Department of Electronics Engineering

Minutes of
Online Board of Studies Meeting
of Electronics Engineering
held on 6.12.2024

The Board of Studies (BoS) meeting of the Electronics Engineering department was held on 6th Dec 2024 at 11:30 AM onwards. Following external and internal members have attended online meeting through google link : . https://meet.google.com/ozm-ehzm-mfn

1. Dr. R.B Pachori, Professor, IIT-Indore, External Member
2. Dr. Ashutosh Datar, Professor, SATI-Vidisha, RGPV-Nominee
3. Dr. Jyoti Singhai, Professor, MANIT-Bhopal, External Member
4. Mr. Saurabh Kumar, MD, Hitsavi Ent, Noida, Industry Representative
5. Mr. Yasho Vijay Singh Yadav, Scientist, CSIR, Alumni Member
6. Dr. P.K Singhal, Professor
7. Dr. Vandana Vikas Thakare, Professor & Head
8. Dr. Laxmi Shrivastava, Professor
9. Dr. R. P. Narwaria, Assistant Professor
10. Dr. Karuna Markam, Assistant Professor
11. Prof Madhav Singh, Assistant Professor
12. Prof Pooja Sahoo, Assistant Professor
13. Prof D K Parsedia, Assistant Professor
14. Dr. Vikas Mahor, Assistant Professor
15. Dr. Rahul Dubey, Assistant Professor
16. Dr. Deepak Batham, Assistant Professor
17. Dr. Hemant Choubey, Assistant Professor
18. Dr. Varun Sharma, Assistant Professor
19. Dr. Shubhi Kansal, Assistant Professor
20. Dr. Varun Mishra, Assistant Professor
21. Dr. Himanshu Singh, Assistant Professor
22. Dr. Mukesh Kumar Mishra, Assistant Professor
23. Dr. Dablu Kumar, Assistant Professor
24. Prof. Prateek Bhadauria, Assistant Professor
25. Dr. R. Jenkin Suji, Assistant Professor
26. Dr. Pawan Dubey, Assistant Professor
27. Dr. Tej Singh, Assistant Professor
28. Dr. Vikram, Assistant Professor
29. Dr. Vibha Tiwari, Assistant Professor
30. Dr. Priyanka Garg, Assistant Professor
31. Dr. Nookala Venu, Assistant Professor
32. Mr. Manoj Kumar, Assistant Professor
33. Dr. Jaydeep Parmar, Assistant Professor

Agenda of the BoS Meeting

Courses where revision was carried out*

(Course/subject name)	Course Code	Year/Date of introduction	Year/Date of revision	Percentage of content added or replaced	Agenda Item No.	Page No.	Link of relevant documents/minutes
Embedded System	900116	2021	6-Dec-2024	50%	Item 8	25	**Annexure VII**

New Courses added*

(Course/subject name)	Course Code	Activities/contents which have a bearing on increasing skill and employability	Agenda Item No.	Page No.	Link of relevant documents/minutes
Microcontroller Systems and Applications	2140616	Design and Debug Embedded Applications	Item 5	11	**Annexure IV**

Feedback on curriculum received from stakeholders: Analysis& ATR*

Stakeholder	Student	Faculty	Alumni	Employer
No of Responses	121	17	20	17
Link of Analysis	https://docs.google.com/document/d/11su6neeJyaa_-UIq8CqHSg522JAmbXK1/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/document/d/1PLhLHNAzJp3YkfLr_5eBQLWw8ExoFC2-/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://drive.google.com/file/d/1RxISICkf6JAQIHXcRPWPmVhS3TNTOYMq/view?usp=drive_link	https://drive.google.com/file/d/1O7rT2dfhqL7STzgeEX81rxjhnyLtoo2G/view?usp=sharing
ATR Link	https://docs.google.com/document/d/1yHE1HygqVY7GnmklCFbaiGxU_GO_SLSo/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/document/d/1iAmS6rtAh4H-2KotKBqlCoaxu2cRCwOz/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://drive.google.com/file/d/1RxISICkf6JAQIHXcRPWPmVhS3TNTOYMq/view?usp=drive_lin	https://drive.google.com/file/d/1hfsFZdzeoNSpIZCphk4MIowo4WAATdS7/view?usp=sharing
Link showing Excel sheet of Google Form details of stakeholders	https://docs.google.com/document/d/11su6neeJyaa_-UIq8CqHSg522JAmbXK1/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/16DNqH-F8REp9UQU70JER6VKg9_7U0MP0/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1k5UT5xdD78YJHosBNpM31Z19E2JJERWI-6Bdowvjkak/edit?usp=sharing	https://docs.google.com/spreadsheets/d/1YUIPrEJrQq4uXIYtBfOzdq9ZxslIWF8F/edit?usp=sharing&ouid=116513051919594709243&rtpof=true&sd=true

BoS Agenda Items	
Item 1	To confirm the minutes of previous BoS meeting held in the month of May-June 2024. **The minutes of previous BOS held on 24 May 2024 has been finalized.**
Item 2	To propose the scheme structure of **VIII Semester** with the provision of **ONE DE & ONE OC course** to be offered in **online mode** with credit transfer for the **batch admitted in academic year 2021-22**. (**The total credits from I-VIII semester should not be less than 160 for this batch**). **The Scheme Structure of B.Tech VIII Semester with provision of One Departmental Electives and One Open Category courses has been discussed and finalized. Annexure I**
Item 3	To propose the list of courses which the students can opt from SWAYAM/NPTEL/ other MOOC Platforms/ Institution (MITS) MOOC, to be offered in online mode under **Departmental Elective (DE) category courses (DE-5) and open category (OC3)** for credit transfer in the **VIII Semester** under the flexible curriculum (**Batch admitted in academic year 2021-22).** **The list of course which the students can opt from SWAYAM/NPTEL/MOOC based platforms, to be offered in online mode under department elective (DE) course, with credit transfer in the VIII Semester under the flexible curriculum has been discussed and finalized Annexure II**
Item 4	To propose the list of "Additional Courses" which can be opted for getting an (i) Honours (for students of the host department) (ii) Minor Specialization (for students of other departments) **[These will be offered through SWAYAM/NPTEL/MOOC based Platforms for the B.Tech. VIII semester students (for the batch admitted in 2021-22)] and for B.Tech. VI semester (for the batch admitted in 2022-23)]. Annexure III**
Item 5	To review and finalize the **scheme structure of B.Tech VI Semester under** the flexible curriculum **(Batch admitted in 2022-23).** **The scheme structure of B.Tech. VI Semester under the flexible curriculum (Batch admitted in 2022-23) has been discussed and finalized. Annexure IV**
Item 6	To review & finalize the **syllabi for all Departmental Core Courses (DC)** of **B. Tech VI Semester** (**for batch admitted in 2022-23)** under the flexible curriculum along with their COs. **The syllabi for all Departmental Core (DC) Courses of B.Tech. VI Semester (for batch admitted in 2022-23) under the flexible curriculum along with their COs has been discussed and finalized.Annexure V**
Item 7	To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered for batches admitted in 2022-23 **in online mode under Departmental Elective (DE) Course** with credit transfer, **in the VI Semester.** **The list of course which the students can opt from SWAYAM/NPTEL/MOOC based platforms, to be offered in online mode under department elective (DE) course, with credit transfer in the VI Semester under the flexible curriculum has been discussed and finalized. Annexure VI**

Item 8	To review and finalize the courses & syllabi to be offered (for batch admitted in 2022-23) under the **Open Category (OC) Courses to be offered in traditional mode for B Tech VI semester** of other departments along with their COs. **The syllabus and scheme of courses to be offered *(for batch admitted in 2022-23)* under the *Open Category (OC) Courses* for B.Tech. *VI semester* students of other departments along with their COs has been discussed and finalized. Annexure VII**
Item 9	To review and finalize the **Experiment list/ Lab manual/Skill based mini-project** for all the Laboratory Courses to be offered in **B.Tech.VI semester *(*for batch admitted in 2022-23).** **The Experiment list/ Lab manual /Skill based mini-project for all the Laboratory Course to be offered in B.Tech. VIth semester *(*for batch admitted in 2022-23) has been finalized and approved by BOS members. Annexure VIII**
Item 10	To review and finalize the **scheme structure of B. Tech. IV Semester** under the flexible curriculum (**for batch admitted in 2023-24**). **The scheme structure of B.Tech. IVth Semester under the flexible curriculum (Batch admitted in 2023-24) has been discussed and finalized. Annexure IX**
Item 11	To review and finalize the syllabi for all Departmental Core (DC) Courses of ***B. Tech. IV Semester*** (for **batch admitted in 2023-24**) under the flexible curriculum along with their COs. **The syllabi for all Departmental Core (DC) Courses of B.Tech. IVth Semester (for batch admitted in 2023-24) under the flexible curriculum along with their COs has been discussed and finalized.Annexure X**
Item 12	To review and finalize the **Experiment list/ Lab manual/skill based mini project** for all the Laboratory Courses to be offered in **B.Tech IV semester (for batch admitted in 2023-24).** The **Experiment list/ Lab manual/skill based mini project** for all the Laboratory Courses to be offered in **B.Tech IV semester (for batch admitted in 2023-24) has been discussed and finalized. Annexure XI**
Item 13	To finalize the **Skill Internship Project** (SIP) module to be offered **in Dec 2024.** **List of Courses in Skill Internship Project** (SIP) module to be offered **in Dec 2024 has been discussed and finalized.Annexure XII**
Item 14	**To propose the content of the courses identified for MITS-MOOC development** to be offered **in blended mode** for VII Semester DE/OC courses for the batch admitted in 2022-23. **List of courses identified for MITS-MOOC development** to be offered **in blended mode** for VII Semester DE/OC courses for the batch admitted in 2022-23. **Annexure XIII**
Item 15	To review the CO attainments, identify gaps and suggest corrective measures for the improvement in the CO attainment levels for the courses taught in **Jan-June 2024 Session**. **The review of the CO attainments, gaps and corrective measures for the improvement in the CO attainment for the courses taught in Jan-June 2024 has been finalized as per the discussion with BOS members. Annexure XIV**

Item 16	To review the PO attainment, CO-PO mapping matrix and action to be taken to improve PO attainment level. **The PO attainment of 2020-2024 batch with attainments level and gap analysis has been discussed and finalized. Annexure XV**
Item 17	To review curricula feedback from various stakeholders, its analysis and impact . **Curricula feedback from various stakeholders includes students, faculty, employer and alumni has been discussed and action taken report has been finalized.Annexure XVI**
Item 18	To discuss and recommend the scheme structure & syllabi of PG Programme (M.E./M.Tech./MCA/MBA) along with their Course Outcomes (COs) **(for batch admitted in 2023-24).** **NA**
Item 19	Any other matter.

The following suggestions were given by the external BOS members:

1. Level of COs in few subject may be redefined.

2. MITS –MOOC course content must differ from Departmental Core course contents.

3.Mentor names may not be proposed in BoS proceedings for the courses run through SWAYAM/NPTEL.

4. For MITS-MOOC Course the prerequisite must be taken care of in the scheme and course structure.

Dr. R.B Pachori

Professor, IIT Indore
(External member)

Dr. Ashutosh Datar

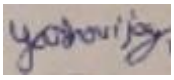
Professor, SATI, Vidisha
(External member)

Dr. Jyoti Singhai

Professor, MANIT, Bhopal
(External member)

Mr. Saurabh Kumar

MD, Hitsavi Ent, Noida
(Industry Representative)



Mr. Yasho Vijay Singh Yadav

Scientist, CSIR
(Alumni Member)

Dr. P. K. Singhal

Dr. Laxmi Shrivastava

Dr. R. P. Narwaria

Dr. Karuna Markam

Prof Madhav Singh

Prof Pooja Sahoo

Prof D K Parsedia	**Dr. Vikas Mahor**	**Dr. Rahul Dubey**
Dr. Hemant Choubey	**Dr. Deepak Batham**	**Dr. Varun Sharma**
Dr. Shubhi Kansal	**Dr. Pawan Dubey**	**Dr. Tej Singh**
Dr. Vikram	**Dr. Vibha Tiwari**	**Dr. Priyanka Garg**
Dr. NookalaVenu	**Dr. Varun Mishra**	**Dr. Himanshu Singh**
Dr. Mukesh Kumar Mishra	**Dr. Dablu Kumar**	**Dr. R. Jenkin Suji**
Prof. Prateek Bhadauria	**Mr. Manoj Kumar**	**Dr. Jaydeep Parmar**

Dr. Vandana Vikas Thakare
Head of the Department

Annexure I

Item 2

To propose the scheme structure of **VIII Semester** with the provision of **ONE DE & ONE OC course** to be offered in **online mode** with credit transfer for the **batch admitted in academic year 2021-22**. (**The total credits from I-VIII semester should not be less than 160 for this batch**).

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
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Scheme of Examination (B.Tech. Electronics Engineering)
B.Tech. VIII Semester *[For batches admitted in Academic Session 2021-22 onwards]*

S.N.	Subject Code	Category	Subject Name & Title	Maximum Marks Allotted					MOOCS		Total Marks	Contact Hours per week			Total Credits
				Theory Slot			Practical Slot								
				End Sem.	Mid Sem. Exam	Quiz/ Assignment	End Sem.	Term Work / Lab Work & Sessional	Assignment	Exams		L	T	P	
1.	**1408XX**	**DE**	**Departmental Elective-5***	-	-	-	-	-	25	75	100	-	-	-	**3**
2.	**9006XX**	**OC**	**Open Course -3**	-	-	-	-	-	25	75	100	3	-	-	**3**
3.	**140804**	**DLC**	**Internship/Project (DLC-9)**	-	-	-	250	150	-	-	400	-	-	18	9
4.	**140805**		**Professional Development#**	-	-	-	50		-	-	50	-	-	4	2
			Total	-	-	-	**300**	**150**	**50**	**150**	**650**	**3**	-	**22**	**17**
Additional Courses for obtaining Honours or minor Specialization by desirous students			**Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization**												

***All of these courses will run through SWAYAM/NPTEL/ MOOC**

 # Evaluation will be based on participation/laurels brought by the students to the institution in national/state level technical and other events during the complete tenure of the UG program (participation in professional chapter activities, club activities, cultural events, sports, personality development activities, collaborative events and technical events)

List of DEs and OCs:

Department Electives-1 (DE-5) (1408XX)	**Fundamental of Power Electronics (140854)**	**Biomedical Signal Processing (140855)**	**Photonic integrated circuit (140856)**
Open Course-3 (OC-3)	Linear Dynamical Systems (900601)	Sensors and Actuators (900602)	

Annexure II

Item 3

To propose the list of courses which the students can opt from SWAYAM/NPTEL/ other MOOC Platforms/ Institution (MITS) MOOC, to be offered in online mode under **Departmental Elective (DE) category courses (DE-5) and open category (OC3)** for credit transfer in the **VIII Semester** under the flexible curriculum (**Batch admitted in academic year 2021-22).**

S.No	Category Code	Course Code	Name of The course	Duration of the Course in weeks	Course Registration		Name of the Mentor Faculty
					Start Date	End Date	
Electronics Engineering							
1	**DE-5**	140856	Photonic integrated circuit	**12**	**20-01-2025**	**11-04-2025**	Dr. Hemant Choubey
2		140854	Fundamental of Power Electronics	**12**	**20-01-2025**	**11-04-2025**	Dr. Varun Sharma
3		140855	Biomedical Signal Processing	**12**	**20-01-2025**	**11-04-2025**	Dr. Shubhi Kansal
4	**OC-3**	900601	Linear Dynamical Systems	**8**	**20-01-2025**	**14-03-2025**	Dr. Deepak Batham
5		900602	Sensors and Actuators	**12**	**20-01-2025**	**11-04-2025**	Dr. Mukesh Kumar Mishra

Annexure III

Item -4

To propose the list of "Additional Courses" which can be opted for getting an

(i) Honours (for students of the host department)

(ii) Minor Specialization (for students of other departments)

[These will be offered through SWAYAM/NPTEL/MOOC based Platforms for the B.Tech. VIII semester students (for the batch admitted in 2021-22)] and for B.Tech. VI semester (for the batch admitted in 2022-23)]

Semester	Hons/ Minor	Domain	Subject Name
VI	Honors	Communication and Signal Processing	1. Electromagnetic waves in guided and wireless media (H140601) 2.Communication Networks (H140606)
		VLSI Design	1. Analog IC design (H140607) 2. Integrated Circuits, MOSFETs, OP-Amps and their Applications (H140609)
	Minors	Control & Sensor Technology	1. Microprocessors and Microcontrollers (M140606) 2. Network Analysis (M140607)
		Communication and Signal Processing	1. Communication Networks (M140604) 2. Fundamentals Of MIMO Wireless Communication (M140605)
VIII	Honors	Communication and Signal Processing	1. An Introduction to Information Theory (H140805) 2. Discrete Time Signal Processing (H140810)
		VLSI Design	1. Digital VLSI Testing (H140809) 2. Integrated Circuits, MOSFET, OPAmps and their Applications (H140807)
	Minors	Control & Sensor Technology	1. Embedded Sensing, Actuation and Interfacing Systems (M140811) 2. Optical Fiber Sensors (M140806)
		Communication and Signal Processing	1. Signal Processing Techniques and its Applications (M140802) 2. Discrete Time Signal Processing (M140810)

Annexure IV

Item -5

To review and finalize the **scheme structure of B.Tech VI Semester under** the flexible curriculum **(Batch admitted in 2022-23).**

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Scheme of Evaluation

B. Tech. VI Semester (Electronics Engineering)

(for batch admitted in academic session 2022-23)

No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted									Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	$$Mode of Exam.
				Theory Slot				Practical Slot			MOOCs								
				End Term Evaluation		Continuous Evaluation		End Sem. Exam.	Continuous Evaluation		Assignment	Exam		L	T	P			
				End Sem. Exam.	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab work & Sessional	Skill Based Mini Project									
1.	2140616	DC	Microcontroller Systems and Applications	50	10	20	20	60	20	20	-	-	200	3	-	2	**4**	Blended	PP
2.	2140XXX	DE	Departmental Elective* (DE-1)	-	-	-	-	-	-	-	25	75	100	3	-	-	**3**	Blended	PP
3.	2900XXX	OC	Open Category (OC-1)**	50	10	20	20	-	-	-	-	-	100	3	-	-	**3**	Blended	PP
4.	2140617	MC	Artificial Intelligence & Machine Learning	50	10	20	20	60	20	20	-	-	200	3	-	2	**4**	Blended	MCQ
5.	2140618	DLC	Minor Project-II#	-	-	-	-	60	40	-	-	-	100	-	-	6	**3**	Offline	SO
6.	200XXX	CLC	Novel Engaging Course (Informal Learning)	-	-	-	-	50	-	-	-	-	50	-	-	2	**1**	Blended	SO
7		NSS	Natural Sciences & Skills##	200	40	80	80	120	40	40	-	-	600	1	-	2	**2***		
Total				**350**	**70**	**140**	**140**	**350**	**120**	**80**	**25**	**75**	**1350**	**13**	**-**	**14**	**20**	**-**	**-**
8.	1000007	**MAC**	Intellectual Property Rights (IPR)	50	10	20	20	-	-	-	-	-	100	2	-	-	GRADE	Online	**MCQ**
Summer Internship-III (On Job Training) for Four weeks duration: Evaluation in VII Semester																			
Additional Course for Honours or minor Specialization				**Permitted to opt for maximum two additional courses for the award of Honours or Minor specialization**															

##Natural Sciences & skills; Engineering Physics / Engineering Chemistry / Environmental Science/ Language

("Natural Sciences & skills; treated as Mandatory Audit Courses from first to fourth semester and cumulative marks converted as a cluster of credits and awarded in the VI semester)

$proficiency in course/subject-includes the weightage towards ability/skill/competence/knowledge level/ expertise attained etc. in that particular course/subject.

$$**MCQ:** Multiple Choice Question $$**AO:** Assignment + Oral $$**PP:** Pen Paper $$**SO:** Submission + Oral

***Course run through SWAYAM/NPTEL/ MOOC Learning Based Platform with credit transfer**

****** **Course run in traditional mode** #The minor project-II may be evaluated by an internal committee for awarding sessional marks.

***This course run through SWAYAM/NPTEL/ MOOC platform**

***DE-1 (SWAYAM/NPTEL/ MOOC platform)**		****Open Category (OC-1)(For students of other branches)**	
2140665	Electromagnetic Waves in Guided and Wireless Media	**2900116**	Embedded Systems
2140662	Digital IC Design	**2900117**	Intelligent Control
2140663	Fuzzy sets, logic and System & Applications		

Annexure V

Item -6

To review & finalize the **syllabi for all Departmental Core Courses (DC)** of **B. Tech VI Semester** (**for batch admitted in 2022-23)** under the flexible curriculum along with their COs.

B.Tech. VI Semester (Electronics Engineering)

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency	Mid Sem marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
2140616	DC	Microcontroller Systems and Applications	50	10	20	20	60	20	20	200	3	-	2	4

Microcontroller Systems and Applications (2140616)

Course Objectives: To introduce the basic concepts of microcontroller and to develop assembly language programming skills along with the introduction of microcontroller applications.

UNIT-I: Introduction: Microcontroller architecture, classification, challenges and design issues, Von Neumann/Harvard architectures, CISC, RISC, microcontrollers types and their selection, Overview of the 8051 family, architecture, pin description, Flags, Register Banks, Internal Memory Organization, I/O configuration, Special Function Registers, addressing modes.

UNIT II: **Assembly programming and instruction of 8051:** An Overview of 8051 instruction set, Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming.

UNIT III: Introduction to ARM Microcontroller: Introduction to pipelining based processors, applications of ARM, Architecture of ARM Cortex M3, Various Units in the architecture, General Purpose Registers, Special Registers, exceptions, interrupts, and stack operation.

UNIT IV: Interfacing real world devices with 8051 microcontroller: Memory address decoding, 8051 interfacing with memory, 8051 interface with 8255 PPI and various interfacings like: LCD, Matrix Keyboard, ADC, DAC and Stepper motor interfacing.

Unit V: System Design With Arduino Board: Overview of Arduino, Configuration, Interfacing, Board layout, Atmega328 specifications, Interfacing of Arduino with LED, Switches, Light dependent resistor (LDR), PWM, 16*2 LCD, Serial, L293D for motor interfacing, ADC.

Course Outcomes:
After successful completion of the course, students will be able to:

CO1. Explain the architecture of embedded system and 8051 microcontroller.
CO2. Develop programming skill for 8051 microcontroller.
CO3. Understand the 32-bit pipelined architecture of ARM microcontroller.
CO4. Design Interfacing circuitry for memory and I/O devices using different interfacing with 8051.
CO5. Develop skill in programming for Arduino with different peripherals.

Text Books:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, “The 8051 Microcontroller and Embedded Systems using Assembly and C” Pearson Education India, 2nd Edition Modern
2. Shibu K V, —”Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited.

Reference Books:

1. Kenneth Ayal, “The 8051 Microcontroller”, Architecture, Programming and Applications.
2. Subrata Ghoshal, “Embedded Systems and Robots, Projects using the 8051Microcontroller”.
3. David A Patterson and John L. Hennessy, “Computer Organization and Design ARM edition”

Course Articulation Matrix

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

B.Tech. VI Semester (Electronics Engineering)

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency in Subject course	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
2140617	MC	Artificial Intelligence & Machine Learning	50	10	20	20	60	20	20	200	3	-	2	4

Artificial Intelligence & Machine Learning (2140617)

Course Objectives: To provide the fundamental knowledge of Artificial Intelligence, Neural Network and Machine Learning, to present the basic representation and reasoning paradigms used in AI & ML, to understand the working of techniques used in AI & ML.

Unit – I Introducing Artificial Intelligence: Definition, Goals of AI, Task of AI, Computation, Psychology and Cognitive Science. Perception, Understanding, and Action. Artificial intelligence vs machine learning vs deep learning and other related fields. Applications of Artificial intelligence and Machine Learning in the real world.

Unit – II Problem, Problem Space and Search: Production System, Blind Search: BFS & DFS, Heuristic Search, Hill Climbing, Best First Search. **Introduction to Neural Networks:** History, Biological Neuron, Artificial Neural Network, Neural Network Architectures, Classification, & Clustering

Unit – III Introduction to Machine Learning: Traditional Programming vs Machine learning. Key Elements of Machine Learning: Representation, process (Data Collection, Data Preparation, Model selection, Model Training, Model Evaluation and Prediction), Evaluation and Optimization. Types of Learning: Supervised, Unsupervised and reinforcement learning. Regression vs classification problems.

Unit – IV: Supervised Machine Learning: Linear regression:implementation, applications & performance parameters. Decision tree classifier, terminology, classification vs regression trees, tree creation with Gini index and information gain, IDE3 algorithms, applications and performance parameters. Random forest classifier. Case study on regression and classification for solving real world problems.

Unit – V: Unsupervised Machine Learning: Introduction, types: Partitioning, density based, DBSCAN, distribution model-based, hierarchical, Agglomerative and Divisive, Common Distance measures, K-means clustering algorithm. Case study on clustering for solving real world problems.

Text Books/Reference Books:

1. Artificial Intelligence: A Modern Approach by Stuart J. Russell and Peter Norvig, Prentice Hall.
2. Artificial Intelligence: Elaine Rich, Kevin Knight, Mc-Graw Hill.
3. Introduction to AI & Expert System: Dan W. Patterson, PHI.
4. Pattern Recognition and Machine Learning, Christopher M. Bishop
5. Introduction to Machine Learning using Python: Sarah Guido
6. Machine Learning in Action: Peter Harrington

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. Explain basic concepts of Artificial Intelligence & Machine Learning.

CO2. **Describe** the techniques for search and processing.

CO3. Compare AI, ANN & Machine Learning techniques.

CO4. Apply AI and ML techniques to solve real world problems

Course Articulation Matrix

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

Annexure VI

Item -7

To propose the list of courses from SWAYAM/NPTEL/MOOC Platforms to be offered for batches admitted in 2022-23 **in online mode under Departmental Elective (DE) Course** with credit transfer, **in the VI Semester.**

S. No	Category Code	Course Code	Name of The course	Duration of the Course in weeks	Course Registration		Name of the Mentor Faculty
					Start Date	End Date	
Electronics Engineering							
1	DE-1	2140665	Electromagnetic Waves in Guided and Wireless Media	8	20-01-2025	14-03-2025	Dr. J.Suji
2		2140662	Digital IC Design	12	20-01-2025	11-04-2025	Dr. Vikas Mahor
3		2140663	Fuzzy sets, logic and System & Applications	12	20-01-2025	11-04-2025	Dr. Hemant Choubey

Annexure VII

Item 8

To review and finalize the courses & syllabi to be offered (for batch admitted in 2022-23) under the **Open Category (OC) Courses to be offered in traditional mode for B Tech VI semester** of other departments along with their COs.

S. No	Category	Subject Code	Subject Name
1	OC-1	2900116	Embedded Systems
2	OC-1	2900117	Intelligent Control

B.Tech. VI Semester (Electronics Engineering)

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency in Subject course	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
2900117	OC	Intelligent Control	50	10	20	20	-	-		100	3	-	-	3

Intelligent Control (2900117)

Course Objectives: The main objective of this course is to develop the basic understanding of an Intelligent control i.e. control system with optimization and prediction using Artificial Neural Network to the students.

Unit I Adaptive Control: Introduction, Close loop and open loop adaptive control. Self-tuning controller, Parameter estimation using least square and recursive least square techniques, Gain Scheduling, Model Reference Adaptive Control, Self Tuning Regulators, Adaptive Smith predictor control, Auto tuning and self tuning smith predictor.

Unit II Artificial Neural Network (ANN) Based Control: Introduction to ANN, Different activation functions, Different architectures and different learning methods, Back Propagation and Radial Basis Function networks.

Unit III Modeling of Control System: Representation and identification, Modeling the plant, Control structures – supervised control, Model reference control, Internal model control, Predictive control,Indirect and direct adaptive controller design using neural network.

Unit IV Fuzzy Logic Based Control: Fuzzy Controllers: Preliminaries – Mamdani and Sugeno inference methods, Fuzzy sets in commercial products – basic construction of fuzzy controller – fuzzy PI, PD and PID control, Analysis of static properties of fuzzy controller, Analysis of dynamic properties of fuzzy controller , Simulation studies and case studies , Stability issues in fuzzy control.

Unit V Hybrid Control: Introduction to Genetic Algorithm (GA), Neuro-Fuzzy and Fuzzy-GA based hybrid system design.

Text Books:

1. Astrom .K, Adaptive Control, Second Edition, Pearson Education Asia Pvt. Ltd, 2002.
2. Shivanandan, Introduction to Artificial Neural Network with MATLAB 6.0.1, Third Edition, Mcgraw Hill India Ltd, 2015.

Reference Books:

1. Klir G.J and Folger T.A, Fuzzy sets, Uncertainty and Information, Prentice Hall of India, New Delhi 1994.
2. Bose and Liang, Artificial Neural Networks, Tata Mcgraw Hill, 1996.
3. Kosco B, Neural Networks and Fuzzy Systems: A Dynamic Approach to Machine Intelligence, Prentice Hall of India, New Delhi, 1992.
4. Chang C. Hong, Tong H. Lee and Weng K. Ho, Adaptive Control, ISA press, Research Triangle Park, 1993.

Course Outcomes:

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

CO1. Explain adaptive control systems.

CO2. Describe neural network architecture and learning algorithms.

CO3. Apply the concept of artificial neural network to model the control system.

CO4. Design fuzzy logic based control system.

CO5. Optimize control system using Genetic algorithm.

Course Articulation Matrix

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

B.Tech. VI Semester (Electronics Engineering)

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credit s
			End Sem Marks	Proficiency in Subject course	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
2900116	OC	Embedded System	50	10	20	20	-	-		100	3	-	-	3

Embedded System (2900116)

Course objectives: To introduce the basic concepts of microcontroller and to develop assembly language programming skills along with the introduction of microcontroller applications.

Unit I Introduction: Embedded system architecture, classification, challenges and design issues, fundamentals of embedded processor and microcontrollers, Von Neumann/Harvard architectures, CISC vs. RISC, microcontrollers types and their selection, Overview of the 8051 family, architecture, pin description, Flags, Register Banks, Internal Memory Organization, I/O configuration, Special Function Registers, addressing modes.

Unit II Assembly programming and instruction of 8051: An Overview of 8051 instruction set, Introduction to 8051 assembly programming, Assembling and running an 8051 program, Data types and Assembler directives, Arithmetic, logic instructions and programs, Jump, loop and call instructions, IO port programming.

Unit III 8051 Timer, Serial port, interrupt Programming: Basics of Timers/Counters, Programming 8051 timers/Counter, basics of serial communication, 8051 connection to RS232, 8051 serial port programming, basics of 8051 Interrupts, 8051 interrupts programming: Timer interrupts, external hardware interrupts and serial communication interrupt, 8051 Interrupt priority.

Unit IV Interfacing real world devices with 8051 microcontroller: Memory address decoding, 8051 interfacing with memory, 8051 interface with 8255 PPI and various interfacings like: LCD and Matrix Keyboard interfacing with 8051 microcontroller, ADC, DAC and Temperature Sensor interfacing with 8051 microcontroller, Stepper motor interfacing.

Unit V Interfacing real world devices with Arduino : Overview of Arduino, Configuration, Interfacing, Board layout, Atmega328 specifications, Interfacing of Arduino with LED, Switches, Light dependent resistor (LDR), PWM, 16*2 LCD, Serial, L293D for motor interfacing, ADC.

Text Book:

1. Muhammad Ali Mazidi, Janice Gillispie Mazidi, Rolin D. Mckinlay, ―The 8051 Microcontroller and Embedded Systems using Assembly and C‖ Pearson Education India, 2nd Edition

Reference Books:

2. Kenneth Ayal, ―The 8051 Microcontroller‖, Architecture, Programming and Applications.
3. SubrataGhoshal, ―Embedded Systems and Robots, Projects using the 8051Microcontroller.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. Explain the architecture of embedded system and 8051.
CO2. Write assembly language programs for 8051.
CO3. Describe the interfacing of 8051 microcontroller with Timers/Counters, Serial communication and interrupt.
CO4. Design memory and I/O interfacing circuits with 8051.
CO5. Explain the interfacing of Arduino with I/O devices.

Course Articulation Matrix

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

Annexure VIII

Item 9

To review and finalize the **Experiment list/ Lab manual/Skill based mini-project** for all the Laboratory Courses to be offered in **B.Tech.VI semester *(*for batch admitted in 2022-23).**

1	**DC**	**2140617**	**Artificial Intelligence & Machine Learning**
2	**DC**	**2140616**	**Microcontroller Systems and Applications**
3	**DLC**	**2140618**	**Minor Project-II**

Subject Name: AIML Lab
Subject Code: 2140617

1. Perform Creation, indexing, slicing, concatenation and repetition operations on Python built-in data types: Strings, List, Tuples, Dictionary, Set.
2. Solve problems using decision and looping statements.
3. Apply Python built-in data types: Strings, list, Tuples, Dictionary, Set and their methods to solve any given problem
4. Manipulation of NumPy arrays- Indexing, Slicing, Reshaping, Joining and Splitting.
5. Computation on NumPy arrays using Universal Functions and Mathematical methods.
6. Import a CSV file and perform various Statistical and Comparison operations on rows/columns
7. Create Pandas Series and DataFrame from various inputs
8. Import any CSV file to Pandas DataFrame and perform the following:
    1. Visualize the first and last 10 records
    2. Get the shape, index and column details
    3. Select/Delete the records(rows)/columns based on conditions.
    4. Perform ranking and sorting operations.
    5. Do required statistical operations on the given columns.
    6. Find the count and uniqueness of the given categorical values.
9. Import any CSV file to Pandas DataFrame and perform the following:
    1. Handle missing data by detecting and dropping/ filling missing values.
    2. Transform data using different me hods.
    3. Detect and filter outliers.
    4. Perform Vectorized String operations on Pandas Series.
    5. Visualize data using Line Plots, Bar Plots, Histograms, Density Plots and Scatter Plots.
10. Use scikit-learn package in python to implement following machine learning models to solve real world problems using open source datasets:
    1. Linear Regression model.
    2. Multi-linear regression model.
    3. Decision tree classification model.
    4. Random forest model.
    5. SVM model.
    6. K-means clustering model

Subject Name: AIML Lab
Subject Code: 2140617
Skill Based Mini Project

1. Write a program to Predicting Iris Flower Species [Dataset: Iris dataset (available in scikit-learn).]
2. Write a program for Handwritten Digits Recognition [Dataset: MNIST dataset of handwritten digits.]
3. Write a program for Sentiment Analysis on Movie Reviews [Dataset: IMDb movie reviews dataset.]
4. Write a program to Predict House Prices [Dataset: Housing price data from Kaggle.]
5. Write a program for Spam Email Detection [Dataset: Enron Email Dataset.]
6. Write a program for Image Classification on CIFAR-10 [Dataset: CIFAR-10 dataset.]
7. Write a program for Credit Card Fraud Detection [Dataset: Credit Card Fraud Detection dataset from Kaggle.]
8. Write a program for Predicting Stock Prices [Dataset: Yahoo Finance or Alpha Vantage API.]
9. Write a program for Customer Segmentation [Dataset: Online Retail Data from UCI Machine Learning Repository.]
10. Write a program to Digit Recognition in Sign Language [Dataset: ASL Alphabet dataset.]
11. Write a program for Predicting Diabetes Onset [Dataset: Diabetes dataset from UCI ML Repository.]
12. Write a program for Facial Recognition [Dataset: Labeled Faces in the Wild (LFW) dataset.]
13. Write a program for Movie Recommendation System [Dataset: MovieLens dataset.]
14. Write a program for Predicting Employee Churn [Dataset: Human Resources Analytics dataset from Kaggle.]
15. Write a program for Text Generation with LSTM [Dataset: Various books, articles, or Kaggle text datasets.]
16. Write a program for Fake News Detection [Dataset: Fake news dataset from Kaggle.]
17. Write a program for Predicting Wine Quality [Dataset: Wine Quality dataset from UCI ML Repository.]
18. Write a program for Object Detection with YOLO [Dataset: COCO (Common Objects in Context) dataset.]
19. Write a program for Customer Lifetime Value Prediction [Dataset: Online Retail Data from UCI ML Repository.]
20. Write a program for Predicting Cardiovascular Disease [Dataset: Framingham Heart Study dataset.]

Subject Name: Microcontroller Systems and Applications Lab
Subject Code: 2140616

Course Objectives: The objective of this course is to provide students with hands-on experience in designing, implementing, and testing embedded systems using microcontrollers.

List of Experiments

1. Write an assembly language program to transfer a block of data bytes from source memory to destination memory and demonstrate on 8051 microcontroller board.
2. Write an assembly language program to perform Addition/subtraction of a given number and demonstrate on 8051 microcontroller board.
3. Write an assembly language program to demonstrate conditional bit jump, conditional byte jump, unconditional jump, call and return instructions on 8051 microcontroller board.
4. Write an assembly language program to demonstrate the basic interface between an LCD display and 4 x 4matrix key board and demonstrate on 8051 microcontroller board.
5. Write an assembly language program to implement a basic temperature sensor using an ADC output is displayed on a 2x16 LCD and demonstrate on 8051 microcontroller board.
6. Write an assembly language program to implement the basic wave form generation using DAC, output is displayed on a CRO and demonstrate on 8051 microcontroller board.
7. Write an Arduino IDE program for Blinking an LED with a delay of 2 seconds and demonstrate on 8051 microcontroller Ardunio board.
8. Write an Arduino IDE program for to demonstrate automatic traffic light control using Ardunio board. Turn ON Red LED for 4 seconds, Green LED for 5 seconds, Yellow for 2seconds.
9. Write an Arduino IDE program for Blinking an 5 LEDs with a delay of 2 seconds in a sequence.
10. Write an Arduino IDE program for connecting a servo motor to Arduino board and rotate in clockwise and anti-clockwise direction using switches.

Course Outcomes:
After successful completion of the course, students will be able to:
CO1. Develop 8051 assembly language programming skills for the various arithmetic and logical operations.
CO2. Demonstrate interfacing of 8051 microcontroller board with various interfacing devices.
CO3. Design Arduino board based automated electronic systems.

Subject Name: Microcontroller Systems and Applications Lab
Subject Code: 2140616
Skill Based Mini Project

1. Design and simulate Arduino based Temperature and Humidity monitoring system with DHT22 sensor on Proteus.
2. Design and simulate Arduino Password Based Door Lock System on Proteus.
3. Design and simulate Digital voltmeter using Arduino UNO Range: 0-50 volt Using SIMULINO UNO on Proteus.
4. Design and simulate Automatic Door Open System with Visitor Counter using ARDUINO UNO R3 on Proteus.
5. Design and simulate Arduino based light sensor using LDR on Proteus.
6. Design and simulate Arduino based Temperature and Humidity monitoring system with DHT22 sensor on Proteus.
7. Simulate a system to measure temperature using an LM35 sensor and display it on an LCD.
8. Design and simulate a traffic light control system with a pedestrian crossing signal.
9. Simulate a digital clock with a 7-segment display.
10. Simulate a motion detection system with an alarm using a PIR sensor.

Annexure IX

Item 10

To review and finalize the **scheme structure of B. Tech. IV Semester** under the flexible curriculum (**for batch admitted in 2023-24**).

MADHAV INSTITUTE OF TECHNOLOGY & SCIENCE, GWALIOR
(Deemed University)
(Declared Under Distinct Category by Ministry of Education, Government of India)
NAAC Accredited with A++ Grade

Scheme of Evaluation
B. Tech IV Semester (Electronics Engineering)

(for batch admitted in academic session 2023-24)

S. No.	Subject Code	Category Code	Subject Name	Maximum Marks Allotted							Total Marks	Contact Hours per week			Total Credits	Mode of Teaching	Mode of Exam
				Theory Slot				Practical Slot									
				End Term Evaluation		Continuous Evaluation		End Sem. Exam	Continuous Evaluation			L	T	P			
				End Sem. Exam	$Proficiency in subject /course	Mid Sem. Exam.	Quiz/ Assignment		Lab Work & Sessional	Skill Based Mini Project							
1.	3100028	BSC	Engineering Mathematics-III	50	10	20	20	-	-	-	100	3	1	-	4	Blended	PP
2.	3140411	DC	Digital Communication	50	10	20	20	40	30	30	200	2	1	2	4	Blended	PP
3.	3140412	DC	Linear Control Theory	50	10	20	20	-	-	-	100	2	1	-	3	Blended	PP
4.	3140413	DC	Microprocessor & Interfacing	50	10	20	20	40	30	30	200	2	1	2	4	Blended	PP
5	3140414	DLC	Software Lab (Introduction to MATLAB)	-	-	-	-	40	30	30	100	-	-	2	1	Offline	SO
5.	3140415	MC	Cyber Security	50	10	20	20	-	-	-	100	2	1	-	3	Blended	MCQ
6.	200xxx	CLC	Novel Engaging Course (Informal Learning)	-	-	-		50	-	-	50	-	-	2	1	Interactive	SO
Total				**250**	**50**	**100**	**100**	**170**	**90**	**90**	**850**	**11**	**5**	**8**	**20**	**-**	**-**
7.		Natural Sciences & Skills	Language	50	10	20	20	30	10	10	150	1	-	-	Grade	Blended	MCQ
8.	1000005	MAC	Project Management & Financing	50	10	20	20	-	-	-	100	2	-	-	Grade	Online	MCQ
Summer Internship Project – II (Institute Level) (Qualifier): Minimum two-week duration: Evaluation in V Semester.																	

$Proficiency in course/subject – includes the weightage towards ability/ skill/ competency /knowledge level /expertise attained etc. in that particular course/subject.
Natural Sciences& Skills: Engineering Physics / Engineering Chemistry / Environmental Science/ Language.
Credits of Natural Sciences & Skills will be added in the VI Semester.
MCQ: Multiple Choice Question **AO:** Assignment + Oral **OB:** Open Book **PP:** Pen Paper **SO:** Submission + Oral

Mode of Teaching					Mode of Examination				Total Credits
Theory				Lab	Theory			Lab	
Offline	Online	Blended		Offline	PP	AO	MCQ	SO	
		Offline	Online						
-	-	12	6	1	15	-	3	1	19
-	-	63.15%	31.57%	5.26%	78.94%	-	15.78%	5.26%	100%

Annexure X

Item 11

To review and finalize the syllabi for all Departmental Core (DC) Courses of ***B. Tech. IV Semester*** (for **batch admitted in 2023-24**) under the flexible curriculum along with their COs.

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
3140411	DC	Digital Communication	50	10	20	20	60	20	20	200	2	1	2	4

Digital Communication (3140411)

Course Objectives: The main objective of this course is to understand the basic concepts of digital modulations and digital transmission techniques.

Unit I Sampling Techniques: Sampling theorem for Low pass signal, Ideal sampling, Natural sampling and Flat top sampling, Time division Multiplexing, Generation and detection of PAM, PPM and PWM.

Unit II Waveform coding techniques: Introduction, Quantization, Quantization noise, Companding, Types of companding: A law and µlaw, Eye pattern, Delta modulation, Adaptive delta modulation and Differential Pulse Code Modulation.

Unit III Band Pass Data Transmission: Binary amplitude shift keying (BASK), Binary phase shift keying (BPSK), Quadrature phase shift keying(QPSK), Differential phase shift keying (DPSK), Coherent and Non coherent Binary frequency shift keying (BFSK), Quadrature amplitude modulation (QAM).

UNIT IV Detection Techniques: Optimum filter, Matched filter and Correlator detector, Gram Schmidt orthogonalization procedure and Concept of signal space for the computation of probability of error, Calculation of error probability for BPSK, QPSK and coherent BFSK, Comparison of different modulation techniques.

Unit V Information Theory & Coding: Concept of information theory, Entropy and Information rate, Channel capacity, Shannon's theorem, Shannon Hartley theorem, Coding Efficiency, Shannon Fano coding, Huffman coding.

Text Books:

1. Singh, R.P. & Sapre, S.D, "Communication Systems: Analog & Digital", Tata McGraw-Hill, 5threprint, 2000.
2. John G. Proakis, "Digital Communication", McGraw Hill Inc, 5th Edition, 2008.

Reference Books:

1. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition, 2000.
2. Taub & Schilling, "Principle of Communication Systems", 2nd Edition, 2003.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1: Explain the sampling process and reconstruction.
CO2: Analyze the performance of waveform coding techniques.
CO3: Describe the mathematical model of digital modulation techniques.
CO4: Determine the error probability of band pass transmission techniques.
CO5: Illustrate the concepts of information theory and coding.

Course Articulation Matrix

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

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
3140412	DC	Linear Control Theory	50	10	20	20				100	2	1		3

Linear Control Theory (3140412)

Course Objectives: Learning of control system theory and its implementation in practical systems using electronic devices.

UNIT I: Introduction to Control Systems: Basic control system terminology, Open loop and Closed loop system, Feedback control, Different modeling of physical systems, Linear approximation of physical systems. Transfer function of linear systems, Block diagram algebra and Signal flow graphs, Effects of negative feedback.

UNIT II: **Time Domain Analysis:** Test input signals, First order systems, Second order systems, Effects of addition of poles and zeros to open and closed loop transfer functions, Steady state error, Constant and error coefficients for type 0, 1, and 2 systems.

UNIT III: Stability Analysis: Concept of stability of linear systems, Relation between the closed loop poles and stability, Relative stability, Absolute stability, Routh Hurwitz criteria and its applications, Root locus plot.

UNIT IV: Frequency Domain Analysis: Performance specifications in frequency domain, Co-relation between frequency domain and time domain, Polar plots and Bode plots of transfer function, Nyquist stability criterion, Assessment of relative stability.

Unit V: Introduction to Controllers: Introduction to Proportional, Integral, and Derivative controller, PD controller, PI controller, PID controller, Design of various controllers and their limitations.

Text Books:

1. Control System Engineering- I. J. Nagrath & M. Gopal, New Age International.
2. Modern Control Engineering –K. Ogata, Prentice Hall.
3. Control System- A. Anand Kumar, PHI
4. Control System Engineering – B.S. Manke, Khanna publications.

Reference Books:

1. Automatic Control System— B. C. Kuo,Wiley.
2. Control System Engineering- Norman Nise, John Wiley & Sons.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. **Analyze** and model linear systems using Block diagram reduction and signal flow graph.
CO2. **Analyze** the time domain behavior of the linear systems.
CO3. **Compute** the steady state error for type 0,1,2 systems.
CO4. **Analyze** the stability of control system using time and frequency domain methods.
CO5. **Design** proportional, integral, and derivative controller, PD, PI, PID controllers.

Course Articulation Matrix

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

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini project		L	T	P	
3140413	DC	Microprocessor & Interfacing	50	10	20	20	60	20	20	200	2	1	2	4

Microprocessor & Interfacing (3140413)

Course objectives: To introduce the basic concepts of microprocessor and microcontroller and to develop assembly language programming skills along with their use in various applications.

Unit I: Introduction to Microprocessor: Introduction to microprocessors and microcomputers, Study of 8 bit Microprocessor, 8085 pin configuration, Internal Architecture and operations, Interrupts, Interrupts and interrupt service routine.

Unit II: 8085 Assembly Language Programming: 8085 instruction set, Data transfer operations, Arithmetic operations, logic operations, Branch operations, 8085 assembly language programming, Debugging the program, Addressing modes of 8085.

Unit III: Timing diagram and interfacing with 8085: Counters and Time delays, Instruction cycle, Machine cycle, T-states, timing diagram for different 8085 arithmetic, logical and branch instructions, Introduction to Memory interfacing and I/O interfacing with 8085.

Unit IV: Peripheral ICs: Memory interfacing and various interfacingschips like: Programmable input/output ports 8155/8255(PPI), Programmable interval timer 8253/8254 (PIT), Programmable interrupt controller 8259 (PIC) and DMA controller 8257.

Unit V: Architecture and Programming of 16-Bit Microprocessor: 8086 Block diagram and Architecture, Pin configuration of 8086, Execution Unit (EU) and Bus Interface Unit(BIU), Minimum mode & Maximum mode operation, Memory segmentation, Instruction set and addressing modes of 8086, Introduction to 8086 assembly language programming.

Text Book:

1. Ramesh. S. Gaonkar, Microprocessor architecture Programming and Application with 8085 Penram International Publishing, 4th Edition.
2. B. Ram, "fundamentals of Microprocessors and Microcomputer" DhanpatRai, 5th Edition.

Reference Books:

1. Douglas V Hall.,"Microprocessor and Interfacing"Tata Mcgraw Hill.
2. A.K.Ray and K.M. Bhurchandi,"Advance Microprocessor and Peripheral",Tata Mcgraw Hill

Course Outcomes

After successful completion of the course, students will be able to:
CO1. Describe the architecture and organization of 8085, 8086 microprocessors.
CO2. Describe the instruction sets of 8085, 8086 microprocessors.
CO3. Develop assembly language programs for 8085.
CO4. Design memory and I/O interfacing circuits with 8085.
CO5. Explain interface of 8085 with 8255 PPI, 8254 PIT, 8259 PIC and 8257 DMA controller.

Course Articulation Matrix

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

Subject Code	Category Code	Subject Name	Theory Slot				Practical Slot			Total Marks	Contact Hr/week			Total Credits
			End Sem Marks	Proficiency	Mid Sem Marks	Quiz/ Assignment Marks	End Sem Mark	Lab work & Sessional Mark	Skill based mini proj		L	T	P	
3140415	MC	Cyber Security	50	10	20	20	-	-	-	100	2	1	-	3

TOPIC-WISE MOOC LINKS FOR CYBER SECURITY (3140415)

UNIT - 1:

Topic of the lecture: Overview of Cyber Security
Topic of the lecture: Introduction to Cyber Security, Cyber-crime
Topic of the lecture: Types of Cyber Attacks
Topic of the lecture: Cyber Vandalism (Hacking), Cyber Stalking, Internet Frauds and Software Piracy

UNIT - 2:

Topic of the lecture: Basics of Internet and Networking
Topic of the lecture: Network Topologies
Topic of the lecture: Wired and Wireless networks, E-commerce
Topic of the lecture: OSI Model:
Topic of the lecture: Internetworking Devices:
Topic of the lecture: Firewall:

UNIT - 3:

Topic of the lecture: Security Principles and Attacks
Topic of the lecture: Cryptography:
Topic of the lecture: Symmetric key Cryptography **Topic of the lecture:** Symmetric key Ciphers **Topic of the lecture:** Public key cryptography **Topic of the lecture:** SSL

UNIT - 4:

Topic of the lecture: Hacker, Types of Hacker **Topic of the lecture:** Malicious Softwares (Part 1) **Topic of the lecture:** Malicious Softwares (Part 2)

UNIT - 5:

Topic of the lecture: Introduction of Intellectual Property and patent
Topic of the lecture: More About Patent **Topic of the lecture:** All about Trademark **Topic of the lecture:** Industrial Design
Topic of the lecture: Geographical Indication **Topic of the lecture:** All about copyright **Topic of the lecture:** IT act 2000
Topic of the lecture: Digital Crime Investigation

Course Outcomes

After successful completion of the course, students will be able to:

CO1. Discuss the basic terminologies of cyber security.
CO2. Explain the basic concept of networking and internet.
CO3. Apply various methods used to protect data in the internet environment in real-world Situations.
CO4. Examine the concept of IP security and architecture.
CO5. Compare various types of cyber security threats/vulnerabilities.
CO6. Develop the understanding of cybercrime investigation and IT ACT 2000

Course Articulation Matrix

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

Annexure XI

Item 12

To review and finalize the Experiment list/ Lab manual/Skill based mini-project for all the Laboratory Courses to be offered in Batch IV semester **(for batch admitted in 2023-24).**

S.No	Category	Subject Code	Subject Name
1	DC	3140411	Digital Communication
2	DC	3140413	Microprocessor & Interfacing
3	DLC	3140414	Software Lab(Introduction to MATLAB)

Subject Name: Digital Communication

Subject Code: 3140411

Course Objective

This course gives the ability to the students to learn the concepts of communication for digital signals using various modulation techniques.

List of Experiment

1. Perform sampling and reconstruction.
2. Analysis of the process of Time Division Multiplexing and demultiplexing.
3. Analyze Pulse Amplitude Modulation on Scilab.
4. Analyze Pulse Width Modulation on Scilab.
5. Analyze Pulse Position Modulation on Scilab.
6. To generate Amplitude Shift Keying signal using Scilab
7. To generate Phase Shift Keying signal using Scilab software
8. To generate Frequency Shift Keying signal using Scilab
9. To generate Quadrature Phase Shift Keying signal using Scilab
10. To generate Pulse code modulation signal using Scilab
11. To generate Time Division Multiplexing signal using Scilab

Course Outcomes:

On completion of this Lab the student will be able to:

CO1. Verify sampling theorem.

CO2. Demonstrate digital modulation techniques.

CO3. Evaluate the performance of the digital communication system using Scilab.

Subject Name: Microprocessor & Interfacing Subject Code: 3140413

Course Objective

This course gives the ability to the students to learn the assembly language programming of 8085 and 8086 microprocessors and their interfacing with different peripherals.

List of Experiments

1. Write an assembly language program to perform addition operation on two immediately given 8 bit numbers using 8085 microprocessor.
2. Write an assembly language program to perform addition operation on two 8 bit numbers stored in memory using an 8085 microprocessor.
3. Write an assembly language program to find whether the number is even or odd using an 8085 microprocessor.
4. Write an assembly language program to obtain 2's complement of a given number using 8085 microprocessor.
5. Write an assembly language program to perform arithmetic operations of two BCD numbers using an 8085 microprocessor.
6. Interface a Stepper Motor to the 8085 microprocessor system using 8255 and write an 8085 assembly language program to control the Stepper Motor.
7. Write an assembly language program to generate standard waveforms using DAC and display waveforms on CRO with an 8085 microprocessor.
8. Write an assembly language program to Move a Block of Data from one memory location to another with an 8086 microprocessor.
9. Write an assembly language program to Multiply Two 16-Bit Numbers with 8086 microprocessor.
10. Write an assembly language program to find the square of a given number with an 8086 microprocessor.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. Develop the assembly language programs for the different arithmetic and logical operations using 8085 and 8086 microprocessors.

CO2. Design interfacing circuits for different I/O devices using PPIs with 8085.

Subject Name: Software Lab Subject Code: 3140414

List of Experiments

1. Study of MATLAB.
2. Write a program performing the MATRIX manipulation using the MATLAB command window.
3. Write a program to plot the various ANALOG functions using plot command. Also label x axis ,y axis and provide the title of figure.
4. Write a program to plot the various DISCRETE functions using plot command. Also label x axis, y axis and provide the title of figure.
5. Write a program to plot more than one ANALOG function in a single window using subplot.
6. Write a program to plot more than one DISCRETE function in a single window using subplot.
7. Write a program to plot Amplitude Modulated signal along with baseband signal.
8. Write a program to plot SSB Modulated signal along with baseband signal.
9. Write a program to plot Frequency Modulated signal along with baseband signal.
10. Write a program to plot Phase Modulated signal along with baseband signal.
11. Write a program to draw root locus of the given function.
    1/(2s^4+5s^3+4s^2+6s+8)
12. Write a program to draw the Bode Plot of the given function.
    1/(2s^4+5s^3+4s^2+6s+8)
13. Write a program to draw Nyquist Plot of the given function.
    1/(2s^4+5s^3+4s^2+6s+8)

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. Develop MATLAB codes for signal representation and modulation techniques.
CO2. Use MATLAB tools for analysis of system performance.
CO3. Simulate the real life problems for performance analysis using MATLAB Simulink.

Subject Name: Digital Communication Lab Subject Code: 3140411

Skill Based Mini Project

1. Implementation of sampling theorem. (a) Sampling at Nyquist rate (b) Over sampling and (c) Under sampling.
2. Implementation of Eye Diagram/Eye Pattern for any of the modulation technique.
3. PPM using IC 555.
4. PAM using IC 555.
5. PWM using IC 555.
6. Generation of On-off Keying signal.
7. Generation of ASK, FSK and PSK signal.
8. Generation of QAM signal and its constellation diagram.
9. To develop a GUI based project in Scilab for PCM.
10. To develop a GUI based project in Scilab for Differential-PCM.
11. To develop a GUI based project in Scilab for Delta Modulation.
12. To develop a GUI based project in Scilab for Adaptive Delta Modulation
13. Digital Communication through Audio Signals
14. Develop a digital pulse counter system to count pulses in a given signal using digital communication
15. Implement a basic digital signal encryption system for secure communication
16. Explore techniques for digital signal compression and implement a simple compression algorithm
17. Create a MATLAB project to visualize signal constellations for different digital modulation schemes
18. Implement a basic error detection system for digital signals using techniques like parity checks
19. Develop a system to digitize and transmit voice signals using basic digital communication principles.

Subject Name: Microprocessor & Interfacing Subject Code: 3140413

Skill Based Mini Project

1. Develop an 8085 microprocessor assembly language program to generate Fibonacci series using 8085 Simulator.
2. Develop an 8085 microprocessor assembly language program to calculate the square root using 8085 Simulator.
3. Develop an 8085 microprocessor assembly language program to check a string as palindrome or not on using 8085 Simulator.
4. Develop an 8085 microprocessor assembly language program to calculate the square root using 8085 Simulator.
5. Develop an 8085 microprocessor assembly language program to multiply two 16-bit numbers using 8085 Simulator.
6. Develop an 8085 microprocessor assembly language program to convert binary to BCD using 8085 Simulator.
7. Develop an 8085 microprocessor assembly language program to find the cube of a number using 8085 Simulator.
8. Develop an 8085 microprocessor assembly language program to divide two numbers using 8085 Simulator.
9. Develop an 8085 microprocessor assembly language program to check a given byte is bitwise palindrome or not using 8085 Simulator.
10. Develop an 8085 microprocessor assembly language program to find smallest no from the given array using 8085 Simulator.
11. Develop an 8086 microprocessor assembly language program to generate Fibonacci series using Simulator emu8086.
12. Develop an 8086 microprocessor assembly language program to calculate the square root using emu8086 Simulator.
13. Develop an 8086 microprocessor assembly language program to check a string as palindrome or not on using emu8086 Simulator.
14. Develop an 8086 microprocessor assembly language program to calculate the square root using emu8086 Simulator.
15. Develop an 8086 microprocessor assembly language program to multiply two 16-bit numbers using emu8086 Simulator.
16. Develop an 8086 microprocessor assembly language program to convert binary to BCD using emu8086 Simulator.
17. Develop an 8086 microprocessor assembly language program to find the cube of a number using emu8086 Simulator.
18. Develop an 8086 microprocessor assembly language program to divide two numbers using emu8086 Simulator.
19. Develop an 8086 microprocessor assembly language program to check a given byte is bitwise palindrome or not using emu8086 Simulator.
20. Develop an 8086 microprocessor assembly language program to find smallest no from the given array using emu8086 Simulator.

Subject Name: Software Lab (Introduction to MATLAB) Subject Code: 3140414

Skill Based Mini Project

1. Generation of wave of any given expression.
2. Calculator Design using MATLAB.
3. Draw and calculate the area of circle of given radius.
4. GUI model for various waveform generation and display.
5. GUI model for display of various transform of specific waves.
6. Create a GUI model in MATLAB to display various transforms (e.g., Fourier, Laplace) of input waveforms.
7. Perform filtering, convolution, and other signal processing operations using MATLAB Signal Processing ToolBox.
8. Develop a MATLAB script to generate and plot 3D surfaces based on mathematical expressions
9. Import data from Excel into MATLAB and create visualizations like bar charts, scatter plots, and histograms.
10. Use MATLAB to perform basic image processing operations like resizing, cropping, and filtering
11. Implement a script to fit curves to experimental data and visualize the best-fit curves.
12. Draw and calculate the area of any 3D object of given dimension.
13. Build a GUI in MATLAB for performing basic statistical analyses on datasets
14. Use MATLAB to perform spectral analysis on signals and visualize frequency content
15. Write a MATLAB script to generate a specified number of random numbers and visualize their distribution using histograms
16. Develop a GUI-based unit converter that allows users to input values in one unit and convert them to another (e.g., Celsius to Fahrenheit)
17. Create a simple digital clock using MATLAB's GUI capabilities, displaying the current time.
18. Import data from Excel into MATLAB and perform mathematical calculations such as mean, median, mode.
19. Write a MATLAB program to perform various operations on matrix like addition, multiplication, and inverse.

Annexure XII

Item 13

To finalize the **Skill Internship Project** (SIP) module to be offered **in Dec 2024.**

S. No.	Name of Module	Name of Module coordinators	Objectives	Content	Mode of Delivery (online/offline/blended)
1	**Analog Circuits Simulation using LT-Spice**	Prof.Madhav Singh	1. To explore LT Spice and its tools 2. To learn simulation of circuits using LT Spice. 3. To learn the basics of analog circuits and its designing. 4. To learn the application of LT Spice.	Introduction to LT Spice, Components and Libraries, Using the component libraries, familiar with the LT spice interface, toolbars and basic commands, Breadboard and its use, analog circuits and simulation. 1. Simulation of nodal analysis for DC Circuits, 2. Designing and simulation of all Filters., 3. Simulation of AC circuits, 4. Simulation of transient and parametric analysis of series RLC circuits using step and pulse input, 5. Verification and simulation of network theorems	Blended
2	**Signal Processing using MATLAB**	Dr.Rahul Dubey	1. To explore MATLAB. 2. To learn Signal Processing toolbox in MATLAB. 3. To develop GUI using MATLAB.	Introduction to MATLAB, Laplace transform, Fourier Transform,	Online
3	**Transforms and its Applications**	Dr. Karuna Markam	The primary objective of using transforms in signal processing is to analyze, manipulate, and extract useful information from signals more effectively.	Z Transform, Signal Processing Toolbox, GUI Development.	Online
4	**Basics of Microsoft Excel**	Prof. Pooja Sahoo	To enhance the skills and growth by organizing and categorizing data into a logical format using Excel.	Excel Basics-Cell Basics, Modifying Cells/Rows/Columns, Basic Cell Formatting, Cell Number Formats Cut, Copy & Paste, Format Painter Personalizing Worksheets, Multiple Worksheets, Find & Replace, Sheet Protection Printing & Page Layout. Formulas & Functions-Introduction, Basic Formulas, Advanced Formulas, Cell References, Excel Functions, Date/Time Functions, Text Functions, Financial Functions, Logical. Working with Data- Working with data, Freezing Options, Data Sorting, Data Filtering, Tables, Charts	Blended
5	**Tinkercad tool for Circuit Design**	Dr. Hemant Choubey	1. To explore Tinkercad software. 2. To learn basic electronics circuits using tinkercad tool. 3. Tinkercad offers an easy-to-use platform for creating code blocks for Arduino Simulations. 4. Tinkercad facilitates rapid prototyping and design of various objects.	Introduction to Tinkercad Software, Electronic Components Library, Circuit Designing using Breadboard,Wiring and Connections, Simulation Environment,Measurement Tools,Code Blocks and Arduino Simulation,Verification of Digital.	Online
6	**Image processing by MATLAB Programming**	Dr. Shubhi kansal	1. To explore fundamentals of image processing toolbox. 2. To learn the basic commands of image processing 3. To learn the image enhancement techniques using MATLAB. 4. Develop algorithm.	Introduction to MATLAB, Introduction to Image processing Toolbox, Importing and exporting images, Enhancing images, Detecting edges and shapes, Segmenting objects based on their color and texture, Modifying objects' shape using morphological operations, Measuring shape properties	Online

7	**MATLAB Programming and Application of Deep Learning**	Prof. Prateek Bhadauria	1. To explore MATLAB. 2. To learn simulation 5G NR toolbox. 3. To learn the basics of ML and DL programming concept. 4. Implementation of ML/DL algorithm in real time datasets.	Introduction to MATLAB, Baisc concept of Machine Learning and Deep Learning, Loading of dataset in hdf5 format, different libraries used in the ML/DL programming, Classification amd Regression concept. Introduction of MATLAB, Functions and Keywords, Array, Matrix, Arithmetic and logical operators, String operations, Plotting, Loops, Programming.	Online
8	**Scilab Programing and Simulation using Xcos**	Dr. Deepak Batham	1. To explore Scilab software tool (Open Source), 2. To learn basic programming in scilab. 3. To design various simulation models using Xcos.	Introduction to scilab software, programming skills, array, matrix, arithmetic and logical operations, complex engineering calculations, conditional commands and loops. Simple and complex model designing using Xcos- signals, digital circuit, control system design and analysis.	Blended
9	**Python based Signal, Image and Video Processing**	Dr. Himanshu Singh	1. To introduce the foundational concepts of signal, image, and video processing using Python. 2. To equip students with the skills to implement processing algorithms for signals and multimedia. 3. To provide hands-on experience with real-world applications such as image enhancement, object detection, and audio analysis. 4. To build proficiency in Python libraries for multimedia processing.	Signal Processing: Signal representation and transformations. Discrete Fourier Transform (DFT), Filtering, and Convolution. Time and frequency domain analysis using Python. Image Processing: Image acquisition, enhancement, and transformation. Filtering, edge detection, and feature extraction. Color space conversion and image segmentation. Video Processing: Frame extraction and video representation.Motion detection and tracking in videos.Real-time video processing using Open CV. Applications: Audio processing (e.g., speech recognition).Object detection and recognition in images and videos.	Online

Annexure XIII

Item 14

To propose the content of the courses identified for MITS-MOOC development to be offered **in blended mode** for VII Semester DE/OC courses for the batch admitted in 2022-23.

S. No.	Course Name	Faculty Name	Category (DE / SPC-3/OC)
1	Mathematical methods for Signal and Image processing	Dr. Himanshu Singh	SPC-3
2	Machine Learning for Signal Processing and Communication Engineering	Dr. Himanshu Singh	DE-3
3	Semiconductor Device Modeling	Dr. Varun Mishra	SPC-3
4	Advanced Optical Communication	Dr. Dablu Kumar	SPC-3
5	Principles of Modern Wireless Technologies	Dr. Karuna Markam	DE-3
6	Consumer Electronics	Dr Vikas Mahor	OC
7	Wireless Sensor Networks	Dr. Laxmi Shrivastava	DE-3

MOOC Course

Mathematical Methods for Signal and Image processing

Course Objectives: The course aims to provide a comprehensive understanding of signal representation, linear algebra, matrix theory, and their applications for signal and image processing.

Unit 1: Basics of Signals and Signal Representation: Definition of Signal, Types of Signals, Various Measures of the Signals, Important Signals, Signal Operations, Signal Representation in Terms of - Orthogonal Functions, Impulse Functions, General Basis Functions, Complex Exponential Functions and Bessel Functions.

Unit 2: Signal Spaces: Vector spaces, Norms and normed vector spaces, Inner products and inner-product spaces, Induced norms, Cauchy-Schwarz inequality, Direction of vectors: Orthogonality, Weighted inner products, Hilbert and Banach spaces, Orthogonal subspaces, Linear transformations, Inner-sum and direct-sum spaces, Projections and orthogonal projections, Projection theorem, Orthogonalization of vectors.

Unit 3: Linear Operators, Matrix Inverses and Matrix Factorizations: Linear operators, Operator norms, Adjoint operators and transposes, Geometry of linear equations, Four fundamental subspaces of a linear operator, Properties of matrix inverses, Pseudoinverses, LU factorization, Cholesky factorization, Unitary matrices and the QR factorization.

Unit 4: Eigenvalues, Eigenvectors and Application of Eigen-decomposition Methods: Eigenvalues and linear systems, Linear dependence of eigenvectors, Diagonalization of a matrix, Karhunen–Loève low-rank approximations and principal component methods, Eigen-filters, Signal subspace techniques, Generalized eigenvalues, Characteristic and minimal polynomials, Singular Value Decomposition-Theory of the SVD, Matrix structure from the SVD, Pseudoinverses and the SVD, Numerically sensitive problems, Rank-reducing approximations: Effective rank, Applications of the SVD.

Unit 5: Some Special Matrices and Their Applications: Modal matrices and parameter estimation, Permutation matrices, Toeplitz matrices and some applications, Vandermonde matrices, Circulant matrices, Triangular matrices, Properties preserved in matrix products, Kronecker Products, Kronecker sum and the Vec Operator, Applications of Kronecker products.

Reference Books:

- Moon & Stirling, Mathematical Methods and Algorithms for Signal Processing, Prentice Hall, 2000.
- Ram Bilas Pachori, Time-Frequency Analysis Techniques and Their Applications, CRC Press, 2023.
- Monson Hayes, Statistical Digital Signal Processing and Modelling, John Wiley and Sons, 1996.

Course Outcomes (COs):

CO1: Describe signals, types, operations, and representations.
CO2: Analyze vector spaces, norms, and orthogonality in signals.
CO3: Apply matrix factorizations and inverses to linear systems.
CO4: Analyze eigenvalues, eigenvectors, and SVD for signal processing.
CO5: Explore properties and applications of special matrices.

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

MOOC Course

Machine Learning in Signal Processing and Communication Engineering

Course Objectives: This course aims to introduce machine learning techniques for solving complex problems in signal processing and communication systems.

Unit 1: Introduction to Machine Learning- Linear Algebra, Probability, Computational Basics – Numerical computation and optimization, Applications in Signal Processing and Communication Engineering.

Unit 2: Linear and Logistic Regression – Bias/Variance Trade-off, Regularization, Variants of Gradient Descent, MLE, MAP, Applications, Neural Networks – Multilayer Perceptron, Backpropagation, Applications.

Unit 3: Convolutional Neural Networks– CNN Operations, CNN architectures, Training, Transfer Learning, Recurrent Neural Networks RNN, LSTM, GRU, Applications in Signal Processing and Communication Engineering.

Unit 4: Classical Techniques – Bayesian Regression, Binary Trees, Random Forests, SVM, Naïve Bayes, k-Means, kNN, GMM, Expectation Maximization, Applications in Signal Processing and Communication Engineering.

Unit 5: Advanced Techniques- Structured Probabilistic Models, Monte Carlo Methods, Autoencoders, Generative Adversarial Networks, Applications in Signal Processing and Communication Engineering

Reference Books:

- Sergios Theodoridis, “Machine Learning: A Bayesian and Optimization Perspective”. 2nd ed., Elsevier, 2020.
- Kevin P. Murphy, “Probabilistic Machine Learning: An Introduction”. The MIT Press, 2022. Available online.
- S. Raschka, V. Mirjalili, “Python Machine Learning”, (3rd ed.), Packt Publishing, 2019.
- Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”. The MIT Press, 2016. Available online.

Course Outcomes (COs):

CO1: Apply linear algebra, probability, and computational techniques in ML for signal processing.
CO2: Implement regression models and neural networks to solve communication engineering problems.
CO3: Design and train CNNs, RNNs, LSTMs, and GRUs for signal and communication applications.
CO4: Utilize classical ML techniques like SVM, Random Forests, and Bayesian models for engineering tasks.
CO5: Apply advanced ML techniques like GANs, Autoencoders, and Monte Carlo methods for innovative solutions in signal processing and communication.

CO-PO Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PS02
CO1	3	3	2	2	3	1	1	-	1	2	-	2	3	2
CO2	3	3	3	3	3	1	2	-	1	2	1	2	3	3
CO3	3	3	3	3	3	1	2	-	2	3	2	2	3	3
CO4	2	3	3	2	3	2	2	-	1	3	2	2	3	2
CO5	3	3	3	3	3	2	3	2	2	3	2	3	3	3

MOOC Course
Semiconductor Device Modeling

Course Objectives: This course will provide a basis for understanding the underlying physics of semiconductor devices, their operation, and their limitation. It is essential to have a thorough insight into semiconductor physics to understand present-day devices and to build future developments in this field. Further, the course will help the students to explore the mathematical modeling of the governed physical phenomenon at the preliminary stage, which can be extrapolated in advanced courses and research in the semiconductor domain.

UNIT-I: Semiconductor Physics Overview: Band and Bond Model of the Intrinsic and Extrinsic semiconductor, Energy band diagram of Uniform and Non-uniform doped semiconductor, Carrier Transport: Drift and Diffusion, Mathematical expressions governing the carrier statistics.

UNIT II: **PN Junction:** Overview of the junctions, PN junction under equilibrium, I/V characteristics of the diode: Forward and Reverse, C-V characteristics in low and high frequency, Contact Potentials.

UNIT III: Two terminal MOS Structure: Flatband voltage, Potential balance and charge balance, Effect of Gate-substrate voltage on surface condition, Accumulation and Depletion, Inversion, Small signal capacitance.

UNIT IV: Three terminal MOS Structure: Contacting the inversion layer, Body effect, Region of inversions, V_{CB} control point of view.

Unit V: Four terminal MOS Transistor: Regions of inversion, Transistor regions of operation, Complete all region model, Effective mobility, Temperature effects.

Text Books:

1. Tsvidis Y. and McAndrew C, "Operation and Modelling of MOS Transistor", 3rd Ed. 2011, Oxford Univ. Press, ISBN 978-0-19-517015-3.
2. Neaman D. A. "Semiconductor Physics and Devices," 4th Ed. 2012, McGraw Hill Publication, ISBN 978-0-07-352958-5.

Reference Books:

1. Streetman B. G. and Banerjee S. K., "Solid State Electronics Devices," 6th Ed. 2009, PHI Learning Pvt. ltd. Publication, ISBN 978-81 -203-3020-7.
2. Mishra U. K. and Singh J. "Semiconductor Device Physics and Design," 2008, Springer, ISBN 978-1-4020-6480-7.

Course Outcomes:

After successful completion of the course, students will be able to:

CO1. Explain the band and bond model of the intrinsic and extrinsic semiconductors along with carrier transport mechanism.
CO2. Analyse the PN junction diode in terms of band diagram for equilibrium and biasing conditions.
CO3. Evaluate MOS capacitor structure in different regions of operation and C-V characteristics.
CO4. Analyse the three terminal MOS structure in terms of electrical potential and charge.
CO5. Develop all region model for MOSFET structure to understand the surface potential and charge variations under different biasing conditions.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

MOOC course
Advanced Optical Communication

Course Objectives:

1. To recognize the several essential concepts of optical fiber/waveguides concepts, suchas linearly polarized modes, several signal degradations/losses in optical fiber, etc.
2. To understand the structures and working principle of several optical sources, opticaldetectors, other related optical devices and their applications.
3. To provide absolute knowledge of optical amplifiers, optical multiplexing schemes, etc. Further, learn about the different optical modulation/demodulation schemes.

Unit I: Fiber Optics and Optical Waveguide: Optical Fibers and Waveguides – Description of Modes, Types of modes, Mode condition, Mode Pattern, Parameters of SMF and MMF; Signal distortions in in optical fiber; Loss mechanism in Fiber (Losses - Insertion, Return, Intrinsic, Reflection, etc.).

Unit II: Optical Sources: Semiconductor materials for optical sources; Light Emitting Diode: Power & Efficiency; Different LED structures; LED characteristics. Introduction to LASERs, Einstein Coefficients for Absorption and Emission, Population Inversion, Laser oscillation & threshold condition, Semiconductor Injection Laser: Structures & characteristics, Modulation of Laser diodes.

Unit III: Optical Detectors: Optical detection theory; Quantum efficiency & Responsivity; Photo detectors without internal gain; Photo detectors with internal gain; Photo-detector noise.

Unit IV: Optical Amplifiers and Multiplexing Techniques: Introduction to Optical amplifiers, Semiconductor optical amplifiers, Erbium-Doped Fiber Amplifiers, Applications of Optical Amplifiers, Multichannel systems: WDM lightwave systems, TDM and CDM, Advances in WDM technologies.

Unit V: Advances in Optical Communication System: Fundamentals of coherent systems, Coherent detection principles, Modulation and demodulation schemes, Free-space optics, Visible light communications.

Text Books:

1. John M. Senior, “Optical Fiber Communications” 3rd Edition, Prentice Hall, 2009.
2. Gerd Keiser, “Optical Fiber Communications”, Fourth Edition, McGraw Hill, 2008.
3. R. Ramaswami, and N. Sivaraja, “Optical Networks”, M. Kauffman Publishers, 2000.

Reference Books:

1. G. P Agrawal, Fiber-Optics Communication Systems, Wiley, 2014
2. A. Ghatak, and K. Thyagarajan, Introduction to Fiber Optics, Cambridge UniversityPress, 2011.
3. H. Kolimbiris, Fiber Optics Communications, Prentice Hall, 2003.
4. P. E. Green, Optical Networks, Prentice Hall, 1994
5. P. Bhattacharya, “Semiconductor Opto-Electronic Devices”, Prentice Hall, 2006.

CO1. **Understand** and analyse the concepts of optical fiber/waveguide structures with mode propagation, and signal distortion/degradation in it.
CO2. **Evaluate** the performance of optical sources, in terms of various design parameters.
CO3. **Evaluate** the performance of optical detectors, in terms of various design parameters.
CO4. **Understand** and apply the optical amplifiers and Multiplexing techniques for the optical communication systems.
CO5. **Analyse** the different modulation and de-modulation schemes in optical communications.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

MOOC Course
Principles of Modern Wireless Technologies

Course Objective: The main objective of the course is to study the performance, evolution and current standards of wireless technologies, including 3G, 4G, and emerging 5G systems

Unit I Introduction to Wireless Systems: Evolution of Wireless Communication Technologies**,** Modeling Wireless Channel**,** Wireless Fading Channel Model**,** Fading Channel Distribution**,** Rayleigh Fading Channel**,** Bit Error Rate (BER) Performance, Bit Error Rate (BER) of AWGN Channels, Bit Error Rate of Rayleigh Fading Wireless Channel.

Unit II Multiple Antenna Wireless Systems and Diversity: Principle of Diversity, Multiple Antenna Diversity, Maximal-Ratio Combining**,** BER of Multiple Antenna Wireless Systems**,**
Examples for BER of Wireless Communication**,** Definition of Diversity Orde**r,** Max Delay Spread**,** RMS Delay Spread**,** Delay Spread and Inter Symbol Interference**,** Coherence Bandwidth of Wireless Channel**,** Mobility and Doppler Effect in Wireless Channels**,** Impact of Doppler Effect on Wireless Channel.

Unit III Principles of CDMA Wireless Communication: Introduction to Code Division Multiple Access (CDMA)**,** Chip Time and Bandwidth Expansion in CDMA**,** Code Generation for CDMA**,** CDMA Codes: Properties of PN Sequences**,** BER of CDMA Systems**,** Analysis of Multi-user CDMA**,** Multipath Diversity in CDMA Systems**,** Near-Far Problem in CDMA**.**

Unit IV : Principles of MIMO Wireless Communication: Multiple Input Multiple Output (MIMO) Systems**,** Examples of MIMO Systems**,** MIMO Receivers**,** BER Performance of ZF Receiver**,** Transmit Beamforming in MISO Systems**,** Alamouti Code and Space-Time Block Codes**,** BER of Alamouti Coded System**,** Singular Value Decomposition (SVD)**,** SVD in MIMO**.**

Unit V : Principles of OFDM Wireless Communication: Orthogonal Frequency Division Multiplexing (OFDM)**,** Transmission in Multicarrier Systems**,** FFT/IFFT Processing in OFDM**,** Cyclic Prefix in OFDM Systems**,** Schematic Representation of OFDM Transmitter and Receiver**,** BER Performance of OFDM Systems.

Course Outcome:

After the completion of the course the student will be able to:

CO1: Analyze the evolution and fundamentals of wireless communication systems.
CO2: Evaluate diversity techniques in multiple antenna wireless systems to improve signal reliability.
CO3: Demonstrate the understanding of Code Division Multiple Access (CDMA) principles.
CO4: Apply principles of Multiple Input Multiple Output (MIMO) wireless communication systems to enhance system efficiency.
CO5: Analyze Orthogonal Frequency Division Multiplexing (OFDM) systems with a focus on multicarrier transmission.

Text Books

1. "Wireless Communications: Principles And Practice" by Theodore S. Rappaport , 2nd edition, Pearson Education in 2010.
2. John G. Proakis, "Digital Communication", McGraw Hill Inc, 5th Edition, 2008.
3. Fundamentals of Wireless Communication" by David Tse and Pramod Viswanath , 1st edition, Cambridge University Press, 2005.

Reference Books

1. Simon Haykin, "Communication Systems", John Wiley & Sons, 4th Edition, 2000.
2. Taub & Schilling, "Principle of Communication Systems", 2nd Edition, 2003.
3. "Wireless Communications" by Andrea Goldsmith , Cambridge University Press, 2nd edition, 2005.

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	1	1	0	-	-	-	-	-	-	-	3	1
CO2	3	3	2	2	1	-	-	-	-	-	-	-	3	2
CO3	3	2	2	1	1	-	-	-	-	-	-	-	3	2
CO4	3	3	2	2	1	-	-	-	-	-	-	-	3	2
CO5	3	2	1	1	1	-	-	-	-	-	-	-	3	1

1 - Slightly; 2 - Moderately; 3 – Substantially

Consumer Electronics

Course objectives: Objective of this course is to make the students understand the technology behind consumer electronics appliances. The units in the course are designed to impart the concepts of Audio Video systems, Television and other domestic appliances like Microwave ovens and air-conditioning system.

Unit I Introduction to Audio Systems: Microphone, Carbon, Crystal and Moving coil microphone. Loudspeakers: Permanent magnet loudspeaker and it's construction, introduction to woofers and it's operation. Audio system, anatomy of Hi-Fi system.

Unit II Television System: Elements of Television system, scanning process, persistence of vision and flicker, vertical and horizontal resolution. Introduction to LCD and Plasma display. Introduction to LED TV technology.

Unit III Landline and Mobile telephony: Telecommunication systems, Modulation techniques: Analog and digital methods, radio system characteristics, telephone receiver and handset.

Unit IV Cellular and Mobile Communication: Cellular Communications, Transmitting Receiving Antenna, Digital Cellular Phone Block Diagram, Types of Mobile Phones, Cellular Systems.

Unit V Domestic Appliances: Microwave Oven: Microwaves, Transit Time, Magnetrons, Wave Guides, Microwave Oven Block Diagram. Air conditioning system: components of air conditioning system, all-water air conditioning system, all-air air conditioning system.

Course Outcome:

After completion of the course the students will be able to:

CO 1. **Understand** electronics engineering concepts used in consumer electronics systems.
CO 2. **Identify** the need of preventive maintenance in various electronic appliances.
CO 3. **Use** different product safety, compliance standards and techniques associated with electronic products.
CO 4. **Evaluate** and analyze different electronic products and systems based on specifications.

Text Book:

1. S. P. Bali, "Consumer Electronics" Pearson Education India, 2nd Edition

Reference Books:

1. Electronic communication systems by Roy Blake, Thomson Delmar.
2. Colour Television by R.R.Gulati. TMH
3. How Electronic Things Work.& What to Do When They Don't -Robert L. Goodman, -TMH
5. Digital Satellite Television Handbook By Mark E. Long

Course Outcomes

After successful completion of the course, students will be able to:

CO1. **Explain** various types of audio systems.
CO2. **State** the principle of television system.
CO3. **Analyze** the operation of a color television.
CO4. **State** the working principle of Cable TV, UHD and Smart TV.
CO5. **Explain** the working of various consumer electronic appliances.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

MOOC Course
Wireless Sensor Network

OBJECTIVES:

- To understand the basics of Wireless sensor Networks
- To understand Design principles and architecture of a WSN.
- To understand the concept of Networking in WSN

UNIT I Introduction: Components of a wireless sensor node, Motivation for a Network of Wireless Sensor Nodes, Classification of sensor networks, Characteristics of wireless sensor networks, Challenges of wireless sensor networks, Comparison between wireless sensor networks and wireless mesh networks, Limitations in wireless sensor networks, Design challenges, Hardware architecture.

UNIT II Network Architecture: Sensor network scenarios, Optimization goals and figures of merit, Design principles for WSNs, Service interfaces of WSNs, Gateway concepts - The need for gateways, WSN to Internet communication, Internet to WSN communication, WSN tunneling.

UNIT III Wsn Networking Concepts and Protocols: MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols And Wakeup Concepts – S-MAC, The Mediation Device Protocol, Contention based protocols – PAMAS, Schedule based protocols – LEACH, IEEE 802.15.4 MAC protocol, Routing Protocols- Energy Efficient Routing, Challenges and Issues in Transport layer protocol.

UNIT IV Infrastructure Establishment: Topology Control, Clustering, Time Synchronization, Localization and Positioning, Sensor Tasking and Control.

UNIT V Sensor Network Platforms and Tools: Sensor Node Hardware – Berkeley Motes, Programming Challenges, Node-level software platforms, Node level Simulators, State-centric programming.

Course Outcomes:

Upon completion of the course, students will be able to:
CO1: Understand the basis of Sensors with its applications
CO2: Understand architecture and sensors
CO3: Interpret the MAC and Routing protocols for Wireless Sensor Networks.
CO4: Establishing infrastructure and simulations
CO5: To design wireless sensor networks for specific applications WSN.

Text Book(s):

1. Holger Kerl, Andreas Willig, “Protocols and Architectures for Wireless Sensor Network”, JohnWiley and Sons, 2005 (ISBN: 978-0-470-09511-9)
2. Raghavendra, Cauligi S, Sivalingam, Krishna M., Zanti Taieb, “Wireless Sensor etwork”, Springer 1st Ed. 2004 (ISBN: 978-4020-7883-5).
3. Feng Zhao, Leonidas Guibas, “ Wireless Sensor Network”,Elsevier, 1st Ed. 2004 (ISBN:13- 978-1-55860-914-3)
4. Kazem, Sohraby, Daniel Minoli, Taieb Zanti, “Wireless Sensor Network: Technology, Protocols and Application”, John Wiley and Sons 1st Ed., 2007 (ISBN: 978-0-471-74300-2).

Reference Books:

1. B. Krishnamachari, “ Networking Wireless Sensors”, Cambridge University Press.
2. N. P. Mahalik, “Sensor Networks and Configuration: Fundamentals, Standards, Platforms, and Applications” Springer Verlag.

Course Articulation Matrix

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

1 - Slightly; 2 - Moderately; 3 – Substantially

Annexure XIV

Item15

To review the CO attainments, identify gaps and suggest corrective measures for the improvement in the CO attainment levels for the courses taught in **Jan-June 2024 Session**.

https://drive.google.com/file/d/11H0LhEq7GnhbBNbLWoHkJlrmEzHSeyez/view?usp=sharing

Annexure XV

Item 16

To review the PO attainment, CO-PO mapping matrix and action to be taken to improve PO attainment level.

https://drive.google.com/file/d/1rQJ8fOtXQAWrb8yHzDHXuKCDZlCjXrZ-/view?usp=sharing

Annexure XVI

Item17

To review curricula feedback from various stakeholders, its analysis and impact.

Stakeholder	Student	Faculty	Alumni	Employer
No. of responses	21	17	20	17
Link of Analysis	https://docs.google.com/document/d/11su6neeJyaa_-UIq8CqHSg522JAmbXK1/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/document/d/1PLhLHNAzJp3YkfLr_5eBQLWw8ExoFC2-/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://drive.google.com/file/d/1RxISICkf6JAQIHXcRPWPmVhS3TNTOYMq/view?usp=drive_link	https://drive.google.com/file/d/1O7rT2dfhqL7STzgeEX81rxjhnyLtoo2G/view?usp=sharing
ATR Link	https://docs.google.com/document/d/1yHE1HygqVY7GnmklCFbaiGxU_GO_SLSo/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/document/d/1iAmS6rtAh4H-2KotKBqlCoaxu2cRCwOz/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://drive.google.com/file/d/1RxISICkf6JAQIHXcRPWPmVhS3TNTOYMq/view?usp=drive_lin	https://drive.google.com/file/d/1hfsFZdzeoNSpIZCphk4MIowo4WAATdS7/view?usp=sharing
Link showing Excel sheet of Google Form details of stakeholders	https://docs.google.com/document/d/11su6neeJyaa_-UIq8CqHSg522JAmbXK1/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/16DNqH-F8REp9UQU70JER6VKg9_7U0MP0/edit?usp=sharing&ouid=106485385695052866512&rtpof=true&sd=true	https://docs.google.com/spreadsheets/d/1k5UT5xdD78YJHosBNpM31Z19E2JJERWI-6Bdowvjkak/edit?usp=sharing	https://docs.google.com/spreadsheets/d/1YUIPrEJrQq4uXIYtBfOzdq9ZxsllWF8F/edit?usp=sharing&ouid=116513051919594709243&rtpof=true&sd=true