	
Point to point communication: detection in Rayleigh fading channel, time diversity, antenna diversity, frequency diversity	**08 Hrs**
UNIT-III	
Capacity of wireless channels: AWGN channel capacity, resources of AWGN channel, Linear time invariant Gaussian channels, capacity of fading channels.	**08 Hrs**
UNIT-IV	
MIMO Systems: Introduction, Space Diversity and Systems Based on Space Diversity, Smart antenna system and MIMO, MIMO based System architecture, MIMO exploits multipath, Space time Processing, Antenna considerations for MIMO, MIMO channel Modeling, MIMO Channel measurement, MIMO Channel capacity, Space Time Coding, Advantages and Applications of MIMO, MIMO applications in 3G.	**08 Hrs**
UNIT-V	
Spatial multiplexing and channel modeling: multiplexing capability of MIMO channels, physical modeling of MIMO channels, modeling MIMO fading channels.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Describe physical modeling for wireless channel and diversity techniques.
CO2	Analyze the Modeling of MIMO fading channels.
CO3	Evaluate diversity techniques and multiplexing capability of MIMO channels.
CO4	Design a MIMO system with smart antennas in wireless communication applications.

Reference Books	
1.	**Fundamentals of wireless communication**, David Tse, P. Viswanath, 2006,Cambridge,.ISBN 0-521-68749-7
2.	**Wireless communication**, Upen Dalal, Oxford university Press, 2009

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE); Theory (100 marks)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

III SEMESTER		
INTERNSHIP		
Course Code: 18MRM33		**CIE Marks: 100**
L:T:P: 0:0:5		**SEE Marks: 100**
Hours: 10Hrs		**SEE Duration: 03Hrs**

Course Learning Objectives (CLO): The students shall be able to

(1) Understand the process of applying engineering knowledge to produce product and provide services.
(2) Explain the importance of management and resource utilization
(3) Comprehend the importance of team work, protection of environment and sustainable solutions.
(4) Imbibe values, professional ethics for lifelong learning.

GUIDELINES FOR INTERNSHIP

1) The duration of the internship shall be for a period of 8 weeks on full time basis between II semester final exams and beginning of III semester.
2) The student must submit letters from the industry clearly specifying his / her name and the duration of the internship on the company letter head with authorized signature.
3) Internship must be related to the field of specialization or the M.Tech program in which the student has enrolled.
4) Students undergoing internship training are advised to report their progress and submit periodic progress reports to their respective guides.
5) Students have to make a presentation on their internship activities in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the internship final report. However interim or periodic reports and reports as required by the industry / organization can be submitted as per the format acceptable to the respective industry /organizations.
6) The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
7) The broad format of the internship final report shall be as follows
    - Cover Page
    - Certificate from College
    - Certificate from Industry / Organization
    - Acknowledgement
    - Synopsis
    - Table of Contents
    - Chapter 1 - Profile of the Organization – Organizational structure, Products, Services, Business Partners, Financials, Manpower, Societal Concerns, Professional Practices,
    - Chapter 2 - Activities of the Department -
    - Chapter 3 – Tasks Performed – summaries the tasks performed during 8 week period
    - Chapter 4 – Reflections – Highlight specific technical and soft skills that you acquired during internship
    - References & Annexure

Course Outcomes: After completing the course, the students will be able to

CO1	Apply engineering and management principles
CO2	Analyze real-time problems and suggest alternate solutions
CO3	Communicate effectively and work in teams

CO4	Imbibe the practice of professional ethics and need for lifelong learning.

Scheme of Continuous Internal Evaluation (CIE):

A committee comprising of the Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries	35%
(2) Ability to comprehend the functioning of the organization/ departments	20%
(3) Importance of resource management, environment and sustainability	25%
(4) Presentation Skills and Report	20%

GUIDELINES FOR INDUSTRIAL VISITS

1. Student must visit a minimum of THREE organizations/industry. The duration of the visit per organization must be for ONE full day, during which he/she must comprehend the importance of organization structure, function of various departments, application of engineering knowledge, resource management, and importance to environment and safety, professional ethics.
2. It is mandatory to visit ONE private multi-national company or public sector industry / organization, ONE medium-small enterprise and ONE rural based or NG organization.
3. The student must submit letter from the industry clearly specifying his / her name and the date of visit to the industry with authorized signatures.
4. Industrial visit must be related to the field of specialization or the M.Tech program in which the student has enrolled.
5. Every student has to write and submit his/her own report on each industrial visit and submit the report to the designated faculty advisor for evaluation.
6. A photograph outside the industry with the name and logo of the industry in the background along with the students and faculty members could be included in the report.
7. Students have to make a presentation on their industrial visit in front of the departmental committee and only upon approval of the presentation should the student proceed to prepare and submit the hard copy of the final report.
8. The reports shall be printed on bond paper – 80GSM, back to back print, with soft binding – A4 size with 1.5 spacing and times new roman font size 12.
9. The broad format of the industrial visit report shall be as follows
   - Cover Page
   - Certificate from College
   - Acknowledgement
   - Synopsis / Executive Summary
   - Table of Contents
   - Chapter 1 - Profile of the PSU or MNC – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices
   - Chapter 2 – Profile of the SME – must include Organizational structure, Products, Services, Financials, Manpower, Societal Concerns, Professional Practices

• Chapter 3 - Profile of the NGO – must include Organizational structure, services, • Chapter 4 – Comparative Analysis of PSU/MNC – SME – NGO • References & Annexure (Permission letters from the organizations for the visit & photographs)	
Course Outcomes: After completing the course, the students will be able to	
CO1	Classify the role of different industries and organization in addressing the needs of the society.
CO2	Explain the process of applying engineering knowledge in industries and organizations.
CO3	Describe the importance of communication and team work.
CO4	Recognize the importance of practicing professional ethics and need for life skills.

Scheme of Continuous Internal Evaluation (CIE):
A committee comprising of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide would review the presentation and the progress reports in two phases. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):
The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

(1) Explanation of the application of engineering knowledge in industries	25%
(2) Ability to comprehend the functioning of the organization/ departments	30%
(3) Importance of resource management, environment and sustainability	20%
(4) Presentation Skills and Report	25%

III SEMESTER		
DISSERTATION PHASE I		
Course Code: 18MRM35		**CIE Marks: 100**
L:T:P: 0:0:5		**SEE Marks: 100**
Hours: 10Hrs		**SEE Duration: 03Hrs**

Course Learning Objectives:

The students shall be able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES FOR DISSERTATION PHASE I

1. Major project will have to be carried out by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
5. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
6. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes: After going through this course the students will be able to

CO1:	Conceptualize, design and implement solutions for specific problems.
CO2:	Communicate the solutions through presentations and technical reports.
CO3:	Apply project and resource managements skills, professional ethics, societal concerns
CO4:	Synthesize self-learning, sustainable solutions and demonstrate life-long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase	Activity	Weightage
4^{th} week	Topic approval along with Synopsis	20%
8^{th} week	Literature survey with Problem Statement	20%
12^{th} week	Motivation and Objectives	20%
15^{th} week	Preliminary report for the approval of selected topic along with methodology.	40%

CIE Evaluation shall be done with marks distribution as follows:

- Selection of the topic 10%
- Literature review and framing of objectives 25%
- Defining the brief methodology along with the algorithm development/experimental setup 25%
- Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Presentation 25%
4. Report 20%
5. Viva Voce 30%

III SEMESTER		
SHORT RANGE WIRELESS COMMUNICATION **(Group E: Core Elective)**		
Course Code: 18MDC3E1		**CIE Marks: 100**
L:T:P::4:0:0		**SEE Marks: 100**
Hours: 45L		**SEE Duration: 3Hrs**

UNIT-I	
Introduction to Short Range Wireless Communication (SWC): Growth of standards, Market, Wireless architecture, wireless parameters, Enabling factors, Design rules for SRC, Short-range vs medium/long range communications., High rate vs Low rate communications, Review of frequency regulations and available frequency bands, State of the Art SWC systems: WLAN, Bluetooth, ZigBee, NFC, UWB, BAN, 60GHz, LiFi, and VLC.	**09 Hrs**
UNIT-II	
Channel Estimation for high-rate systems: High rate UWB and 60GHz communications - Overview and Application Scenario's, ECMA-368 High rate UWB standard, ECMA-387 Millimeter wave radio standard, IEEE 802.15.3C, Channel models for high rate systems, Review of channel estimation techniques, Impact on channel estimation error on performance.	**09 Hrs**
UNIT-III	
Adaptive Modulation and coding for high rate systems: Adaptive modulation and coding, AMC in MB-OFDM systems, WPAN link architecture in ECMS-368, Packet level model for UWB channels with shadowing, WPAN link performance analysis, AMC in 60GHz millimeter wave radio systems, modulation techniques and system architectures for multi-Gb/s, RF Packaging and Antenna design issues.	**09 Hrs**
UNIT-IV	
PHY Layer Design Issues for High Data Rate (Gbps) communication: Principles of MIMO systems, MIMO for UWB systems, Adaptive Antenna Array Systems Design, active phased array based on analog beam-forming, PAPR Reduction for Discrete-time OFDM Signals, Soft Iterative Equalization for Clipped and Filtered COFDM Signals, power-amplifier utilization - significantly improved by clipping and filtering; matching receive algorithm for equalization of in-band distortion noise.	**09 Hrs**
UNIT-V	
Low rate systems & Emerging concepts in Short Range communications: ZigBee networks and low rate UWB communications - Overview and application examples, ZigBee, Impulse radio based UWB (IEEE 802.15.4a), Low latency MAC for WPANs (IEEE 802.15.4e), Active RFID (IEEE 802.15.4f), Smart utility Networks (IEEE 802.15.4g), Energy efficiency in Low rate systems- Background, Energy saving MACs. UROOF' (UWB radio-over-optical-fibre), UROOF - user applications and basic system configuration, Fundamentals of UROOF Technologies, Link Analysis of UROOF Systems, Analysis of UWB Technologies for UROOF, Visible Light Communications, Discrete Multitone Modulation, Potential applications of VLC, Technical challenges of implementing VLC.	**09 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain the architectures and operations of state-of-the-art short range wireless networking standards.
CO2	Analyze the error performance of short range communication systems in presenceof noise and other interferences.
CO3	Gain in-depth knowledge about multicarrier and multiantenna techniques and their

	applications in current and emerging communication systems.
CO4	Identify various technical challenges on low rate systems and short range communication systems.
Reference Books	
1	**Reliable Communications for Short-Range Wireless Systems**, Ismail Guvenc, Sinan Gezici, Zafer Sahinoglu and Ulas C. Kozat, 1st Edition, 2011, Cambridge University Press, ISBN: 978-0-521-76317-2.
2	**Essentials of short-range wireless,** Nick Hunn, 1st Edition, 2010, Cambridge University Press, ISBN: 978-0521760690

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE); Theory (100 marks)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

III SEMESTER		
SOFTWARE DEFINED NETWORKS (Group E: Core Elective)		
Course Code: 18MDC3E2		**CIE Marks: 100**
L:T:P:: 4:0:0		**SEE Marks: 100**
Hours: 41L		**SEE Duration: 3Hrs**

UNIT-I	
Software Defined Networking: Introduction, Modern Data Center, Traditional Switch Architecture, Layer 2 & 3 Control, Evolution of switches and control planes, Data Center Innovation & Needs, The Evolution of Networking Technology, Forerunners of SDN, Open Source Contributions and Network Virtualization.	**08 Hrs**
UNIT-II	
How SDN Works: Fundamental Characteristics of SDN, SDN Operation SDN Devices, SDN Controller, SDN Applications. **The Open Flow Specification**: Open Flow Overview, Open Flow 1.0 and Open Flow Basics, Open Flow 1.1, 1.2, and 1.3 Additions and Open Flow Limitations.	**08 Hrs**
UNIT-III	
Spectrum Analyzer: Common Measurements Using the Spectrum Analyzer, Types of Signal Analyzers, Basic Idea Behind Spectrum Analyzers, Building Blocks of a Spectrum Analyzer, Features of the Spectrum Analyzer, Extending the Frequency Range, Dynamic Range and Sensitivity, Component Characterization.	**09 Hrs**
UNIT-IV	
SDN in Other Environments: Consistent Policy Configuration**,** Global Network View**,** WANs**,** Service Provider and Carrier Networks**,** Campus Networks**,** Hospitality Networks**,** Mobile Networks**,** In-Line Network Functions, and Optical Networks. **Players in the SDN Ecosystem:** Academic Research Institutions**,** Industry Research Labs and Network Equipment Manufacturers**.**	**08 Hrs**
UNIT-V	
SDN Applications: Reactive versus Proactive Applications**,** A Simple Reactive Java Application**,** Background on various Controllers like Floodlight Controller**,** Open Daylight Controller**,** Cisco XNC Controller**,** and Hewlett-Packard Controller**.** Switch Considerations**,** Creating NV Tunnels**,** Offloading Flows in the Data Center**,** Access Control for the Campus**,** Traffic Engineering for Service Providers**.**	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to	
CO1	Explain and discuss the basic concepts and architectural differences of conventional networking approaches and SDN.
CO2	Analyze and apply implementation of SDN through Open Flow Switches.
CO3	Apply the principles of SDN for the design of data centre using SDN elements of reputed vendors.
CO4	Design and implement software defined network application on SDN-based networking devices.

Reference Books	
1	**Software Defined Networks: A Comprehensive approach,** Paul Goransson, Chuck Black, Timothy Culver, 2nd Edition, Elsevier, ISBN-13: 978-0128045558, ISBN-10: 0128045558, 2014.
2	**Software Defined Networking design and deployment,** Patricia A. Morreale, James M. Anderson, 1st Edition, CRC Press, **ISBN-10:** 1482238632, **ISBN-13:** 978-1482238631, 2015.
3	**SDN: Software Defined Networks: An Authoritative Review of Network, Programmability Technologies,** Thomas D. Nadeau, Ken Gray, 1st Edition, ISBN-13: 978-1449342302, ISBN-10: 9781449342302, 2013.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE); Theory (100 marks)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

III SEMESTER		
NETWORK SECURITY **(Group E: Core Elective)**		
Course Code: 18MDC3E3		**CIE Marks: 100**
L:T:P::4:0:0		**SEE Marks: 100**
Hours: 40L		**SEE Duration: 3Hrs**

UNIT-I	
Introduction: OSI Security Architecture, Classical Encryption techniques: Symmetric Cipher Model, Substitution Techniques, Transportation Techniques. **Block Ciphers and Data Encryption Standards:** Traditional Block Cipher Structure, The Data Encryption Standard, A DES Example, The Strength of DES. **Advanced Encryption Standard:** AES Transformation Functions, AES Key Expansion, An AES Example, AES Implementation.	**08 Hrs**
UNIT-II	
Public Key Cryptography and RSA: Principles of Public-Key Cryptosystems, The RSA Algorithm. **Other Public-Key Cryptosystems:** Diffie-Hellman Key Exchange, Elgamal Cryptographic System, Elliptic Curve Arithmetic, Elliptic Curve Cryptography, Pseudorandom Number Generation Based on an Asymmetric Cipher.	**08 Hrs**
UNIT-III	
Cryptographic Hash Functions: Applications of Cryptographic Hash Functions, Two Simple Hash Functions, Hash Functions Based on Cipher Block Chaining, Secure Hash Algorithm (SHA), SHA-3. **Message Authentication Codes:** Message Authentication Requirements, Message Authentication Functions, Requirements for Message Authentication Codes, Security of MACs, MACs Based on Hash Functions: HMAC, MACs Based on Block Ciphers: DAA and CMAC, Authenticated Encryption: CCM and GCM, Pseudorandom Number Generation Using Hash Functions and MACs. **Digital Signatures:** Digital Signatures, Elgamal Digital Signature Scheme, Schnorr Digital Signature Scheme, NIST Digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, RSA-PSS Digital Signature Algorithm.	**08 Hrs**
UNIT-IV	
Network Access Control and Cloud Security: Network Access Control, Extensible Authentication Protocol, IEEE 802.1X Port-Based Network Access Control. **Wireless Network Security:** Wireless Security, Mobile Device Security, IEEE 802.11 Wireless LAN Overview, IEEE 802.11i Wireless LAN Security.	**08 Hrs**
UNIT-V	
Electronic Mail Security: Internet Mail Architecture, Email Formats, Email Threats and Comprehensive Email Security, S/MIME, Pretty Good Privacy, DNSSEC, DNS-Based Authentication of Named Entities, Sender Policy Framework, Domain Keys Identified Mail. **IP Security:** Overview, IP Security Policy, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.	**08 Hrs**

Course Outcomes: After completing the course, the students will be able to

CO1	Describe the issues addressed by Network Security and understand the concepts of cryptography and Network security.
CO2	Apply cryptographic techniques and algorithms to provide security to the transmitted information.
CO3	Analyze the concepts of Authentication and Hash functions.
CO4	Understand and analyze System level security issues.

Reference Books	
1	**Cryptography And Network Security - Principles and Practices**, William Stallings Pearson Education Limited, 7th Edition, 2017. ISBN-13: 978-0134444284 ISBN-10: 0134444280 .
2	**Cryptography and Network Security**, Behrouz A. Forouzan, Tata McGraw-Hill, 2008, *ISBN*-13: 978-0-13-187319-3.
3	**Computer Security: Principles and Practice** ,William Stallings, Lawrie Brown , Pearson Education Limited, 4th Edition. *ISBN*-10: 9780134794105.

Scheme of Continuous Internal Evaluation (CIE); Theory (100 Marks)

CIE is executed by way of quizzes (Q), tests (T) and assignments. A minimum of two quizzes are conducted and each quiz is evaluated for 10 marks adding up to 20 marks. Faculty may adopt innovative methods for conducting quizzes effectively. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50 marks. A minimum of two assignments are given with a combination of two components among 1) solving innovative problems 2) seminar/new developments in the related course 3) Laboratory/field work 4) mini project. **Total CIE is 20+50+30=100 Marks.**

Scheme of Semester End Examination (SEE); Theory (100 marks)

The question paper will have FIVE questions with internal choice from each unit. Each question will carry 20 marks. Student will have to answer one full question from each unit.

IV SEMESTER		
DISSERTATION PHASE II		
Course Code: 18MRM41		**CIE Marks: 100**
L:T:P::0:0:20		**SEE Marks: 100**
Hours: 40		**SEE Duration: 3Hrs**

Course Learning Objectives: The students shall be able to

1. Understand the method of applying engineering knowledge to solve specific problems.
2. Apply engineering and management principles while executing the project
3. Demonstrate good verbal presentation and technical report writing skills.
4. Identify and solve complex engineering problems using professionally prescribed standards.

GUIDELINES DISSERTATION PHASE II

1. Major project will have to be done by only one student in his/her area of interest.
2. Each student has to select a contemporary topic that will use the technical knowledge of their program of specialization.
3. Allocation of the guides preferably in accordance with the expertise of the faculty.
4. The project can be carried out on-campus or in an industry or an organization with prior approval from the Head of the Department.
5. The standard duration of the project is for 16 weeks, however if the guide and the evaluation committee of the department, after the assessment feel that the work is insufficient and it has to be extended, then the student will have to continue as per the directions of the guide and the committee.
6. It is mandatory for the student to present his/her work in one of the international conferences or publish the research finding in a reputed unpaid journal with impact factor.

Course Outcomes: After completing the course, the students will be able to

CO1	Conceptualize, design and implement solutions for specific problems.
CO2	Communicate the solutions through presentations and technical reports.
CO3	Apply project and resource managements skills, professional ethics, societal concerns
CO4	Synthesize self-learning, sustainable solutions and demonstrate life long learning

Scheme of Continuous Internal Examination (CIE)

Evaluation will be carried out in THREE Phases. The evaluation committee will comprise of: guide, two senior faculty members, one industry member and Head of the Department.

Phase II	Activity	Weightage
5th week	Review and refinement of Objectives and methodology.	20%
10th week	Mid-term progress review shall check the compliance with the objectives and methodology presented in Phase I, review the work performed.	40%
15th week	Oral presentation, demonstration and submission of project report. Outcome and publication	40%

CIE Evaluation shall be done with marks distribution as follows:

- Review of formulation of objectives and methodology 10%
- Design and simulation/ algorithm development/experimental setup 25%
- Conducting experiments / implementation / testing / analysis 25%
- Demonstration & Presentation 20%
- Report writing 20%

Scheme for Semester End Evaluation (SEE):

The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

1. Brief write-up about the project 5%
2. Formulation of Project Objectives & Methodology 20%
3. Experiments / Analysis Performed; Results & Discussion 25%
4. Report 20%
5. Viva Voce 30%

IV SEMESTER		
TECHNICAL SEMINAR		
Course Code: 18MRM42		**CIE Marks: 50**
L:T:P::0:0:2		**SEE Marks: 50**
Hours: 4		**SEE Duration: 3 Min**

Course Learning Objectives (CLO): The students shall be able to:

(1) Understand the technological developments in their chosen field of interest
(2) Explain the scope of work and challenges in the domain area
(3) Analyze these engineering developments in the context of sustainability and societal concerns.
(4) Improve his/her presentation skills and technical report writing skills

GUIDELINES TECHNICAL SEMINAR

1) The presentation will have to be done by individual students.
2) The topic of the seminar must be in one of the thrust areas with in-depth review and analysis on a current topic that is relevant to industry or on-going research.
3) The topic could be an extension or complementary to the project
4) The student must be able to highlight or relate these technological developments with sustainability and societal relevance.
5) Each student must submit both hard and soft copies of the presentation.

Course Outcomes: After completing the course, the students will be able to

CO1	Identify topics that are relevant to the present context of the world
CO2	Perform survey and review relevant information to the field of study.
CO3	Enhance presentation skills and report writing skills.
CO4	Develop alternative solutions which are sustainable

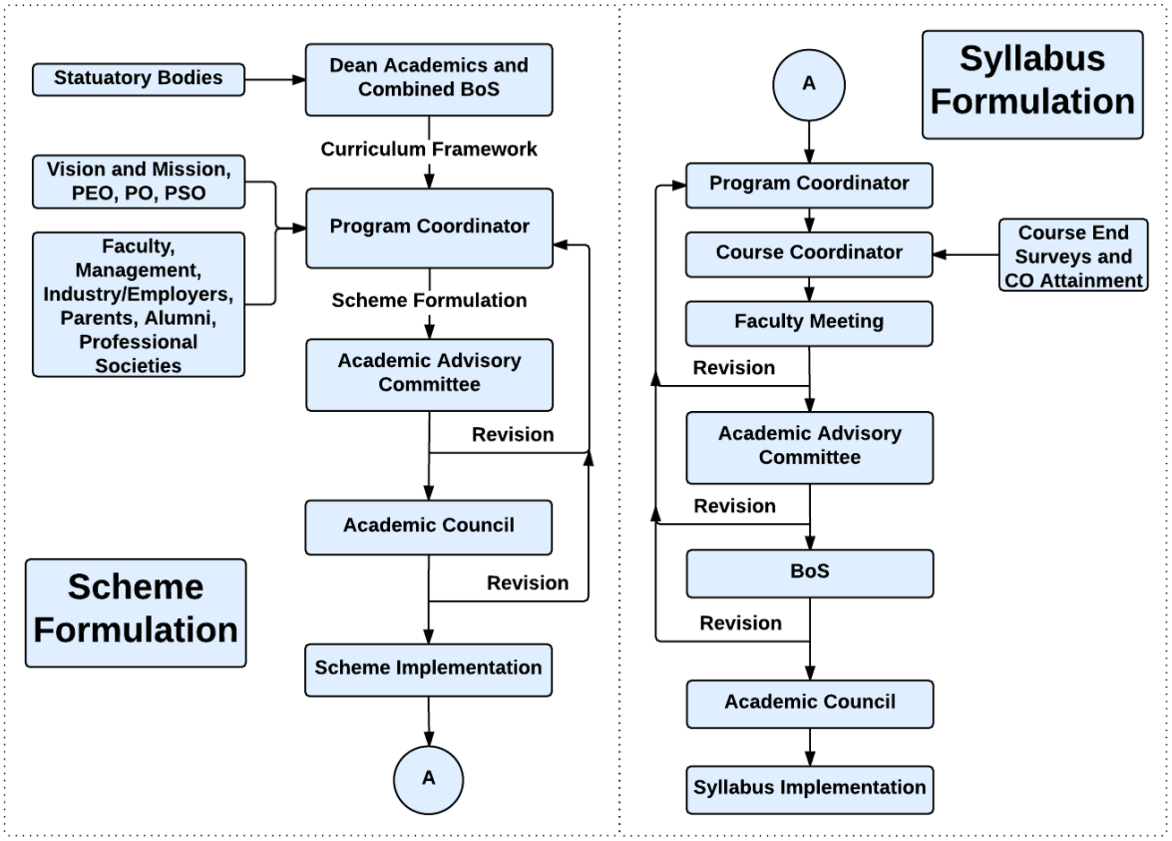
Scheme of Continuous Internal Evaluation (CIE): Evaluation would be carried out in TWO phases. The evaluation committee shall comprise of Head of the Department / Associate Dean, Associate Professor, Assistant Professor and Guide. The evaluation criteria shall be as per the rubrics given below:

Scheme for Semester End Evaluation (SEE):
The evaluation will be done by ONE senior faculty from the department and ONE external faculty member from Academia / Industry / Research Organization. The following weightages would be given for the examination. Evaluation will be done in batches, not exceeding 6 students.

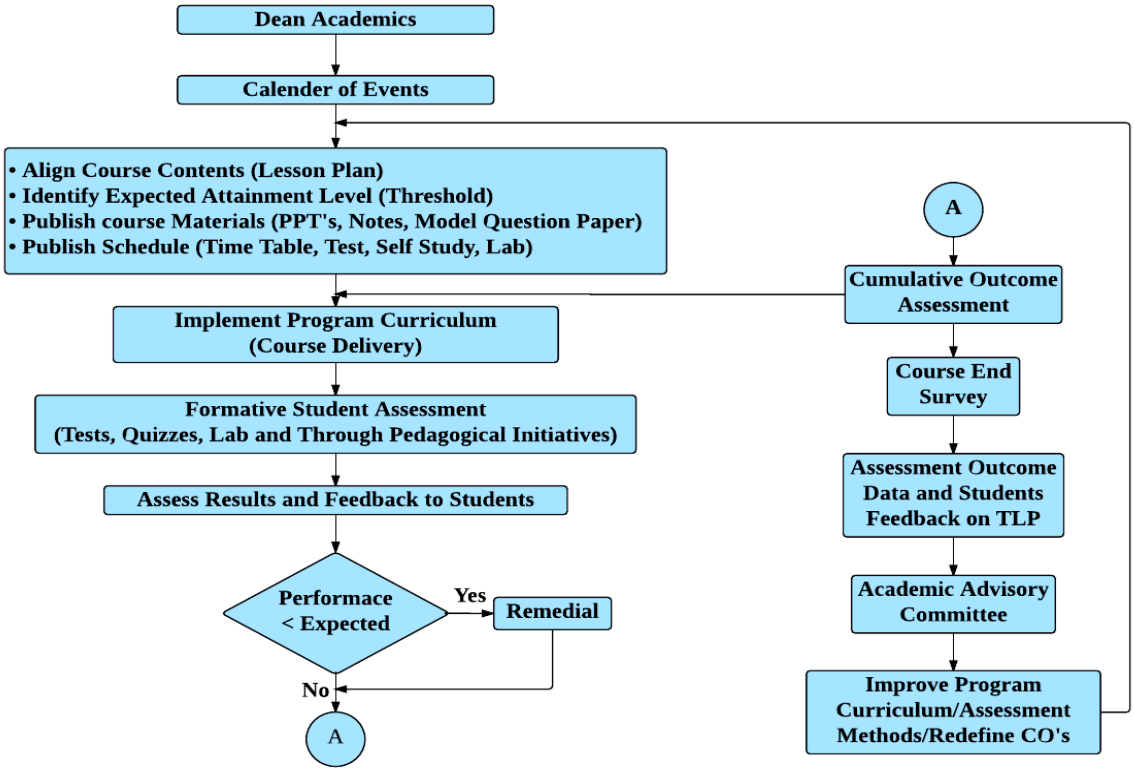
Rubrics for Evaluation:

1) Topic – Technical Relevance, Sustainability and Societal Concerns 15%
2) Review of literature 25%
3) Presentation Skills 35%
4) Report 25%

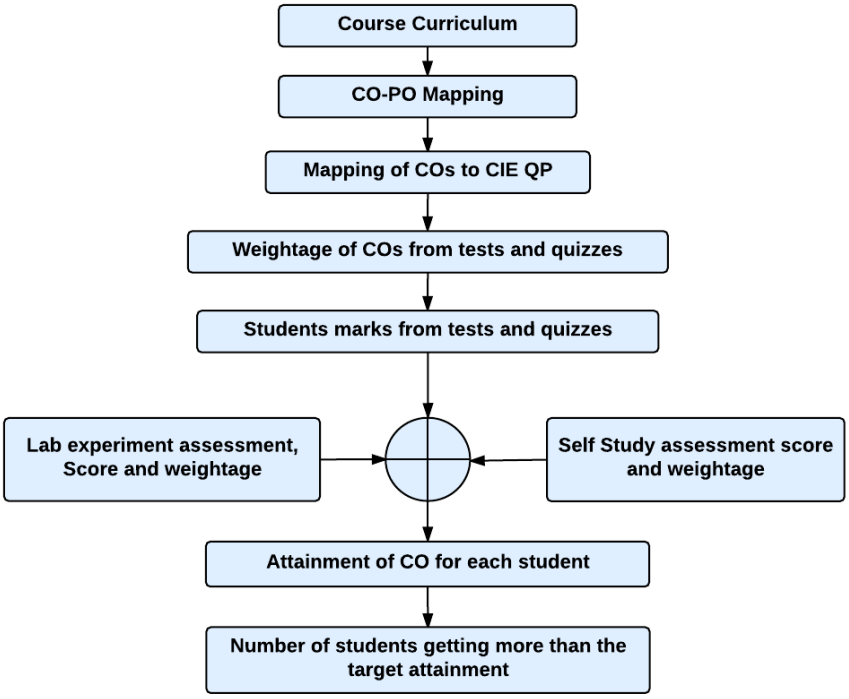
Curriculum Design Process



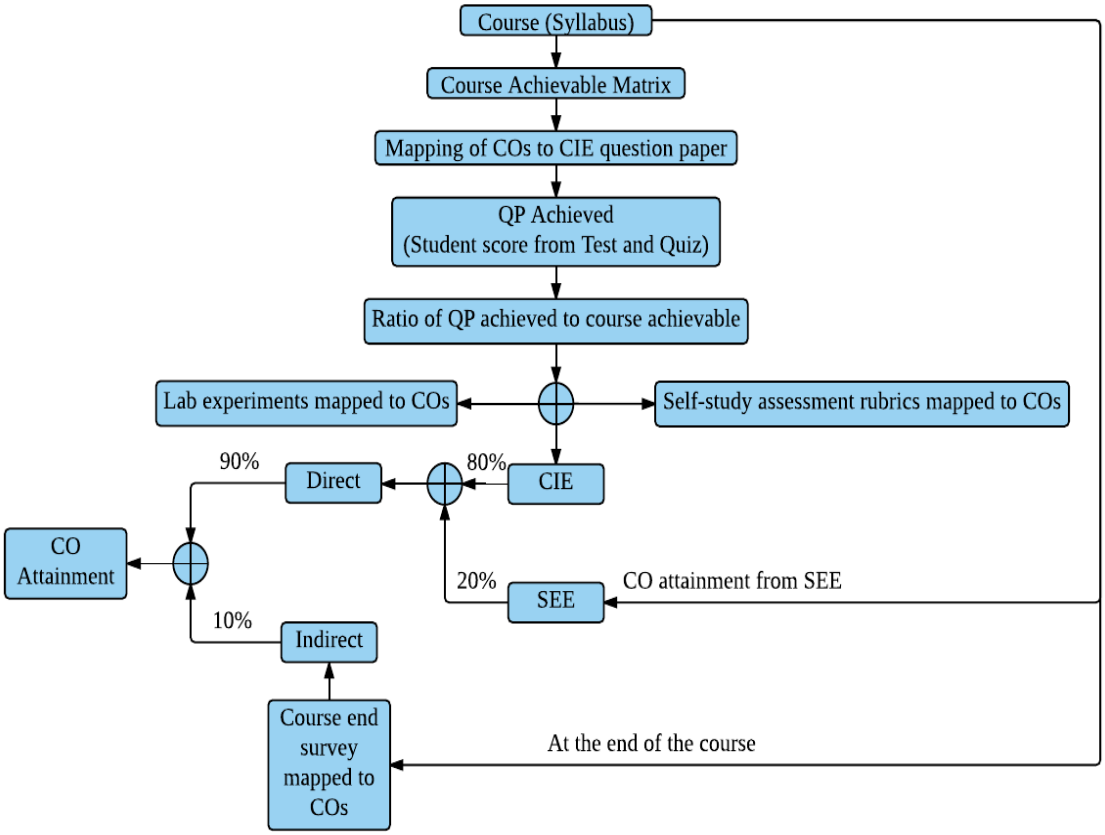
Academic Planning and Implementation



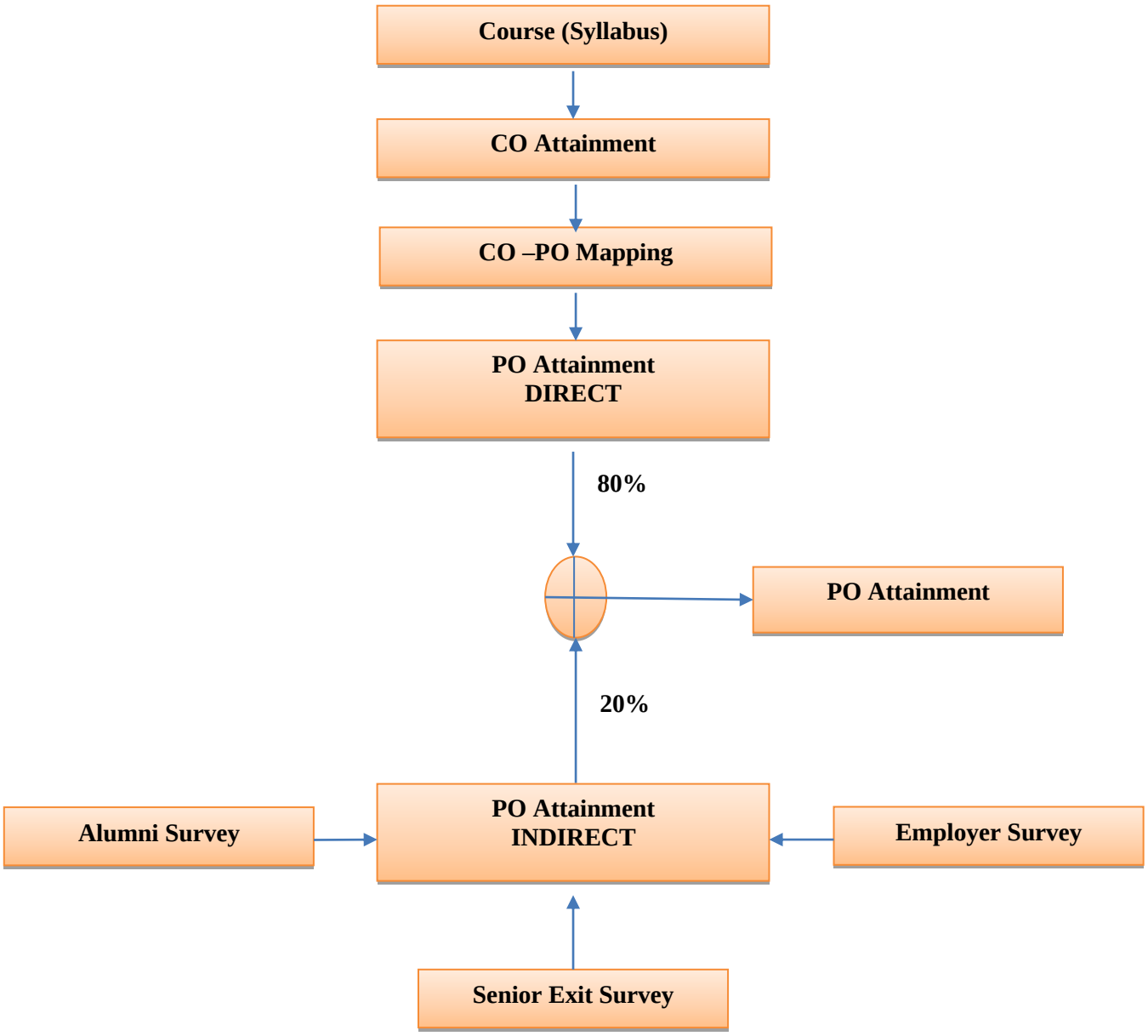
Process for Course Outcome Attainment



Final CO Attainment Process



Program Outcome Attainment Process



Guidelines for Fixing Targets

- The target may be fixed based on last years' average attainment