DETAILED SYLLABI

FOR

B. TECH DEGREE PROGRAMME

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

MINOR BASKETS: 2022 Revised – Minor baskets added

2020 SCHEME – 2022 Revised

(AUTONOMOUS)

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY
(Approved by AICTE, Autonomous Institution Affiliated to APJ Abdul Kalam Technological University)
MAR IVANIOS VIDYANAGAR, NALANCHIRA, THIRUVANANTHAPURAM – 695015, KERALA.
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MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B. TECH DEGREE PROGRAMME

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

CURRICULUM AND DETAILED SYLLABI (S1-S8)

Items	Board of Studies (BoS)	Academic Council (AC)
Date of Approval	18.11.2020	30.12.2020
	04.02.2021	17.02.2021
	25.11.2021	22.04.2022
	11.08.2022	29.08.2022
	24.02.2023	20.03.2023

Head of Department
Chairman, Board of Studies

MAR BASELIOS COLLEGE OF ENGINEERING & TECHNOLOGY (Autonomous) Mar Ivanios Vidyanagar Nalanchira Thiruvananthapuram-695015

08/01/2024
Principal
Chairman, Academic Council

Principal
Mar Baselios College
of Engineering & Technology
Mar Ivanios Vidyanagar, Nalanchira
Thiruvananthapuram-695015

MAR BASELIOS COLLEGE OF ENGINEERING AND TECHNOLOGY

Vision and Mission of the Institution

Vision:

To be an Institution moulding globally competent professionals as epitomes of Noble Values.

Mission:

To transform the Youth as technically competent, ethically sound and socially committed professionals, by providing a vibrant learning ambience for the welfare of humanity.

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

Vision and Mission of the Department

Vision:

To be a Centre of Excellence in Electronics and Communication Engineering Education and Research for the service of humanity.

Mission:

To provide quality Engineering Education and to carry out Research in the field of Electronics and Communication Engineering addressing the challenges faced by the society.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: The graduates of the Programme will have a successful career as Professionals in Industry or as Entrepreneurs, encompassing a broad spectrum of areas related to Electronics and Communication Engineering.

PEO2: They will be able to adapt to the changing needs of Industry and Academia through continuous learning and professional upgrading.

PEO3: They will exhibit social responsibility in their pursuit of technical excellence.

PROGRAMME OUTCOMES (POs)

Engineering Graduates will have the ability to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineeringfundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complexengineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems anddesign system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutionsin societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms ofthe engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader indiverse teams, and in multidisciplinary settings.

10. **Communication**: Communicate effectively on complex engineering activities with the engineeringcommunity and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

PSO1: Design Electronic Circuits and Systems for Communication, Monitoring and Control Applications.

PSO2: Demonstrate the knowledge, in Electronics, Signal processing, Embedded Systems and Communication Engineering, required for providing technical solutions to real world problems

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

B.Tech Programme in Electronics and Communication Engineering

For the students admitted from 2020-21

Scheduling of Courses

i) Knowledge Segments and Credits

Every course of B.Tech Programme is placed in one of the nine categories as listed in table below. No semester shall have more than six lecture-based courses and two laboratory courses, and/or drawing/seminar/project courses in the curriculum.

Table 1: Credit distribution and the Knowledge Domains

Sl. No.	Category	Category Code	Total credits
1	Humanities and Social Sciences including Management Courses	HSC	8
2	Basic Science Courses	BSC	26
3	Engineering Science Courses	ESC	22
4	Programme Core Courses, Comprehensive Course Work and Viva Voce	PCC	76
5	Programme Elective Courses	PEC	15
6	Open Elective Courses	OEC	3
7	Project Work and Seminar	PWS	10
8	Mandatory Non-credit Courses (P/F) with Grade	MNC	---
9	Mandatory Student Activities (P/F)	MSA	2
	Total Mandatory Credits		**162**
	Value Added Courses (Optional) – Honours/Minor	VAC	20

ii) Semester-wise Credit Distribution

Semester	**I**	**II**	**III**	**IV**	**V**	**VI**	**VII**	**VIII**	***Total Credits***
Credits for Courses	*17*	*21*	*22*	*22*	*23*	*23*	*15*	*17*	***160***
Activity Points (Min.)	*40*				*60*				***100***
Credits for Activities	*2*								***2***
Total Credits									***162***
Value Added Courses (Optional) – Honours / Minor									***20***
Total Credits									***182***

SEMESTER I						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	BSC	MA0U10A	Linear Algebra and Calculus	3-1-0	4	4
B ½	BSC	PH0U10A	Engineering Physics A	3-1-0	4	4
		CY0U10A	Engineering ChemistryA	3-1-0	4	4
C ½	ESC	ES0U10A	Engineering Mechanics	2-1-0	3	3
		ES0U10B	Engineering Graphics	2-0-2	4	3
D ½	ESC	ES0U10C	Basics of Civil and Mechanical Engineering	4-0-0	4	4
		ES0U10D	Basics of Electrical and Electronics Engineering	4-0-0	4	4
E	HSC	HS0U10A	Life Skills	2-0-2	4	---
S ½	BSC	PH0U18A	Engineering Physics Lab	0-0-2	2	1
		CY0U18A	Engineering Chemistry Lab	0-0-2	2	1
T ½	ESC	ES0U18A	Civil and Mechanical Workshop	0-0-2	2	1
		ES0U18B	Electrical and Electronics Workshop	0-0-2	2	1
			TOTAL		**23/24**	**17**

SEMESTER II						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	BSC	MA0U10B	Vector Calculus, Differential Equations and Transforms	3-1-0	4	4
B ½	BSC	PH0U10A	Engineering Physics A	3-1-0	4	4
		CY0U10A	Engineering Chemistry	3-1-0	4	4
C ½	ESC	ES0U10A	Engineering Mechanics	2-1-0	3	3
		ES0U10B	Engineering Graphics	2-0-2	4	3
D ½	ESC	ES0U10C	Basics of Civil and Mechanical Engineering	4-0-0	4	4
		ES0U10D	Basics of Electrical and Electronics Engineering	4-0-0	4	4
E	HSC	HS0U10B	Professional Communication	2-0-2	4	---
F	ESC	ES0U10E	Programming in **C**	2-1-2	5	4
S ½	BSC	PH0U18A	Engineering Physics Lab	0-0-2	2	1
		CY0U18A	Engineering Chemistry Lab	0-0-2	2	1
T ½	ESC	ES0U18A	Civil and Mechanical Workshop	0-0-2	2	1
		ES0U18B	Electrical and Electronics Workshop	0-0-2	2	1
			TOTAL		**28/29**	**21**

SEMESTER III						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	BSC	MA0U20A	Partial Differential Equations and Complex Analysis	3-1-0	4	4
B	PCC	EC1U20A	Solid State Devices	3-1-0	4	4
C	PCC	EC1U20B	Logic Circuit Design	3-1-0	4	4
D	PCC	EC1U20C	Network Theory	3-1-0	4	4
E 1/2	ESC	ES0U20A	Design & Engineering	2-0-0	2	2
	HSC	HS0U20A	Professional Ethics	2-0-0	2	2
F	MNC	NC0U20A	Sustainable Engineering	2-0-0	2	---
S	PCC	EC1U28A	Scientific Computing Lab	0-0-3	3	2
T	PCC	EC1U28B	Logic Design Lab	0-0-3	3	2
R/M	VAC		Remedial/Minor Course	3-1-0/ 4-0-0	4	4
			TOTAL		**26/30**	**22/26**

SEMESTER IV						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	BSC	MA0U20C	Probability, Random Processes and Numerical Methods	3-1-0	4	4
B	PCC	EC1U20D	Analog Circuits	3-1-0	4	4
C	PCC	EC1U20E	Signals and Systems	3-1-0	4	4
D	PCC	EC1U20F	Computer Architecture and Microcontrollers	3-1-0	4	4
E ½	ESC	ES0U20A	Design & Engineering	2-0-0	2	2
	HSC	HS0U20A	Professional Ethics	2-0-0	2	2
F	MNC	NC0U20B	Constitution of India	2-0-0	2	---
S	PCC	EC1U28C	Analog Circuits and Simulation Lab	0-0-3	3	2
T	PCC	EC1U28D	Microcontroller Lab	0-0-3	3	2
R/M/H	VAC		Remedial/Minor/Honours Course	3-1-0/ 4-0-0	4	4
			TOTAL		**26/30**	**22/26**

SEMESTER V						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	PCC	EC1U30A	Linear Integrated Circuits	3-1-0	4	4
B	PCC	EC1U30B	Digital Signal Processing	3-1-0	4	4
C	PCC	EC1U30C	Analog and Digital Communication	3-1-0	4	4
D	PCC	EC1U30D	Control Systems	3-1-0	4	4
E ½	HSC	HS0U30A	Industrial Economics and Foreign Trade	3-0-0	3	3
		HS0U30B	Management for Engineers	3-0-0	3	3
F	MNC	NC0U30A	Disaster Management	2-0-0	2	--
S	PCC	EC1U38A	Analog Integrated Circuits and Simulation Lab	0-0-3	3	2
T	PCC	EC1U38B	Digital Signal Processing Lab	0-0-3	3	2
R/ M/ H	VAC		Remedial/Minor/Honours Course	3-1-0/ 4-0-0	4	4
			TOTAL		**27/31**	**23/27**

SEMESTER VI						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	PCC	EC1U30E	Electromagnetics	3-1-0	4	4
B	PCC	EC1U30F	VLSI Circuit Design	3-1-0	4	4
C	PCC	EC1U30G	Information Theory and Coding	3-1-0	4	4
D	PEC	EC1UXXX	Programme Elective I	2-1-0 /3-0-0	3	3
E 1/2	HSC	HS0U30A	Industrial Economics and Foreign Trade	3-0-0	3	3
		HS0U30B	Management for Engineers	3-0-0	3	3
F	PCC	EC1U30H	Comprehensive Course work	1-0-0	1	1
S	PCC	EC1U38C	Communication Lab	0-0-3	3	2
T	PWS	EC1U39A	Mini Project	0-0-3	3	2
R/ M/ H	VAC		Remedial/Minor/Honours Course	3-1-0/ 4-0-0	4	4
			TOTAL		**25/29**	**23/27**

PROGRAMME ELECTIVE I

Slot	Category Code	Course Number	Courses	L-T-P	Hours	Credit
D	PEC	EC1U31A	Digital System Design	2-1-0	3	3
		EC1U31B	Power Electronics	3-0-0	3	3
		EC1U31C	Data Analysis	2-1-0	3	3
		EC1U31D	Embedded System	3-0-0	3	3
		EC1U31E	Digital Image Processing	2-1-0	3	3
		EC1U31F	Introduction to MEMS	2-1-0	3	3
		EC1U31G	Quantum Computing	2-1-0	3	3

SEMESTER VII						
Slot	**Category Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	PCC	EC1U40A	Microwaves and Antennas	2-1-0	3	3
B	PEC	EC1UXXX	Programme Elective II	2-1-0/ 3-0-0	3	3
C	OEC	EC0UXXX	Open Elective	2-1-0/ 3-0-0	3	3
D	MNC	NC0U40A	Industrial Safety Engineering	2-1-0	3	---
E	PCC	EC1U48A	Electromagnetics Lab	0-0-3	3	2
T	PWS	EC1U49A	Seminar	0-0-3	3	2
U	PWS	EC1U49B	Project Phase I	0-0-6	6	2
R/ M/ H	VAC		Remedial/Minor/Honours Course	0-1-6/ 4-0-0	7/4	4
TOTAL					**24/(3 1/28)**	**15/19**

PROGRAMME ELECTIVE II

Slot	Category Code	Course Number	Courses	L-T-P	Hours	Credit
B	PEC	EC1U41A	Optical Fiber Communication	3-0-0	3	3
		EC1U41B	Computer Networks	3-0-0	3	3
		EC1U41C	Opto Electronic Devices	2-1-0	3	3
		EC1U41D	Instrumentation	2-1-0	3	3
		EC1U41E	Error Control Codes	2-1-0	3	3
		EC1U41F	Machine Learning	2-1-0	3	3
		EC1U41G	DSP Architectures	2-1-0	3	3

OPEN ELECTIVE

Slot	Category Code	Course Number	Courses	L-T-P	Hours	Credit
C	OEC	EC0U41A	Mechatronics	2-1-0	3	3
		EC0U41B	Biomedical Instrumentation	3-0-0	3	3
		EC0U41C	Electronic Hardware for Engineers	3-0-0	3	3
		EC0U41D	IoT and Applications	2-1-0	3	3
		EC0U41E	Entertainment Electronics	2-1-0	3	3

SEMESTER VIII						
Slot	**Cate-gory Code**	**Course Number**	**Courses**	**L-T-P**	**Hours**	**Credit**
A	PCC	EC1U40B	Wireless Communication	3-0-0	3	3
B	PEC	EC1UXXX	Programme Elective III	3-0-0/ 2-1-0	3	3
C	PEC	EC1UXXX	Programme Elective IV	3-0-0/ 2-1-0	3	3
D	PEC	EC1UXXX	Programme Elective V	3-0-0/ 2-1-0	3	3
T	PCC	EC1U40C	Comprehensive Viva Voce	1-0-0	1	1
U	PWS	EC1U49C	Project Phase II	0-0-12	12	4
R/ M/ H	VAC		Remedial/Minor/Honours Course	0-1-6	7	4
			TOTAL		**25/32**	17/21

PROGRAMME ELECTIVE III

Slot	Category Code	Course Number	Courses	L-T-P	Hours	Credit
B	PEC	EC1U42A	Biomedical Engineering	3-0-0	3	3
		EC1U42B	Satellite Communication	3-0-0	3	3
		EC1U42C	Secure Communication	3-0-0	3	3
		EC1U42D	Pattern Recognition	3-0-0	3	3
		EC1U42E	RF Circuit Design	3-0-0	3	3
		EC1U42F	Mixed Signal Circuit Design	2-1-0	3	3
		EC1U42G	Entrepreneurship	3-0-0	3	3

PROGRAMME ELECTIVE IV

Slot	Category Code	Course Number	Courses	L-T-P	Hours	Credit
C	PEC	EC1U43A	Modern Communication Systems	3-0-0	3	3
		EC1U43B	Real Time Operating Systems	2-1-0	3	3
		EC1U43C	Adaptive Signal Processing	2-1-0	3	3
		EC1U43D	Microwave Devices and Circuits	3-0-0	3	3
		EC1U43E	Speech & Audio Processing	3-0-0	3	3
		EC1U43F	Analog CMOS Design	2-1-0	3	3
		EC1U43G	Robotics	3-0-0	3	3

OGRAMME ELECTIVE V

Slot	Category Code	Course Number	Courses	L-T-P	Hours	Credit
D	PEC	EC1U44A	Mechatronics	3-0-0	3	3
		EC1U44B	Optimization Techniques	2-1-0	3	3
		EC1U44C	Computer Vision	2-1-0	3	3
		EC1U44D	Low Power VLSI	2-1-0	3	3
		EC1U44E	Internet of Things	2-1-0	3	3
		EC1U44F	Renewable Energy Systems	3-0-0	3	3
		EC1U44G	Organic Electronics	3-0-0	3	3

B. Tech ECE (MINOR)

Semester	BASKET I				BASKET II				BASKET III			
	Course Number	Course	L-T-P	Credit	Course Number	Course	L-T-P	Credit	Course Number	Course	L-T-P	Credit
S3	EC0M 20A	Electronic Circuits	3-1-0	4	EC0M 20B	Analog Communication	4-0-0	4	EC0M 20C	Introduction to Signals and Systems	3-1-0	4
S4	EC0M 20D	Microcontrollers	3-1-0	4	EC0M 20E	Digital Communication	3-1-0	4	EC0M 20F	Introduction to Digital Signal Processing	3-1-0	4
S5	EC0M 30A	Embedded System Design	3-1-0	4	EC0M 30B	Communication Systems	4-0-0	4	EC0M 30C	Topics in Digital Image Processing	3-1-0	4
S6	EC0M 30D	VLSI Circuits	3-1-0	4	EC0M 30E	Data Networks	4-0-0	4	EC0M 30F	Topics in Computer Vision	3-1-0	4
S7	EC0M 49A	Mini Project	0-1-6	4	EC0M 49A	Mini Project	0-1-6	4	EC0M 49A	Mini Project	0-1-6	4
S8	EC0M 49B	Mini Project	0-1-6	4	EC0M 49B	Mini Project	0-1-6	4	EC0M 49B	Mini Project	0-1-6	4

B. Tech ECE (MINOR) cont…

Semester	BASKET IV				BASKET V			
	Course Number	Course	L-T-P	Credit	Course Number	Course	L-T-P	Credit
S3	EC0M 20G	Fundamentals of Robotics	4-0-0	4	EC0M 20H	Fundamentals of Biomedical Engineering	4-0-0	4
S4	EC0M 20I	Introduction to industrial automation	4-0-0	4	EC0M 20J	Bio Signal and Image Procegssing	4-0-0	4
S5	EC0M 30G	Vision System	4-0-0	4	EC0M 30H	Artificial Organs & Implants	4-0-0	4
S6	EC0M 30I	AI & Machine Learning For Robotics	4-0-0	4	EC0M 30J	Assistive Medical Devices	4-0-0	4
S7	EC0M 49A	Mini Project	0-1-6	4	EC0M 49A	Mini Project	0-1-6	4
S8	EC0M 49B	Mini Project	0-1-6	4	EC0M 49B	Mini Project	0-1-6	4

B. Tech (HONOURS)

Semester	GROUP I				GROUP II				GROUP III			
	Course Number	Course	L-T-P	Credit	Course Number	Course	L-T-P	Credit	Course Number	Course	L-T-P	Credit
S4	EC1H 20A	Nanoelectronics	4-0-0	4	EC1H 20B	Stochastic Process for Communication	4-0-0	4	EC1H 20C	Stochastic Signal Processing	4-0-0	4
S5	EC1H 30A	FPGA based System Design	4-0-0	4	EC1H 30B	Detection and Estimation Theory	4-0-0	4	EC1H 30C	Computational Tools for Signal Processing	4-0-0	4
S6	EC1H 30D	Electronic Design and Automation Tools	4-0-0	4	EC1H 30E	MIMO and Multiuser Communication Systems	4-0-0	4	EC1H 30F	Detection and Estimation Theory	4-0-0	4
S7	EC1H 40A	RF MEMS	4-0-0	4	EC1H 40B	Design and Analysis of Antennas	4-0-0	4	EC1H 40C	Multirate Signal Processing and Wavelets	4-0-0	4
S8	EC1H 49A	Mini Project	0-1-6	4	EC1H 49A	Mini Project	0-1-6	4	EC1H 49A	Mini Project	0-1-6	4

Basket I			
Course Code	Course	L-T-P	Credit
EC0M 20A	ELECTRONIC CIRCUITS	3-1-0	4
EC0M 20D	MICROCONTROLLERS	3-1-0	4
EC0M 30A	EMBEDDED SYSTEM DESIGN	3-1-0	4
EC0M 30D	VLSI CIRCUITS	3-1-0	4
EC0M 49A	MINI PROJECT	0-1-6	4
EC0M 49B	MINI PROJECT	0-1-6	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0 M20A	ELECTRONIC CIRCUITS	VAC (MINOR)	3	1	0	4	2020

i) COURSE OVERVIEW:

This course introduces the concepts of basic electronic circuits and develop the skill of designing amplifiers, oscillators, and regulators.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the working of simple circuits using diodes, resistors, and capacitors.	Understand
CO 2	Analyse the transistor biasing circuits.	Analyze
CO 3	Design amplifier and oscillator circuits.	Apply
CO 4	Explain the working of MOSFETS, Power supplies, D/A and A/D converters.	Understand
CO 5	Design circuits using operational amplifiers and 555 IC.	Apply

iii) SYLLABUS

Wave shaping circuits: Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Clipping circuits - Positive, negative, and biased clipper. Clamping circuits - Positive, negative, and biased clamper.
Transistor biasing: Introduction, operating point, concept of load line, thermal stability (derivation not required), fixed bias, self-bias, voltage divider bias.

MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics.
Amplifiers: Classification of amplifiers, RC coupled amplifier – design and working, voltage gain and frequency response. Multistage amplifiers - effect of cascading on gain and bandwidth. Feedback in amplifiers - Effect of negative feedback on amplifiers.
MOSFET Amplifier- Circuit diagram, design and working of common source MOSFET amplifier.

Oscillators: Classification, criterion for oscillation, Wien bridge oscillator, Hartley, and Crystal oscillator. (design equations and working of the circuits; analysis not required).
Regulated power supplies: Review of simple zener voltage regulator, series voltage regulator, 3 pin regulators-78XX and 79XX, DC to DC conversion, Circuit/block diagram and working of SMPS.

Operational amplifiers: Characteristics of op-amps (gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp (IC741), Applications of op-amps- scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, Comparator, Instrumentation amplifier.

Integrated circuits: D/A and A/D convertors – important specifications, Sample and hold circuit, R-2R ladder type D/A convertors. Flash and sigma-delta type A/D convertors.
Circuit diagram and working of Timer IC555, astable and monostable multivibrators using 555.

iv) a) TEXT BOOKS

1) Boylestad and L Nashelsky, *Electronic Devices and Circuit Theory*, Pearson, 11/e, 2008.
2) Salivahanan S. and V. S. K. Bhaaskaran, *Linear Integrated Circuits*, Tata McGraw Hill, 3/e, ` 2008.

b) REFERENCES

1) David A Bell, *Electronic Devices and Circuits*, Oxford University Press, 2008.
2) Neamen D., *Electronic Circuits, Analysis and Design*, 3/e, TMH, 2007.
3) Millman J. and C. Halkias, *Integrated Electronics*, 2/e, McGraw-Hill, 2011.
4) Ramakant A Gayakwad, *Op-Amps and Linear Integrated Circuits*, 4/e,PHI, 2000.
5) K.Gopakumar, *Design and Analysis of Electronic Circuits*, Phasor Books, Kollam, 2013

v) COURSE PLAN

Module	Contents	No. of hours
I	**Wave shaping circuits:** Sinusoidal and non-sinusoidal wave shapes, Principle and working of RC differentiating and integrating circuits, Clipping circuits - Positive, negative, and biased clipper. Clamping circuits - Positive, negative, and biased clamper. **Transistor biasing:** Introduction, operating point, concept of load line, thermal stability (derivation not required), fixed bias, self-bias, voltage divider bias.	**12**
II	MOSFET- Structure, Enhancement and Depletion types, principle of operation and characteristics. **Amplifiers:** Classification of amplifiers, RC coupled amplifier – design and working, voltage gain and frequency response. Multistage amplifiers - effect of cascading on gain and bandwidth. Feedback in amplifiers - Effect of negative feedback on amplifiers. MOSFET Amplifier- Circuit diagram, design and working of common source MOSFET amplifier.	**12**
III	**Oscillators:** Classification, criterion for oscillation, Wien bridge oscillator, Hartley, and Crystal oscillator. (design equations and working of the circuits; analysis not required). **Regulated power supplies:** Review of simple zener voltage regulator, series voltage regulator, 3 pin regulators-78XX and 79XX, DC to DC conversion, Circuit/block diagram and working of SMPS.	**12**
IV	**Operational amplifiers: C**haracteristics of op-amps (gain, bandwidth, slew rate, CMRR, offset voltage, offset current), comparison of ideal and practical op-amp (IC741), Applications of op-amps- scale changer, sign changer, adder/summing amplifier, subtractor, integrator, differentiator, Comparator, Instrumentation amplifier.	**12**
V	**Integrated circuits:** D/A and A/D convertors – important specifications, Sample and hold circuit, R-2R ladder type D/A convertors. Flash and sigma-delta type A/D convertors. **Circuit diagram and working of Timer IC555**, astable and monostable multivibrators using 555	**12**
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 20D	MICROCONTROLLERS	VAC (MINOR)	3	1	0	4	2020

i) COURSE OVERVIEW

This course aims to impart the overview of a microcontroller-based system design and interfacing techniques.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the building blocks of a typical microcomputer/microcontroller system.	Understand
CO 2	Apply the knowledge of addressing modes and instructions to develop assembly language programs for 8051 microcontrollers.	Apply
CO 3	Interface the various peripheral devices to the 8051-microcontroller using assembly language program.	Apply
CO 4	Develop microcontroller-based applications using Open-Source Embedded Development boards.	Apply
CO 5	Explain the architecture of 8051, ATmega 2560 and ARM microcontrollers.	Understand

iii) SYLLABUS

Computer Arithmetic and Processor Basics: Functional units of a computer, Von Neumann and Harvard computer architectures, Processor Architecture – General internal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute.

8051 Architecture: Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts, Addressing Modes, Instruction set (brief study of 8051 instruction set).

Programming and Interfacing of 8051: Simple assembly language programs- addition, subtraction, multiplication, and division. Interfacing of LCD display, Keyboard, Stepper Motor, DAC, and ADC - with 8051 and its programming.

Open-Source Embedded Development Boards - Introduction to ATmega 2560 microcontroller - block diagram and pin description, Introduction to Arduino Mega 2560 board, Simple applications- Solar tracker, 4- digit 7 segment LED display, Tilt sensor, Home security alarm system, Digital Thermometer, IoT applications.

ARM Based System:
Introduction - ARM family, ARM 7 register architecture. ARM programmer's model.
Introduction to Raspberry pi 4 board, Applications- Portable Bluetooth speaker, remote controlled car, Photo Booth, IoT weather station, Home automation centre, Portal Digital eBook Library.

iv) a) TEXT BOOKS

1) Subrata Ghoshal, Computer Architecture and Organization: From 8085 to Core 2 Duo and beyond, Pearson, 2011.
2) M. A.Mazidi, J. G. Mazidi and R. D. McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C",Pearson Education, Second edition, 2011.
3) Steve Furber, ARM System - on-chip Architecture, Pearson Education, 2001.

b) REFERENCES

1) Stallings W., Computer Organisation and Architecture, 5/e, Pearson Education, 2019.
2) https://www.microchip.com/wwwproducts/en/ATmega2560
3) www.arduino.cc
4) www.raspberrypi.org

v) COURSE PLAN

Module	Contents	No. of hours
I	**Computer Arithmetic and Processor Basics:** Functional units of a computer, Von Neumann and Harvard computer architectures, Processor Architecture – General internal architecture, Address bus, Data bus, control bus. Register set – status register, accumulator, program counter, stack pointer, general purpose registers. Processor operation – instruction cycle, instruction fetch, instruction decode, instruction execute.	**12**

II	**8051 Architecture:** Block diagram of 8051, Pin configuration, Registers, Internal Memory, Timers, Port Structures, Interrupts, Addressing Modes, Instruction set (brief study of 8051 instruction set).	**12**
III	**Programming and Interfacing of 8051:** Simple assembly language programs- addition, subtraction, multiplication, and division. Interfacing of LCD display, Keyboard, Stepper Motor, DAC, and ADC -with 8051 and its programming.	**12**
IV	**Open-Source Embedded Development Boards** - Introduction to ATmega 2560 microcontroller - block diagram and pin description, Introduction to Arduino Mega 2560 board, Simple applications- Solar tracker, 4- digit 7 segment LED display, Tilt sensor, Home security alarm system, Digital Thermometer, IoT applications.	**12**
V	**ARM Based System:** Introduction - ARM family, ARM 7 register architecture. ARM programmer's model. Introduction to Raspberry pi 4 board, Applications- Portable Bluetooth speaker, remote controlled car, Photo Booth, IoT weather station, Home automation centre, Portal Digital eBook Library.	**12**
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30A	EMBEDDED SYSTEM DESIGN	VAC (MINOR)	3	1	0	4	2020

i) PREREQUISITE: EC1U20B - Logic Circuit Design, EC1U20F - Computer Architecture and Microcontrollers

ii) COURSE OVERVIEW

Goal of this course is to introduce embedded systems, various protocols used for communication between peripheral devices and processor, Embedded programming, the ARM processor organization and programming, and the basic concepts of real time operating systems.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Discuss the basic concepts of embedded systems and different phases in the embedded system design process/EDLC.	Understand
CO 2	Describe the peripheral devices and their interfacing with the processor.	Understand
CO 3	Prepare the programs using high-level languages for embedded systems.	Apply
CO 4	Explain the ARM processor architecture and pipeline processor organization. .	Understand
CO 5	Prepare programs in assembly and highlevel languages for ARM processor	Apply

iv) SYLLABUS

Introduction to Embedded Systems:

Complex Systems and Microprocessors, The Embedded System Design Process, Formalisms for System Design , Embedded product development cycle (EDLC).

Embedded system interfacing and peripherals:

Serial Communication Standards and Devices, Serial Bus Protocols, Parallel communication standards, Memory, DMA, I/O Device- Interrupts.

Embedded Programming:

Programming languages, Embedded C programming.

ARM Processor fundamentals:

ARM Processor architecture, ARM Assembly Language Programming, ARM Organization and Implementation.

ARM Programming:
Architectural Support for High Level Languages, The Thumb Instruction Set , Architectural Support for System Development- The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA).

v) a) TEXT BOOKS

1) K.V. Shibu, *Introduction to Embedded Systems*, 2e, McGraw Hill Education India, 2016.
2) Wayne Wolf, *Computers as Components: Principles of Embedded Computing System Design*, Morgan Kaufman Publishers - Elsevier 3e, 2008.
3) Steve Furber, *ARM system-on-chip architecture*, Addison Wesley, Second Edition, 2000.
4) Raj Kamal,*Embedded Systems Architecture, Programming and Design*, TMH, Third Edition, 2017.

b) REFERENCES

1) David E. Simon, *An Embedded Software Primer*, First IndianReprint, Pearson Education Asia, 2000.
2) Steve Heath, *Embedded Systems Design*, Newnes – Elsevier 2/ed, 2002.
3) Andrew N. Sloss, Dominic Symes, Chris Wright, *ARM System Developer's Guide Designing Optimizing System Software*, Morgan Kaufmann Publishers, 2004
4) Frank Vahid and Tony Givargis,*Embedded Systems Design – A Unified Hardware /Software Introduction*, John Wiley, 2002.
5) Tammy Noergaard, *Embedded Systems Architecture, A Comprehensive Guide for Engineers and Programmers*, Newnes – Elsevier 2/ed, 2013.
6) Iyer - *Embedded Real time Systems*, 1/e, McGraw Hill Education New Delhi, 2003
7) Lyla B. Das,*Embedded Systems: An Integrated Approach*, 1/e, 2012.
8) SarmadNaimi, Muhammad Ali Mazidi, SepehrNaimi, *The STM32F103 Arm Microcontroller and Embedded Systems: Using Assembly and C*, MicroDigitalEd.,2020
9) Shujen Chen, Muhammad Ali Mazidi, EshraghGhaemi, *STM32 Arm Programming for Embedded Systems*, 2018.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Complex Systems and Microprocessors:** Embedding Computers, Characteristics of Embedded Computing Applications, Application of Microprocessors, The Physics of Software, Challenges in Embedded Computing System, Characteristics and quality attributes of an embedded system, Performance in Embedded Computing. **The Embedded System Design Process:** Requirements, Specification,	**11**

	Architecture Design, Designing Hardware and Software Components and System Integration. **Formalisms for System Design:** Structural Description, Behavioral Description, An embedded system design example. **Embedded product development cycle (EDLC):** Different phases of EDLC and EDLC models	
II	**Communication devices:** Serial Communication Standards and Devices - UART, HDLC and SPI. Serial Bus Protocols - I 2C Bus, CAN Bus and USB Bus, Parallel communication standards-ISA, PCI and PCI-X Bus. **Memory:** Memory devices and systems:– ROM-Flash, EEPROM: RAM-SRAM, DRAM, Cache memory, memory mapping and addresses, memory management unit– DMA. **I/O Device:** Interrupts:-Interrupt sources, recognizing an interrupt, ISR – Device drivers for handling ISR, Interrupt latency.	**12**
III	**Programming languages**:-Assembly Languages, High level languages, Embedded C, Object oriented programming, C++, JAVA. **Embedded C programming**: Keywords and Identifiers, Data Types, Storage Class, operators, branching, looping, arrays, pointers, characters, strings, functions, function pointers, structures, unions, pre-processors and macros, constant declaration, volatile type qualifier, delay generation, infinite loops, bit manipulation, ISR, direct memory allocation	**13**
IV	**ARM Processor architecture**:The Acorn RISC Machine- Architectural inheritance, The ARM programmer's model, ARM development tools. **ARM Assembly Language Programming**:Data processing instructions, Data transfer instructions, Control flow instructions, writing simple assembly language programs. **ARM Organization and Implementation**: 3 stage pipeline ARM organization, 5-stage pipeline ARM organization, ARM instruction execution, ARM implementation, The ARM coprocessor interface	**12**
V	**Architectural Support for High Level Languages**: Abstraction in software design, Data types, Floating-point data types, The ARM floating-point architecture, Expressions, Conditional statements, Loops, Functions and procedures, Use of memory, Run-time environment. **The Thumb Instruction Set**: The Thumb bit in the CPSR, The Thumb programmer's model, Thumb branch instructions, Thumb software interrupt instruction, Thumb data processing instructions, Thumb single register data transfer instructions, Thumb multiple register data transfer instructions, Thumb breakpoint instruction, Thumb implementation, Thumb applications. **Architectural Support for System Development**: The ARM memory interface, The Advanced Microcontroller Bus Architecture (AMBA).	**12**
	Total hours	**60**

Simulation Assignments

1. At least one assignment should be of programming (Both assembly and C languages) of embedded processor with simulation tools like Keil, Eclipse.

2. Another assignment should be an embedded system design mini project like, Programming assignments can be the following. a) Print "HELLO WORLD" or any text, b)Data transfer, copy operations c)Arithmetic operations d)Sorting operations, e)Input/output control, f)Programs using functions, g) Interrupts and ISR h) controller design

3. Mini project can be done in the following areas. a) Elevator controller design (b) Chocolate vending machine design (c) Industrial controller using sensors (d) IOT applications using sensors, communication devices and actuators

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30D	VLSI CIRCUITS	VAC (MINOR)	3	1	0	4	2020

i) PREREQUISITE: EC0M20A Electronic Circuits

ii) COURSE OVERVIEW

Goal of this course is to impart the knowledge about the fundamentals of Digital Systems,MOSFETs, basic VLSI circuits and Application Specific Integrated Circuits.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the working of various functional building blocks used in digital system design.	Understand
CO 2	Explain Structure and Working of MOSFETS and basic VLSI circuits using MOSFET.	Understand
CO 3	Explain the circuit technique used to implement dynamic logic and storage cells.	Understand
CO 4	Explain the application specific integrated circuit design flow and design approached.	Understand
CO 5	Explain the programmable logic cells, programming technologies, different type of i/o cells and different timing constraints in ASIC design.	Understand

iv) SYLLABUS

Basic logic gates, binary adder, subtractor, magnitude comparator, decoders, encoders, multiplexers, simple examples for combinational circuits (discuss with respective truth tables) Sequential circuits, Latched and flip-flops, clocked sequential circuits ,registers, shift registers, counters (analysis not required).

Structure and working principle of MOSFETS, VI characteristics, current equations(derivations not required),NMOS and CMOS inverter circuits, static characteristics and comparison, implementation of CMOS logic gates, stick diagram representation, Layout Design and Design rules- Lambda rules and micron rules (Definitions only).

Dynamic Logic Design-Pre charge- Evaluate logic, Domino Logic, NP domino logic. Read Only Memory-4x4 MOS ROM Cell Arrays (NOR) Random Access Memory –SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and One transistor Dynamic Memory Cell.

Introduction Moores law .ASIC design, Full custom ASICs, Standard cell based ASICs, Gate array based ASICs, SoCs, FPGA devices, ASIC and FPGA Design flows Top-Down and Bottom-Up design methodologies. Logical and Physical design. Speed power and area considerations in VLSI design.

FPGA Architecture :Programmable logic cells: multiplexer based logic cells(ACT1), lookup table based logic implementation(XC3000 CLB), programmable array based logic implementation (Altera MAX).

ASIC programming technologies: antifuse, SRAM, EPROM, EEPROM Different types of I/O cells used in programmable ASICs

Timing constraints in ASIC design: setup time, hold time, propagation delay, clock to output delay, critical path (concept only).

v) a) TEXT BOOKS

1. M. Morris Mano, *Digital Design*, 3/e, Prentice Hall of India, 2002.
2. M. J. S. Smith, *Application Specific Integrated Circuits*, Pearson Education,2007.
3. Jan M. Rabaey, *Digital Integrated Circuits- A Design Perspective*, Second Edition, Prentice Hall, 2005.

b) REFERENCES

1. Thomas Floyd, *Digital Fundamentals*, 11/e, Pearson Publication, 2015.
2. Neil H.E. Weste, Kamran Eshraghian, *Principles of CMOS VLSI Design - A Systems Perspective*, Second Edition. Pearson Publication, 2005.
3. Sung –Mo Kang & Yusuf Leblebici, *CMOS Digital Integrated Circuits - Analysis & Design*, McGraw-Hill, Third Ed., 2003.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Basic Building Blocks in Digital Systems: Basic logic gates, binary adder, subtractor, magnitude comparator, decoders, encoders, multiplexers, simple examples for combinational circuits (discuss with respective truth tables)Sequential circuits, Latched and flip-flops, clocked sequential circuits ,registers, shift registers, counters (analysis not required).	**12**
II	MOSFET Fundamentals and basic VLSI circuits: Structure and working principle of MOSFETS, VI characteristics, current equations(derivations not required),NMOS and CMOS inverter circuits, static characteristics and comparison, implementation of CMOS logic gates, stick diagram representation, Layout Design and Design rules- Lambda rules and micron rules (Definitions only).	**12**
III	Dynamic logic Design and Storage Cells: Dynamic Logic Design-Pre charge- Evaluate logic, Domino Logic, NP domino logic. Read Only Memory-4x4 MOS ROM Cell Arrays (NOR) Random Access Memory –SRAM-Six transistor CMOS SRAM cell, DRAM –Three transistor and	**12**

	One transistor Dynamic Memory Cell.	
IV	VLSI Design Methodologies: Introduction Moore s law .ASIC design, Full custom ASICs, Standard cell based ASICs, Gate array based ASICs, SoCs, FPGA devices, ASIC and FPGA Design flows Top-Down and Bottom-Up design methodologies. Logical and Physical design. Speed power and area considerations in VLSI design.	**12**
V	FPGA Architecture:Programmable logic cells: multiplexer based logic cells(ACT1), lookup table based logic implementation(XC3000 CLB), programmable array based logic implementation (Altera MAX). ASIC programming technologies: antifuse, SRAM, EPROM, EEPROM Different types of I/O cells used in programmable ASICs. Timing constraints in ASIC design: setup time, hold time, propagation delay, clock to output delay, critical path (concept only).	**12**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49A	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system

For enabling the students to gain experience in organisation and implementation of small projects.

Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

i) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous InternalEvaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	75	75	1 Hours

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49B	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system
For enabling the students to gain experience in organisation and implementation of small projects.
Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project

through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	75	75	1 Hours

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Basket II			
Course Code	**Course**	**L-T-P**	**Credit**
EC0M 20B	ANALOG COMMUNICATION	4-0-0	4
EC0M 20E	DIGITAL COMMUNICATION	3-1-0	4
EC0M 30B	COMMUNICATION SYSTEMS	4-0-0	4
EC0M 30E	DATA NETWORKS	4-0-0	4
EC0M 49A	MINI PROJECT	0-1-6	4
EC0M 49B	MINI PROJECT	0-1-6	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M20B	ANALOG COMMUNICATION	VAC (MINOR)	4	0	0	4	2020

i) COURSE OVERVIEW

The goal of this course is to expose the students to different analog modulation schemes namely amplitude modulation and frequency modulation. Also it gives a brief overview on signal classification, LTI systems and Fourier Transform. It also gives a broad vision on different types of AM and FM transmitters and Receivers.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Discuss various components, sources of noise and it's effect in a communication system.	Understand
CO 2	Explain various analog modulation schemes in a communication system.	Understand
CO 3	Apply the knowledge of signals and system/modulation to study the behavior of a communication system.	Apply
CO 4	Discuss various transmitter and receiver systems of AM and FM.	Understand

iii) SYLLABUS

Introduction, Elements of communication systems, Examples of analog communication systems, Frequency bands, Need for modulation.
Noise in communication system, Definitions of Thermal noise (white noise), Various types of noise -- Shot noise, Partition noise, Flicker noise, Burst noise, (No analysis required) Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise.

Brief overview of signals and systems -- Signals, Classification of signals, Energy and power of signals, Basic signal operations, Impulse function, Properties of impulse function, Convolution, LTI system, Fourier Transform, Basic properties, Using Fourier transform to study LTI system.

Amplitude modulation (AM), Double-side band suppressed carrier (DSB-SC) modulation
Single sideband modulation (SSB) – spectrum, power, efficiency of all the three variants.(Study of only tone modulation in DSB-SC, AM, and SSB.) Amplitude-modulator implementations – switching modulator, balanced modulator. AM demodulators –Coherent demodulator. Envelope detector.

Frequency modulation – modulation index, frequency deviation, average power, spectrum of tone modulated FM. Heuristics for bandwidth of FM. Narrow band FM and wide-band

FM. FM generation: Varactor diode modulator, Armstrong's method. FM demodulation –slope detection, PLL demodulator.

Superheterodyne receiver, Principle of Carrier synchronization using PLL, NTSC Television broadcasting.

iv)(a) TEXT BOOKS

1) Kennedy, Davis, *Electronic Communication Systems*, 4th Edition, Tata McGraw Hill,2008 .
2) Wayne Tomasi, *Electronic Communication Systems – Fundamentals through Advanced*, 5th edition, Pearson, 2008.
3) B.P.Lathi, Zhi Ding, *Modern Digital and Analog Communication Systems*, 4th edition, Oxford University Press,2017.

(b) REFERENCES

1) Leon W. Couch, *Digital and Analog Communication Systems*, 8th edition, Prentice Hall,2013

v) COURSE PLAN

Module	Contents	No. of hours
I	Introduction, Elements of communication systems, Examples of analog communication systems, Frequency bands, Need for modulation. Noise in communication system, Definitions of Thermal noise (white noise), Various types of noise -- Shot noise, Partition noise, Flicker noise, Burst noise, (No analysis required) Signal to noise ratio, Noise factor, Noise temperature, Narrow band noise.	**12**
II	Brief overview of signals and systems -- Signals, Classification of signals, Energy and power of signals, Basic signal operations, Impulse function, Properties of impulse function, Convolution, LTI system, Fourier Transform, Basic properties, Using Fourier transform to study LTI system.	**12**
III	Amplitude modulation (AM), Double-side band suppressed carrier (DSB-SC) modulation Single sideband modulation (SSB) – spectrum, power, efficiency of all the three variants. (Study of only tone modulation in DSB-SC, AM, and SSB.) Amplitude-modulator implementations – switching modulator, balanced modulator. AM demodulators -- Coherent demodulator. Envelope detector.	**12**
IV	Frequency modulation – modulation index, frequency deviation, average power, spectrum of tone modulated FM. Heuristics for bandwidth of FM. Narrow band FM and wide-band FM. FM generation: Varactor diode modulator, Armstrong method. FM demodulation – slope detection, PLL demodulator	**12**
V	Super heterodyne receiver, Principle of Carrier synchronization using PLL, NTSC Television broadcasting.	**12**
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M20E	DIGITAL COMMUNICATION	VAC (MINOR)	3	1	0	4	2020

i) PREREQUISITE: NIL

ii) COURSE OVERVIEW

The goal of this course is to expose the students to various sources coding schemes and signalling codes in telephony. It also gives an idea on various modulation and channel coding schemes in a digital transmission system.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain various source coding schemes.	Understand
CO 2	Describe various signalling codes in telephony.	Understand
CO 3	Apply the knowledge of digital modulation schemes in a digital transmission system.	Apply
CO 4	Explain various channel coding techniques and receivers in a digital transmission system.	Understand

iv) SYLLABUS

Linear Source Coding

Elements of digital communication system.Sources, channels and receivers.Classification of communication channels.Discrete sources.Source coding techniques.Waveform coding methods.Sampling theorem.Sampling and reconstruction. Pulse code modulation. Sampling, quantization and encoding.Different quantizers.A-law and mu-law quantization. Practical 15 level mu and A law encoding.

Nonlinear Source Coding

Differential PCM, adaptive PCM, Delta modulator and adaptive delta modulator.Issues in delta modulation. Slope overload.

Signaling Codes in Telephony

Signalling codes in digital telephony.T1 signalling system.AMI and Manchester codes.Binary N-zero substitution, B3ZS code, B6ZS code.

Digital Modulation Schemes

Digital modulation schemes.Baseband BPSK system and the signal constellation.BPSK transmitter and receiver.Baseband QPSK system and Signal constellations.Plots of BER Vs SNR (Analysis not required).QPSK transmitter and receiver.Quadrature amplitude modulation.

Channel Coding and Receivers

Transmission through AWGN Channel.Capacity of an AWGN channel.Receivers. Correlation and matched filter receiver. Channel coding schemes. Repetition code. Block codes Cyclic codes.

v) (a) TEXT BOOKS

1) Simon Haykin, *Communication Systems*, 4/e ,Wiley India, 2012
2) John G. Proakis, Masoud Salehi, *Digital Communication*, 5/e McGraw Hill Education Edition, 2014

(b) OTHER REFERENCES

1) John C. Bellamy, *Digital Telephony*, 3/e,Wiley,2000.
2) H.Taub and Schilling, P*rinciples of Communication Systems*, TMH, 2007.
3) Couch, *Digital and Analog Communication Systems*, 8/e, Pearson Education India, 2013.
4) Ramakrishna Rao, Digital communication, Tata McGraw Hill Education Pvt. Limited, 2017.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Linear Source Coding:** Elements of digital communication system. Sources, channels and receivers. Classification of communication channels. Discrete sources. Source coding techniques. Waveform coding methods. Sampling theorem. Sampling and reconstruction. Pulse code modulation. Sampling, quantization and encoding. Different quantizers. A-law and mu-law quantization. Practical 15 level mu and A law encoding.	**12**
II	**Nonlinear Source Coding:** Differential PCM, adaptive PCM, Delta modulator and adaptive delta modulator. Issues in delta modulation. Slope overload.	**12**
III	**Signaling Codes in Telephony :**Signaling codes in digital telephony. T1 signalling system. AMI and Manchester codes. Binary N-zero substitution, B3ZS code, B6ZS code.	**12**
IV	**Digital Modulation:** Digital modulation schemes. Baseband BPSK system and the signal constellation. BPSK transmitter and receiver. Base band QPSK system and Signal constellations. Plots of BER Vs SNR(Analysis not required). QPSK transmitter and receiver. Quadrature amplitude	**12**

	modulation.	
V	**Channel Coding and Receivers:** Transmission through AWGN Channel. Capacity of an AWGN channel. Receivers. Correlation and matched filter receiver. Channel coding schemes. Repetition code. Block codes Cyclic codes.	**12**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30B	COMMUNICATION SYSTEMS	VAC (MINOR)	4	0	0	4	2020

i) COURSE OVERVIEW

The goal of this course to give awareness about various communication systems using in real life.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the components required for an Optical Communication Systems	Understand
CO 2	Discuss the principle involved in RADAR and Navigation	Understand
CO 3	Explain the concept and subsystems for Cellular Communication networks	Understand
CO 4	Describe the requirement for Satellite communication systems	Understand
CO 5	Discuss the role of different layers in TCP/IP protocol stack in communication networks	Understand

iii) SYLLABUS

Optical Communication System – Block Diagram – Advantages Of Optical Fiber Communication Systems – Principles Of Light Transmission in a Fiber using Ray Theory – Types of Fibers, Attenuation in Optical Fibers, Optical transmitters: LED and semiconductor LASER, characteristics, transmitter design. Optical receivers: Common photo detectors. Receiver design.

Basic Radar System– Applications – Radar Range Equation (Qualitative Treatment Only) – Factors Influencing Maximum Range – Basic Pulsed Radar System – Block Diagram – Display Methods- A - Scope, PPI Display - Instrument Landing System – Ground Controlled Approach System.

Cellular Communication, Hand off, Frequency Reuse, Principles of Multicarrier communication, Multiple Access techniques, CDMA Systems: General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, GSM standard and service aspects – GSM architecture, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards,4G, 5G

Basic concept of satellite communication, Keppler's law, Satellite orbits, Geosynchronous satellites, Active and Passive satellite, Block diagram for Satellite uplink, Transponder and earth station receiver.

Study of OSI and TCP/IP protocol suit: The Model, Functions of each layer, TCP/IP Protocol Suites. Wireless Ad Hoc Networks: Issues and Challenges, Wireless Sensor

Networks: Architecture, Data dissemination, Data gathering, MAC Protocols, Location discovery, Quality of a sensor network 6LoWPAN

iv) a) TEXT BOOKS

1) Wayne Tomasi, *Electronic communication system fundamentals*, 5/e, Pearson Education, Jan 2008
2) Behrouz A. Forouzan, *Data Communication and Networking*, 4/e, Tata McGraw Hill

b) REFERENCES

1) T S Rappaport, *Wireless communication principles and practice*, 2e/d, Pearson Education, 2002
2) G. E. Keiser, *Optical Fibre Communication*, McGraw Hill Publication.
3) D. C. Agarwal ,*Satellite Communication*, Khanna Publications, 1989.
4) Jochen Schiller, *Mobile Communications*, 2e/d, Pearson Education, 2008.
5) Siva ram Murthy, B S Manoj,*Ad Hoc Wireless Networks*, Printice Hall, 2004.

v) COURSE PLAN

Module	Contents	No. of hours
I	Optical Communication System – Block Diagram – Advantages Of Optical Fiber Communication Systems – Principles Of Light Transmission In A Fiber Using Ray Theory – Single Mode Fibers, Multimode Fibers – Step Index Fibers, Graded Index Fibers (Basic Concepts Only) – Attenuation In Optical Fibers – Absorption Losses, Scattering Losses, Bending Losses, Core And Cladding Losses. Optical transmitters: LED and semiconductor LASER, characteristics, transmitter design. Optical receivers: Common photo detectors. Receiver design	**11**
II	Basic Radar System– Applications – Radar Range Equation (Qualitative Treatment Only) – Factors Influencing Maximum Range – Basic Pulsed Radar System – Block Diagram – Display MethodsA - Scope, PPI Display, Instrument Landing System – Ground Controlled Approach System	**11**
III	Cellular Communication, Hand off, Frequency Reuse, Principles of Multicarrier communication, Multiple Access techniques, CDMA Systems: General aspects of CDMA cellular systems, IS-95 standard, Downlink and uplink, GSM standard and service aspects – GSM architecture, Evolution to Third Generation systems, WCDMA and CDMA-2000 standards,4G, 5G	**12**
IV	Basic concept of satellite communication, Keppler's law, Satellite orbits, Geosynchronous satellites, Active and Passive satellite, Block diagram for Satellite uplink, Transponder and earth station receiver	**13**
V	Study of OSI and TCP/IP protocol suit: The Model, Functions of each layer, TCP/IP Protocol Suites, Issues and challenges in Wireless Ad Hoc	**13**

	Networks, Vehicular Ad Hoc Networks, Wireless Sensor Networks: Architecture, Data dissemination, Data gathering, MAC Protocols, Location discovery, Quality of a sensor network, 6LoWPAN	
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30E	DATA NETWORKS	VAC (MINOR)	4	0	0	4	2020

i) COURSE OVERVIEW

Goal of this course is to provide an insight into the basic concepts of data communication and networking.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the concepts of data communication, structure of networks and compare OSI and TCP/IP networking models.	Understand
CO 2	Explain the responsibilities of the data link layer including framing, addressing, flow control, error control and media access control.	Understand
CO 3	Illustrate the functions and protocols of network layer, transport layer and application layer in inter-networking.	Apply
CO 4	Discuss congestion control techniques and Quality of Service requirements for a network.	Understand

iii) SYLLABUS

Data Communications- Components, Network criteria, Physical Structures, Switching, Categories of Networks, Interconnection of Networks, OSI Model, TCP/IP Protocol Suite, Physical Layer, Data Link Layer – Framing, Flow and Error Control, Error Correction and Detection, Networking Devices. Multiple Access Protocols, Ethernet, Wireless LANs, IPV4, IPV6, ARP, RARP, BOOTP, DHCP, Routing protocols, Transport Layer, Congestion Control & Quality of Service, Application Layer.

iv) a) TEXT BOOKS

1) Behrouz A Forouzan, *Data Communication and Networking*, 5/e, Tata McGraw Hill, 2012

b) REFERENCES

1) Andrew S. Tanenbaum, *Computer Networks*, 4/e, PHI (Prentice Hall India), 2002
2) William Stallings, *Computer Networking with Internet Protocols and technology*, Prentice-Hall, 2004

3) Fred Halsall, *Computer Networking and the Internet*, 5/e, Pearson Education, 2005.
4) Larry L Peterson and Bruce S Davie, *Computer Networks – A Systems Approach*, 5/e, Morgan Kaufmann, 2011
5) James F. Kurose, Keith W. Ross, *Computer Networking: A Top-Down Approach*, 6/e, Pearson Education, 2013

v) COURSE PLAN

Module	Contents	No. of hours
I	Data Communications- Components, Data representation, Data flow- Simplex, Half Duplex, Full Duplex Modes, Networks- Network criteria, Physical Structures- Point to Point Connection, Multipoint Connection, Physical Topology, Switching- Circuit Switched Networks and Datagram Networks, Categories of Networks, Interconnection of Networks, Protocols, Network models – OSI Model, Layers in the OSI Model, TCP/IP Protocol Suite.	**12**
II	**Physical Layer and Data Link Layer:** Guided Media and Unguided Transmission Media, Data Link Layer – Framing, Flow and Error Control - Stop and Wait Protocol, Sliding Window Protocol, Error Correction and Detection - Types of Errors, Redundancy, Detection vs Correction, Forward Error Correction vs Retransmission, Check Sum, Networking Devices- Hubs, Bridges, Switches.	**12**
III	**Multiple Access, Ethernet, Wireless LANs**: Multiple Access Protocols – Random Access, ALOHA, CSMA, CSMA/CD, CSMA/CA, Controlled Access, Channelization -FDMA, TDMA, CDMA, Ethernet - IEEE standards, Wireless LANs- IEEE 802.11, Bluetooth.	**11**
IV	**Network Layer**: Internetworking- Need for Network Layer, Internet as a Datagram Network, Internet as a Connectionless Network, Network Layer Logical Addressing – IPv4 and IPv6 Addressing only, Address Mapping -ARP, RARP, BOOTP, DHCP. Delivery, Forwarding, Routing Protocols - Distance Vector routing.	**12**
V	**Transport Layer, Application layer**: Transport layer – UDP, TCP, Congestion, Congestion Control, Quality of Service, Techniques to Improve QoS. Application Layer- FTP, Telnet, DNS, Electronic Mail.	**13**
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49A	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system

For enabling the students to gain experience in organisation and implementation of small projects.

Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design

specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

ii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous InternalEvaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**75**	**75**	**1 Hours**

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49B	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

iv) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system
For enabling the students to gain experience in organisation and implementation of small projects.
Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

v) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

vi) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project

through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	75	75	1 Hours

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Basket III			
Course Code	Course	L-T-P	Credit
EC0M 20C	INTRODUCTION TO SIGNALS AND SYSTEMS	3-1-0	4
EC0M 20F	INTRODUCTION TO DIGITAL SIGNAL PROCESSING	3-1-0	4
EC0M 30C	TOPICS IN DIGITAL IMAGE PROCESSING	3-1-0	4
EC0M 30F	TOPICS IN COMPUTER VISION	3-1-0	4
EC0M 49A	MINI PROJECT	0-1-6	4
EC0M 49B	MINI PROJECT	0-1-6	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M20C	INTRODUCTION TO SIGNALS AND SYSTEMS	VAC (MINOR)	3	1	0	4	2020

i) COURSE OVERVIEW

The course aims to introduce various type of signals and systems in analog and discrete domain. It gives an insight into the properties and analysis of convolution integral and sum. It also deals with the frequency analysis of signals using fourier transform and introducing sampling theorem.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the concepts of Signals and Systems	Understand
CO 2	Apply properties and operations of signals and systems .	Apply
CO 3	Apply various transform techniques for analysing a signal in frequency domain	Apply
CO 4	Apply convolution for finding the response and transfer function of a system	Apply
CO 5	Describe correlation of discrete time signals	Understand
CO 6	Apply sampling theorem to discretize and analyse continuous time signals	Apply

iii) SYLLABUS

Introduction to continuous time signals: Definition of signal. Basic continuous-time signals. Frequency and angular frequency of continuous-time signals.Basic operation on signals. Classification of continuous-time signals: Periodic and Non-periodic signals. Even and Odd signals, Energy and power signals.Noise and Vibration signals.

Discrete time signals: Basic discrete-time signals. Frequency and angular frequency of discrete-time signals. Classification of discrete-time signals: Periodic and Non-periodic signals. Even and Odd signals, Energy and power signals.

Systems: System definition. Continuous-time and discrete-time systems. Properties – Linearity, Time invariance, Causality, Invertibility, Stability. Representation of systems using impulse response.

Linear time invariant systems: LTI system definition. Response of a continuous-time LTI system and the Convolutional Integral.Properties.Response of a discrete-time LTI system and the Convolutional Sum.Properties.Correlation of discrete-time signals.

Frequency Analysis of Signals: Concept of frequency in continuous-time and discrete-time signals. Fourier transforms of continuous-time and discrete-time signals. Parseval's theorem.

Interpretation of Spectra. Case study of a vibration signal.Sampling theorem – perfect reconstruction of sampled signal.

iv) (a) TEXT BOOKS

1) Simon Haykin, Barry Van Veen, "Signals and systems", John Wiley, 2/e, 2007.
2) Hwei P Hsu, "Theory and problems of signals and systems", Schaum Outline Series, MGH, 1995.
3) Anders Brandt, "Noise and Vibration Analysis - Signal Analysis and Experimental Procedures", Wiley publication, 1/e, 2011.

(b) REFERENCES

1) Anand Kumar, "Signals and Systems", PHI, 3/e, 2013.
2) P Ramesh Babu, R. Ananda Natarajan, "Signals and Systems", 5/e, 2019.
3) Sanjay Sharma, "Signals and Systems", Kindle edition, 1/e, 2020.

v) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to continuous time signals:** Definition of signal. Basic continuous-time signals. Frequency and angular frequency of continuous-time signals. Basic operation on signals. Classification of continuous-time signals: Periodic and Non-periodic signals. Even and Odd signals, Energy and power signals. Noise and Vibration signals	12
II	**Discrete time signals:** Basic discrete-time signals. Frequency and angular frequency of discrete-	12

	time signals. Classification of discrete-time signals: Periodic and Non-periodic signals. Even and Odd signals, Energy and power signals.	
III	**Systems:** System definition. Continuous-time and discrete-time systems. Properties – Linearity, Time invariance, Causality, Invertibility, Stability. Representation of systems using impulse response	**12**
IV	**Linear time invariant systems:** LTI system definition. Response of a continuous-time LTI system and the Convolutional Integral. Properties. Response of a discrete-time LTI system and the Convolutional Sum. Properties. Correlation of discrete-time signals	**10**
V	**Frequency Analysis of Signals:** Concept of frequency in continuous-time and discrete-time signals. Fourier transforms of continuous-time and discrete-time signals. Parseval's theorem. Interpretation of Spectra. Case study of a vibration signal. Sampling theorem – perfect reconstruction of sampled signal.	**14**
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M20F	INTRODUCTION TO DIGITAL SIGNAL PROCESSING	VAC (MINOR)	3	1	0	4	2020

i) PREREQUISITE: EC0M20C – Introduction to Signals and Systems

ii) COURSE OVERVIEW: The course aims to introduce the concept of converting a continuous time signal to its digital versions and its analysis using Fourier transform.It also deals with the design and realization of FIR and IIR filters and practical limitations of their implementation. It gives an introduction about the structure of a DSP processor.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain how digital signals are obtained from continuous time signals	Understand
CO 2	Apply the concepts to analyse digital signals using Fourier transform	Apply
CO 3	Apply the concepts to design analog and digital filters	Apply
CO 4	Apply the concepts to analyse the practical limitations in DSP implementation	Apply
CO 5	Explain the structure of a DSP architecture	Understand

iv) SYLLABUS

Signal Processing Fundamentals: Discrete-time and digital signals. Basic elements of digital processing system- ADC, DAC and Nyquist rate.Frequency aliasing due to sampling. Need for anti-aliasing filters. Discrete Time Fourier Transforms – Properties. Computation of spectrum

Discrete Fourier Transform – Properties and Application: Discrete Fourier transform - DFT as a linear transformation, Properties - circular convolution. Filtering of long data Sequences - FFT-Radix-2 DIT and DIF algorithms. Computational complexity of DFT and FFT –application

Digital Filters: Digital FIR Filter: Transfer function - Difference equation, Linear phase FIR filter, Concept of windowing, Direct form and cascade realization of FIR and

IIR filters. Digital IIR Filters - Transfer function, Difference equation. Direct and parallel Structures. Design of analogue Butterworth filters, Analog frequency transformations, Impulse invariance method. Bilinear transformation, Analog prototype to digital transformations.

Finite word length effects in digital filters and DSP Hardware: Fixed point arithmetic, Floating point arithmetic, Truncation and Rounding, Quantization error in ADC, Overflow error, Product round off error, Scaling, Limit cycle oscillation.

General and special purpose hardware for DSP: Computer architectures for DSP – Harvard, pipelining, MAC, special instruction, replication, on chip cache. General purpose digital signal processors (TMS 320 family) - Implementation of digital filtering on DSP processor. Special purpose DSP hardware.

v) (a) TEXT BOOKS

1) John G Proakis, G. Manolakis, "*Digital Signal Processing : Principles , Algorithms, and Applications*", Pearson Education, New Delhi, 4/e, 2007.
2) Alan V. Oppenheim, Ronald W. Schafer, "*Discrete time signal processing*", Prentice Hall, 3/e, 2009.
3) Rulph chasseing, "*Digital Signal Processing and applications with C6713 and C6416 DSK*", Wiley, Kindle edition, 2005.

(b) REFERENCES

1) Sanjit K Mitra, "*Digital Signal Processing, A Computer based Approach*", Tata McGraw-Hill, New Delhi, 4/e, 2011.
2) Emmanuel I. feacher, and Barrie W. Jervis, "*Digital Signal Processing-A Practical Approach*", Pearson Education, 2/e, 2011
3) Ramesh Babu, "Digital Signal Processing", Scitech Publications, 7/e, 2017

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Signal Processing Fundamentals:** Discrete-time and digital signals. Basic elements of digital processing system- ADC, DAC and Nyquist rate. Frequency aliasing due to sampling. Need for anti-aliasing filters. Discrete Time Fourier Transforms – Properties. Computation of spectrum	12
II	**Discrete Fourier Transform – Properties and Application** Discrete Fourier transform - DFT as a linear transformation, Properties - circular convolution. Filtering of long data sequences - FFT-Radix-2 DIT and DIF algorithms. Computational complexity of DFT and FFT – application	14

III	**Digital Filters** Digital FIR Filter: Transfer function - Difference equation, Linear phase FIR filter, Concept of windowing, Direct form and cascade realization of FIR and IIR filters. Digital IIR Filters - Transfer function, Difference equation. Direct and parallel Structures. Design of analogue Butterworth filters, Analog frequency transformations, Impulse invariance method. Bilinear transformation, Analog prototype to digital transformations	**14**
IV	**Finite word length effects in digital filters and DSP Hardware** Fixed point arithmetic, Floating point arithmetic, Truncation and Rounding, Quantization error in ADC, Overflow error, Product round off error, Scaling, Limit cycle oscillation.	**10**
V	**General and special purpose hardware for DSP:** Computer architectures for DSP – Harvard, pipelining, MAC, special instruction, replication, on chip cache. General purpose digital signal processors (TMS 320 family) - Implementation of digital filtering on DSP processor. Special purpose DSP hardware	**10**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30C	TOPICS IN DIGITAL IMAGE PROCESSING	VAC (MINOR)	3	1	0	4	2020

i) PREREQUISITE: EC0M20F - Introduction to Digital Signal Processing

ii) COURSE OVERVIEW:

This course aims to develop the skills for methods of various transformation and analysis of image enhancement, image reconstruction, image compression, image segmentation and image representation.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the various basic concepts of digital image processing	Understand
CO 2	Apply the concepts to analyse a 2D discrete signal in time and frequency domain	Apply
CO 3	Explain two-dimensional sampling and quantization	Understand
CO 4	Apply the concepts to enhance and restore digital images using various filtering techniques	Apply
CO 5	Explain various image compression techniques	Understand

iv) SYLLABUS

Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, image sampling and quantization, basic relationships between pixels – neighbourhood, adjacency, connectivity, distance measures.Brightness, contrast, hue, saturation, mach band effect, Colour image fundamentals-RGB, CMY, HIS models, 2D sampling, quantization.
Image Enhancement: Spatial domain methods: point processing-intensity transformations, histogram processing, image subtraction, image averaging, geometric transformation Sharpening filters – first and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.

Image segmentation: Classification of Image segmentation techniques, region approach, clustering techniques Classification of edges, edge detection, Hough transform, active contour Thresholding – global and adaptive
Image restoration: Restoration Models, Linear Filtering Techniques: Inverse and Wiener, Non-linear filtering: Mean, Median, Max and Min filters Noise Models: Gaussian, Uniform, Additive, Impulse Image restoration applications

Image Compression- Need for compression, redundancy, classification of image compression schemes, Huffman coding, arithmetic coding Redundancy–inter-pixel and psycho-visual; Lossless compression – predictive, entropy; Lossy compression- predictive and transform coding – DST, DCT, wavelet transform (basics only); Still image compression standards – JPEG and JPEG-2000.

v) a) TEXT BOOKS

1) Farid Gonzalez Rafel C., *Digital Image Processing*, 3/e, Pearson Education, 2017
2) S. Jayaraman, S. Esakkirajan, T. Veerakumar, *Digital image processing*, Tata McGraw Hill, 2015

b) REFERENCES

1) Jain Anil K, *Fundamentals of digital image processing*, PHI, US edition, 1988
2) Kenneth R Castleman, *Digital image processing*, 2/e, Pearson Education, 2003
3) Pratt William K, *Digital Image Processing*, 4/e, John Wiley, 2007

vi) COURSE PLAN

Module	Contents	No. of hours
I	Digital Image Fundamentals-Elements of visual perception, image sensing and acquisition, Image sampling and quantization, basic relationships between pixels – neighbourhood, adjacency, connectivity, distance measures, Brightness, contrast, hue, saturation, mach band effect, Impulse response and its relation with transfer function of linear systems. Block diagram representation and reduction methods, 2D sampling, quantization	**12**
II	Image Enhancement: Spatial domain intensity transformations, Histogram processing, image subtraction, image averaging, geometric transformations, Sharpening filters, First and second derivative, two-dimensional DFT and its inverse, frequency domain filters – low-pass and high-pass.	**12**
III	Image segmentation: Spatial domain methods: point processing-intensity transformations, Classification of Image segmentation techniques, region approach, clustering techniques, Classification of edges, edge detection, Hough transform, active contour, Thresholding – global and adaptive.	**12**
IV	Image Restoration: Restoration Models -Noise Models: Gaussian, Uniform, Additive, Impulse and Erlang, Linear Filtering Techniques: Inverse and Wiener, Non-linear filtering:	**12**

	Mean, Median, Max and Min filters, Applications of Image restoration	
V	Image Compression: Need for compression, redundancy, classification of image compression schemes, Huffman coding, arithmetic coding, Redundancy–inter-pixel and psycho-visual, Lossless compression – predictive, entropy, Lossy compression- predictive and transform coding DST, wavelet, Still image compression standards – JPEG and JPEG2000	**12**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30F	TOPICS IN COMPUTER VISION	VAC (MINOR)	3	1	0	4	2020

i) COURSE OVERVIEW

This course aims to develop the knowledge of various methods, algorithms and applications of computer vision

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Apply basic point operators and 2D transforms for digital filtering operations	Apply
CO 2	Apply various algorithms for morphological operations and binary shape analysis.	Apply
CO 3	Describe the theoretical aspects of image formation models, projections and transformations in a 3D vision system.	Understand
CO 4	Explain different feature detection methods and optical flow algorithms to locate objects in-vision system.	Understand
CO 5	Explain the motion analysis of objects in a given scene using appropriate computer vision algorithms for real time applications.	Understand

iii) SYLLABUS

Review of image processing techniques: Filtering, Point operators-Histogram Based operators, neighbourhood operators, Thresholding - linear filtering – development of filtering masks - 2D Fourier transforms – filtering in frequency domain, Homomorphic filtering

Mathematical Operators: Binary shape analysis: Basics of Morphological operations, structuring element, Erosion, Dilation, Opening and Closing, Hit-or-Miss Transform, Connectedness, object labelling and counting , Boundary descriptors – Chain codes.

Camera models: Monocular and binocular imaging system, Orthographic and Perspective Projection, Image formation, geometric transformations, Camera Models (Basic idea only), 3D-Imaging system-Stereo Vision.

Feature Detection: Edge detection – edges, lines, active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts, energy-based and Canny's methods. Corner detection, Harris corner detection algorithm, Line and curve detection, Hough transform SIFT operators, Shape from X, Shape Matching, Structure from motion.

Motion Analysis- Regularization theory, Optical Flow: brightness constancy equation, aperture problem, Horn-Shunck method, Lucas-Kanade method. (Analysis not required) Object Detection and Object classification: SVM, Linear discriminant analysis, Bayes rule, ML. Face detection, Face Recognition, Eigen faces, 3D face models Applications of Computer Vision: Context and scene understanding, Real Time applications: Locating road way and road marking, locating road signs and pedestrians.

iv) a) TEXT BOOKS

1) E. R .Davies, *Computer and Machine Vision -Theory Algorithm and Practicalities*, 4/e, Academic Press, 2012
2) Richard Szeliski, *Computer Vision: Algorithms and Applications*, ISBN 978-1- 84882-935-0, Springer 2011.
3) David Forsyth and Jean Ponce, *Computer Vision: A Modern Approach*,2/e, Pearson India, 2012

c) REFERENCES

1) Goodfellow, Bengio, and Courville, *Deep Learning*, MIT Press, 2016
2) Daniel LelisBaggio, KhvedcheniaIevgen, ShervinEmam, David MillanEscriva, NaureenMahmoo, Jason Saragi, Roy Shilkrot, *Mastering Open CV with Practical Computer Vision Projects*, Packt Publishing Limited, 2012
3) Simon J D Prince, *Computer Vision: Models, Learning, and Inference*, Cambridge University Press, 2012
4) Schalkoff, *Digital Image Processing and Computer Vision*, John Wiley, 2004.

v) COURSE PLAN

Module	Contents	No. of hours
1	Introduction, Review of image processing techniques: filtering, Point operators- Histogram, neighbourhood operators, thresholding– development of filtering masks, 2D Fourier transforms – filtering in frequency domain, homomorphic filtering	12
2	Mathematical Operators: Basics of Morphological operations, structuring element, Binary shape analysis: Erosion, Dilation, Opening and Closing, Hit-or-Miss Transform, Connectedness, object labelling and counting, Boundary descriptors –Chain Codes	12
3	Camera models - Monocular and binocular imaging system, Orthographic & Perspective Projection, Image formation, geometric transformations, camera Models(Basic idea only), 3D-Imaging system- Stereo Vision	10
4	Feature Detection: Edge detection – edges, lines, active contours, Split and merge, Mean shift and mode finding, Normalized cuts, Graph cuts, energy-based and Canny's methods. Corner detection, Harris corner detection algorithm, Line and curve	12

	detection, Hough transform, SIFT operators, Shape from X, Shape Matching	
5	Motion Analysis - Motion Analysis- Regularization theory, Optical Flow: brightness constancy equation, aperture problem, Horn-Shunck method, Lucas-Kanade method (Analysis not required) Object Detection and Object classification: SVM, Linear discriminant analysis, Bayes rule, maximum likelihood, Face detection, Face Recognition, Eigen faces, 3D face models Applications of Computer Vision: Context and scene understanding, Real Time applications: Locating road way and road marking, locating road signs and pedestrians	14
	Total hours	**60**

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49A	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system

For enabling the students to gain experience in organisation and implementation of small projects.

Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

iii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous InternalEvaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**75**	**75**	**1 Hours**

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49B	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system
For enabling the students to gain experience in organisation and implementation of small projects.
Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project

through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	75	75	1 Hours

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Basket IV			
Course Code	Course	L-T-P	Credit
EC0M 20G	FUNDAMENTALS OF ROBOTICS	4-0-0	4
EC0M 20I	INTRODUCTION TO INDUSTRIAL AUTOMATION	4-0-0	4
EC0M 30G	VISION SYSTEM	4-0-0	4
EC0M 30I	AI & MACHINE LEARNING FOR ROBOTICS	4-0-0	4
EC0M 49A	MINIPROJECT	0-0-6	4
EC0M 49B	MINIPROJECT	0-1-6	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 20G	FUNDAMENTALS OF ROBOTICS	VAC (MINOR)	4	0	0	4	2022

(i) PRE-REQUISITE: PH0U10A - ENGINEERING PHYSICS,
ES0U10A - ENGINEERING MECHANICS

(ii) COURSE OVERVIEW: Goal of this course is to expose the students

1. To acquire basics of robot and its application.
2. To acquire the concept of actuators and robot configuration.
3. To impart the knowledge of kinematics and dynamic model in robotics.

(iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the anatomy, specifications and applications of Robots	Understand
CO 2	Choose the appropriate sensors and actuators for robots	Apply
CO 3	Choose the appropriate Robotic configuration and gripper for a particular application	Apply
CO 4	Explain the kinematic model of robotic manipulators	Understand

(iv) SYLLABUS

Robotics; Types of Robots, Anatomy of a robotic manipulator, robot considerations for applications, Robot Applications in different fields.Sensors and Actuators Sensor classification, External sensors-contact type, noncontact type, Elements of vision sensorActuators for robots- classification-Electric, Hydraulic, Pneumatic actuators, Robotic configurations and end effectors
Robot configurations- Kinematics and Motion Planning Robot Coordinate System,
Direct Kinematics: The Arm equation, Motion Planning Dynamics and Control of Robots, linear trajectory with parabolic blends; Cartesian space planning, Point to point vs continuous path planning

(v) a) TEXT BOOKS

1. Introduction to Robotics by S K Saha, Mc Graw Hill Education
2. Robert. J. Schilling, "Fundamentals of robotics – Analysis and control", Prentice Hall of India 1996.
3. R K Mittal and I J Nagrath, "Robotics and Control", Tata McGraw Hill, New Delhi, 2003.

b) OTHER REFERENCES

1. Introduction to Robotics (Mechanics and control), John. J. Craig, Pearson Education Asia 2002.
2. Ashitava Ghosal, "Robotics-Fundamental concepts and analysis", Oxford University press.
3. Robotics Technology and Flexible Automation, Second Edition, S. R. Deb

(vi) COURSE PLAN

Module	Contents	No. of hours
I	Definitions- Robots, Robotics; Types of Robots- Manipulators, Mobile Robots-wheeled & Legged Robots, Aerial Robots; Anatomy of a robotic manipulator-links, joints, actuators, sensors, controller; open kinematic vs closed kinematic chain; degrees of freedom; Robot considerations for an application- number of axes, work volume, capacity & speed, stroke &reach, Repeatability, Precision and Accuracy, Operating environment, point to point control or continuous path control. Robot Applications- medical, mining, space, defence, security, domestic, entertainment, Industrial Applications-Material handling, welding, Spray painting, Machining.	**12**
II	Sensors and Actuators Sensor classification- touch, force, proximity, vision sensors. Internal sensors-Position sensors, velocity sensors, acceleration sensors, Force sensors; External sensors-contact type, noncontact type; Vision - Elements of vision sensor, image acquisition, image processing; Selection of sensors.	**11**
III	Actuators for robots- classification-Electric, Hydraulic, Pneumatic actuators; their advantages and disadvantages; Electric actuators- Stepper motors, DC motors, DC servo motors and their drivers, AC motors, Linear actuators, selection of motors; Hydraulic actuators-	**12**

	Components and typical circuit, advantages and disadvantages; Pneumatic Actuators- Components and typical circuit, advantages and disadvantages.	
IV	Robot configurations-PPP, RPP, RRP, RRR; features of SCARA, PUMA Robots; Classification of robots based on motion control methods and drive technologies; 3R concurrent wrist; Classification of End effectors - mechanical grippers, special tools, Magnetic grippers, Vacuum grippers, adhesive grippers, Active and passive grippers, selection and design considerations of grippers in robot.	**12**
V	Kinematics and Motion -Planning Robot Coordinate Systems-Fundamental and composite rotations, homogeneous co-ordinates and transformations, Kinematic parameters, D-H representation, Direct Kinematics. The Arm equation forward Kinematic analysis of typical robots up to 3 DOF. Motion Planning- joint space trajectory planning-cubic polynomial, linear trajectory with parabolic blends; Cartesian space planning, Point to point vs continuous path planning	**13**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 20I	INTRODUCTION TO INDUSTRIAL AUTOMATION	VAC (MINOR)	4	0	0	4	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW: Goal of this course is to expose the students

1. To acquire the concept of automation methods.
2. To develop knowledge on sensors and actuators for automation.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the basic concepts of automation methodologies and trends in manufacturing automation.	Understand
CO 2	Discuss the working principle of different types of sensors and actuators for automation.	Apply
CO 3	Apply different pneumatic circuits based on their applications.	Apply
CO 4	Explain the basic concepts of PLC	Understand
CO5	Explain the design aspects of modern CNC machines and operation of different types of material handling devices.	Understand

iv) SYLLABUS

Automation methodologies: Concept of Mechanization and Automation, Trends in manufacturing- Flexible manufacturing systems. Sensors and actuators for automation: Classification-fundamental sensor methodologies, Practical examples on design, selection and implementation of sensor systems. Pneumatic/Hydraulic Automation: sequential control of single /multiple actuator systems, cascade and Karnaugh Veitch map methods.Electro pneumatic/electro hydraulic automation: relay, solenoid, timers, pneumatic – electrical converters. Automation Control: Sequence control and PLC controllers – logic control and sequencing elements. Elements of CNC systems: servomotor and servo system design trends.

v) a) TEXT BOOKS

1) Groover M.P , Automation, Production Systems and Computer Integrated Manufacturing, , Prentice – Hall Ltd., 1997.

b) OTHER REFERENCES

1) Yoram Koren , Computer Control of Manufacturing Systems‖, Tata McGraw-Hill Edition 2005.

2) Radhakrishnan P., CNC Machines, New Central Book Agency, 1992.
3) W. Bolton, Mechatronics: A Multidisciplinary Approach, 4/E‖,. Pearson Education India.
4) Peter Rohner& Gordon Smith , Pneumatic Control for Industrial Automation, John Wiley and Sons, 1987.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Automation methodologies: Concept of Mechanization and Automation – Types of Automation Detroit type Automation, Automated flow lines, Fundamentals of Transfer Lines. Trends in manufacturing – GT and Cellular Manufacturing, Flexible manufacturing systems – features of FMS, computer integrated manufacturing – need for AI and expert systems in CIM, Automated assembly system – flexible assembly automation.	**10**
II	Sensors and actuators for automation: Classification of position and motion sensors, inductive type, electromechanical switches, rotary position sensors – resolver, encoders, integrated motion systems, fundamental sensor methodologies, LVDT, RVDT, photo electric, thermo electric, capacitive, magnetic detectors, impedance type gauging transducers, linear potentiometer, strain gauges. Practical examples on design, selection and implementation of sensor systems, calibration of sensors. Electrical, Hydraulic and pneumatic actuators and their comparison, Examples - use of Electrical, Hydraulic and pneumatic actuators in industrial automation.	**14**
III	Pneumatic/Hydraulic Automation: control valves – direction, pressure and flow, sequential control of single /multiple actuator systems, cascade and Karnaugh Veitch map methods, step-counter systems.	**12**
IV	Electro pneumatic/electro hydraulic automation: Symbols: Basic electrical elements – relay, solenoid, timers, pneumatic – electrical converters. Automation Control: Sequence control and programmable controllers – logic control and sequencing elements, ladder diagram, PLC, programming the PLC. Practical Examples on PLC ladder programming.	**12**
V	Elements of CNC systems: servomotor and servo system design trends, stepper motors and controls, adaptive control, ball screws and guide ways, spindle, bearings and mountings. Drive systems. Automated tool changers and pallet changers. Accessories and selection of drives for CNC machines. Advantages of CNC machines, Difference between CNC and conventional machine tools. Case study: car parking system, automatic packing and sorting, manufacturing	**12**
	Total hours (Approx.)	**60**

viii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 30G	VISION SYSTEM	VAC (MINOR)	4	0	0	4	2022

i) PRE-REQUISITE:

ii) COURSE OVERVIEW: Goal of this course is to expose the students

1. To acquire the concept of computer vision.
2. To acquire the methods used for segmentation .
3. To develop a basic programming in opencv and matlab.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the basic concept of vision and camera-computer interface.	Understand
CO 2	Explain the image representation and filters in spatial and frequency domain	Understand
CO 3	Interpret different segmentation methods.	Apply
CO 4	Describe vision based mapping, tracking and localizing methods	Understand
CO5	Apply Opencv and MATLABprogramming for basic image processing application.	Apply

iv) SYLLABUS

Vision system: basic components - elements of visual perception, image formation model, and picture camera-computer interfaces.Low-level vision: image representation, filters: spatial filters, frequency filters. Higher-level vision; segmentation using thresholding, region based. The use of motion in segmentation; descriptors, decision-theoretic methods and structural methods.

Applications-camera calibration, stereo imaging, aligning laser scan measurements - vision and tracking: video tracking - learning landmarks: landmark spatiograms, k-means clustering, EM clustering, Kalman filtering. Introduction to ROS-opencv image processing library and matlab programming.

v) a) TEXT BOOKS

1) K.S.Fu, R.C.Gonzalez, CSG. Lee, ―Robotics control, sensing, vision and Intelligence‖, McGraw Hill Education Pvt. Ltd., 2013.
2) Richard D Klafter, Thomas A Chmielewski, Michael Negin, ―Robotics Engineering: An Integrated Approach‖, PHI Learning, New Delhi, 2009.

b)OTHER REFERENCES

1) Damian M Lyons,―Cluster Computing for Robotics and Computer Vision‖, World Scientific, Singapore, 2011.
2) RafelC.Gonzalez, Richard E.Woods, Steven L.Eddins,‖Digital ImageProcessing using MATLAB‖,2nd edition, Tata McGraw Hill, 2010.
3) Carsten Steger, Markus Ulrich, Christian Wiedemann, ―Machine Vision Algorithms and Applications‖, WILEY-VCH, Weinheim, 2008.
4) Kenneth Dawson-Howe, ―A Practical Introduction to Computer Vision with OpenCV‖, Wiley, Singapore, 2014

vi) COURSE PLAN

Module	Contents	No. of hours
I	VISION SYSTEM: Basic Components - Elements of visual perception: structure of human eye, image formation in the eye – pinhole cameras - color cameras – image formation model – imaging components and illumination techniques - picture coding – basic relationship between pixels - Camera-Computer interfaces.	**10**
II	LOW-LEVEL VISION: Image representation – gray level transformations, Histogram equalization, image subtraction, image averaging – Filters: smoothing spatial filters, sharpening spatial filters, smoothing frequency domain filters, sharpening frequency domain filters - edge detection	**12**
III	HIGHER-LEVEL VISION: Segmentation: Edge linking and boundary detection, Thresholding, Region-oriented segmentation, the use of motion – Description: Boundary Descriptors, Regional Descriptors, Recognition: Decision-Theoretic methods, structural methods.	**12**
IV	APPLICATIONS: Camera Calibration - Stereo Imaging - Transforming sensor reading, Mapping Sonar Data, Aligning laser scan measurements - Vision and Tracking: Following the road, Iconic image processing, Multiscale image processing, Video Tracking - Learning landmarks: Landmark spatiograms, K-means Clustering, EM Clustering, Kalman Filtering.	**13**
V	ROBOT VISION: Basic introduction to Robotic operating System (ROS) - Introduction to OpenCV image processing library and MATLAB programming (Basic programming using matlab or open cv)	**13**
	Total hours (Approx.)	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 30I	AI AND MACHINE LEARNING FOR ROBOTICS	VAC (MINOR)	4	0	0	4	2020

i) PRE-REQUISITE: nil

ii) COURSE OVERVIEW: Goal of this course is to expose the students

1. To acquire knowledge on basics of AI and ML.
2. To develop the concept of neural network for robots.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Discuss the concepts of machine learning and AI	Understand
CO 2	Explain supervised and advanced supervised learning	Understand
CO 3	Interpret the detail about unsupervised learning, dimensionality concepts	Apply
CO 4	Explain the concepts of neural networks in robots	Understand

iv) SYLLABUS

Introduction to artificial learning and Machine learning; types of Machine learning.Supervised learning; Decision trees,nearest neighbors, Logistic regression, binary classification. Advanced supervised learning; Linear models and gradient descent – Support Vector machines, Naïve Bayes models and probabilistic modeling.Unsupervised learning; Curse of dimensionality, Dimensionality Reduction, PCA, Clustering – K-means – Expectation Maximization Algorithm – Mixtures of latent variable models – Supervised learning after clustering – Hierarchical clustering.Neural Network Representation, Feed-forward Networks, Back propagation, Gradient-descent method.

v) a) TEXT BOOKS

1) Tom Mitchell, ‘Machine Learning’, McGraw Hill, 1997.
2) Peter Flach, ‘Machine Learning: The Art and Science of Algorithms that make sense of data’, Cambridge, 2014.

b) OTHER REFERENCES

1) David Jefferis, “Artificial Intelligence: Robotics and Machine Evolution”, Crabtree Publishing Company, 1992.
2) EthemAlpaydin, ‘Introduction to Machine Learning’, The MIT Press, 2004
3) David MacKay, ‘Information Theory, Inference and Learning Algorithms‘, Cambridge, 2003

vi) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to Artificial Intelligence: History, state of the art, Need for AI in Robotics. Thinking and acting humanly, intelligent agents, structure of agents. Machine learning – Learning Input- Output functions: – Input Vectors – Outputs – Training regimes, noise- types of Machine learning – supervised and unsupervised learning-reinforced learning.	**11**
II	SUPERVISED LEARNING: classifications-Decision trees-entropy-information gain-tree construction- nearest neighbours (KNN). Regression-linear regression- Logistic regression – Binary classification. Performance evaluation-precision recall.	**12**
III	ADVANCED SUPERVISED LEARNING: Linear models and gradient descent – Support Vector machines – Naïve Bayes models and probabilistic modelling – Model selection and feature selection – Model Complexity and Regularization. Simulation modelling for understanding both regression and classification techniques.	**12**
IV	UNSUPERVISED LEARNING: Curse of dimensionality, Dimensionality Reduction, PCA, Clustering – K-means – Expectation Maximization Algorithm – Mixtures of latent variable models – Supervised learning after clustering – Hierarchical clustering	**13**
V	NEURAL NETWORKS: Network Representation, Perceptron, Feed-forward Networks, Back propagation, Gradient-descent method. Case Study: The effectiveness of the Bias-variance. Obstacle avoidance and navigation of a mobile robot in an unknown environment with the help of Neural Network.	**12**
	Total hours (Approx.)	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49A	MINI PROJECT	VAC (MINOR)	0	1	6	4	2022

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system

For enabling the students to gain experience in organisation and implementation of small projects.

Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

iv) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous InternalEvaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**75**	**75**	**1 Hours**

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49B	MINI PROJECT	VAC (MINOR)	0	1	6	4	2022

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system
For enabling the students to gain experience in organisation and implementation of small projects.
Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project

through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	75	75	1 Hours

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Basket V			
Course Code	**COURSE**	**L-T-P**	**Credit**
EC0M 20H	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	4-0-0	4
EC0M 20J	BIO SIGNAL AND IMAGE PROCEGSSING	4-0-0	4
EC0M 30H	ARTIFICIAL ORGANS & IMPLANTS	4-0-0	4
EC0M 30J	ASSISTIVE MEDICAL DEVICES	4-0-0	4
EC0M 49A	MINIPROJECT	0-1-6	4
EC0M49B	MINIPROJECT	0-1-6	4

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 20H	FUNDAMENTALS OF BIOMEDICAL ENGINEERING	VAC (MINOR)	4	0	0	4	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

1. To introduce basics of biomedical engineering technology
2. To understand the anatomy & physiology of major systems of the body in designingequipment for medical treatments.
3. To impart knowledge about the principle and working of different types of bio-medicalelectronic equipment/devices
4. To Introduce the concept of Bio telemetry and electrical safety

iii) COURSE OUTCOMES

Course Outcomes	Description	Level
CO 1	Explain the generation of bioelectric potential, working of bio potential electrodes and bio medical instrumentational system	Understand
CO 2	Describe Electrocardiography and working of various Therapeutic Equipments used in cardiovascular system	Understand
CO 3	Explain differentBlood pressure and Blood flow measurement techniques	Understand
CO 4	Explain the functioning of Human nervous system and EMG measurement	Understand
CO 5	Describe about respiratory system, bio telemetry system and Electrical safety	Understand

iv) SYLLABUS

Introduction to bio-medical instrumentation system-overview of anatomy and physiological systems of the body. Sources of bio-electric potential- Bioelectric potentials examples Biopotential electrodes

Heart and cardiovascular system- ECG machine – pacemakers, cardiac defibrillators, heart–lung machine

Measurement of blood pressure: Auscultatory method-oscillometric and ultrasonic non-invasive pressure measurements- Measurement of blood flow.

The human nervous system: Neuron-action potential of brain- types of electrodes, 10-20 electrode system, block diagram of EEG machine, Applications of EEG-applications-Measurement of EMG.

Physiology of respiratory: Respiratory parameters, spirometer, ventilators. Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, Electrical safety– shock hazards from electrical equipment.

v) (a) TEXT BOOKS

1) J JCarr and J M Brown, "Introduction to Biomedical Equipment Technology", 4ed, Pearson Education
2) K S Kandpur, "Hand book of Biomedical instrumentation", Tata McGraw Hill 2nd e/d.
3) Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI, 2nd Edition, 2004

(b) OTHER REFERENCES

1) Barbara Christe, Introduction to Biomedical Instrumentation, Cambridge University Press, 2008.
2) John G Webster, "Medical Instrumentation application and design", 3ed,John Wiley
3) Richard Aston, "Principle of Biomedical Instrumentation and Measurement", Merrill Education/Prentice Hall

vi) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to bio-medical instrumentation system, overview of anatomy and physiological systems of the body.	4
	Sources of bio-electric potential: Resting and action potential, propagation of action potentials. Bioelectric potentials examples (ECG, EEG, EMG, ERG, EOG, EGG, etc introduction only.)	4
	Biopotential electrodes: Microelectrodes, skin surface electrodes, needle electrodes.	6

II	Heart and cardiovascular system (brief discussion), Electrocardiogram: Generation of ECG, Recording of ECG: lead configurations, Einthoven triangle, ECG machine – Block diagram	**6**
	Arrhythmias: rate abnormalities, fibrillation. Principle, block schematic diagram and working of: pacemakers, cardiac defibrillators, heart–lung machine	**6**
III	Measurement of blood pressure: Auscultatory method, oscillometric and ultrasonic non-invasive pressure measurements.	**6**
	Measurement of blood flow: Electromagnetic blood flow meters and ultrasonic blood flow meters, plethysmography	**5**
IV	The human nervous system. Neuron, action potential of brain, brain waves, types of electrodes, 10-20 electrode system, block diagram of EEG machine, Applications of EEG, Evoked potentials- visual, auditory & somatosensory – applications	**7**
	Electrical activity of muscles- EMG. Measurement of EMG - block diagram of EMG machine. Applications of EMG	**4**
V	Physiology of respiratory system (brief discussion), Respiratory parameters, spirometer, ventilators.	**4**
	Biomedical Telemetry system: Components of biotelemetry system, application of telemetry in medicine, single channel telemetry system for ECG.	**4**
	Electrical safety– physiological effects of electric current – shock hazards from electrical equipment – method of accident prevention	**4**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 20J	BIO SIGNAL AND IMAGE PROCEGSSING	VAC (MINOR)	4	0	0	4	2022

i) PRE-REQUISITE: Nil

ii) COURSE OVERVIEW:

1) To introduce basic Bio signals and concepts of various techniques used to process bio signals.
2) To study the concept of image processing techniques like image enhancement, image reconstruction, image compression, image segmentation, image representation and image compression.
3) To study the concept and working of various medical imaging techniques and imaging systems.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Describe the concepts of Bio signal analysis, signal conversion and averaging	Understand
CO 2	Explain adaptive noise cancellation and data compression techniques	Understand
CO 3	Explain the fundamentals of digital images and concept of image enhancement	Understand
CO 4	Describe various image processing techniques like Image restoration, segmentation, morphological operation and compression	Understand
CO 5	Explain the concept various medical imaging techniques and imaging systems	Understand

iv) SYLLABUS

Introduction to Biomedical Signals, Signal Conversion, Signal Averaging, Adaptive Noise Cancelling, Data Compression Techniques, Digital Image Fundamentals, Image Enhancement: Spatial domain methods, Image Restoration, Image segmentation, Morphological Image Processing, Image Compression, Medical Imaging systems (Basic Principle only): X-ray imaging, Computed Tomography, Ultrasonic imaging systems, Magnetic Resonance Imaging**.**

v) (a) TEXT BOOKS

1) Biomedical Digital Signal Processing- Willis J. Tompkins, PHI 2001
2) Gonzalez Rafel C, Digital Image Processing, Pearson Education, 2009
3) J JCarr and J M Brown, "Introduction to Biomedical Equipment Technology", 4ed, Pearson Education

(b) OTHER REFERENCES

1) Biomedical Signal Processing Principles and Techniques- D C Reddy, McGraw-Hill publications 2005
2) Jain Anil K, Fundamentals of digital image processing: , PHI,1988
3) K S Kandpur, "Hand book of Biomedical instrumentation", Tata McGraw Hill 2nd e/d.
4) Leslie Cromwell, Fred J. Weibell, Erich A. Pfeiffer, Biomedical Instrumentation and Measurements, PHI, 2nd Edition, 2004

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Introduction to Biomedical Signals**: The nature of Biomedical Signals, Examples of Biomedical Signals, Objectives and difficulties in Biomedical analysis. **Signal Conversion:** Simple signal conversion systems, Conversion requirements for biomedical signals. **Signal Averaging:** Basics of signal averaging, signal averaging as a digital filter, a typical averager, limitations of signal averaging.	**11**
II	**Adaptive Noise Cancelling:** Principal noise canceller model, 60-Hz adaptive cancelling using a sine wave model, other applications of adaptive filtering. **Data Compression Techniques:** Huffman coding, The Fourier transform, Frequency domain analysis of the ECG	**11**
III	**Digital Image Fundamentals:** Image representation, basic relationship between pixels, basic properties like brightness, contrast, hue, saturation, RGB model, Introduction to 2D image transform. **Image Enhancement:Spatial domain methods:** point processing-histogram processing, image subtraction, image averaging, Spatial filtering: smoothing filters, sharpening filters.	**12**
IV	**Image Restoration:** Degradation model, inverse filtering, Weiner filtering.	**13**

	Image segmentation: Classification of Image segmentation techniques, region approach, Segmentation based on thresholding, edge-based segmentation **Morphological Image Processing:** erosion, dilation, opening and closing. **Image Compression:** Need for compression, redundancy, transform based compression.	
V	**Medical Imaging systems (Basic Principle only): X-rayimaging** - Properties and production of X-rays, X-ray machine applications of X-rays in medicine. **Computed Tomography:** Principle, image reconstruction, scanning system and applications. **Ultrasonic imaging systems:** Basic principle, display types: A-Scan, B-Scan, M-Scan, applications. **Magnetic Resonance Imaging** – Basic NMR components, Biological effects and advantages of NMR imaging	**13**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30H	ARTIFICIAL ORGANS & IMPLANTS	VAC (MINOR)	3	1	0	4	2022

i) PRE-REQUISITE: NIL

ii) COURSE OVERVIEW:

The goal of this course is to introduce the students to existing artificial organs, prostheses, working principles, andlimitations. To stimulate the student's innovation skills through the deep understanding of the global problem of interfacing a human with such adevice.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the role of an organ in sustaining the biological functions of the whole body, and its functional principle, both in normal and pathologicalconditions.	Understand
CO 2	Discuss the various design principles of artificial heart and CirculatoryAssist Devices.	Understand
CO 3	Describe about the functioning of Wearable artificial kidney machine and Artificial blood.	Understand
CO 4	Explain about functioning of artificial pancreas, artificial skin and its substitutes	Understand
CO 5	Explain the effects of implant system.	Understand
CO 6	Discuss the various types of disability and its rehabilitation models.	Understand

iv) SYLLABUS

Introduction to artificial organs, Engineering Design of artificial Heart & Circulatory Assist Devices, Artificial heart-lung machine, Oxygenators, Artificial kidney, Artificial sphincters and catheters, Artificial blood, Artificial pancreas, Artificial skin, Artificial liver, Cochlear implants, Occular implants, dental implants, cosmetic implants, Rehabilitation Engineering, prosthetic and orthopedic devices, total knee replacement surgery, total hip prosthesis, Externally powered and controlled orthotics and prosthetics. Myoelectric hand and arm prostheses.

v) (a) TEXT BOOKS

1) "Biomaterials Science: An Introduction to Materials in Medicine" Buddy D.Ratner, Frederick J. Schoen, Allan, S. Hoffman, Jack E.Lemons., 3rd edition, 2012.
2) Gerald E Miller, "Artificial Organs", Morgan & Claypool Publishers ,2006.
3) "Textbook of Rehabilitation" by S. Sunder, Jaypee Brothers Medical Publishers,4th Edition.

(b) OTHER REFERENCES

1) "Biomedical Engineering fundamentals" Joseph D Bronzino , Donald R PetersonCRC Press , 4th edition .
2) Albert N Cook and Webster J.G, Therapeutic medical devices, Prentice HallInc., New Jercy.
3) R. S. Khandpur, Biomedical Instrumentation: Technology and Application, McGraw- HillProfessional.

vi) COURSE PLAN

Module	Contents	No. of hours
I	Introduction to artificial organs Biomaterials outlook for organ transplant Design considerations, evaluation process. Engineering Design of artificial Heart & CirculatoryAssist Devices: Prosthetic Heart Valves, Vascular grafts . Artificial heart-lung machine: Brief of lungs gaseous exchange / transport, artificial heart-lung devices. Oxygenators:bubble,film oxygenators and membrane oxygenators.	13
II	Artificial kidney: kidney filtration, artificial waste removal methods, hemodialysis, equation for artificial kidney and middle molecule hypothesis. Hemodialysers, mass transfer Analysis, regeneration of dialysate, membrane configuration. Wearable artificial kidney machine, Artificial sphincters and catheters. Artificial blood: Blood components & characteristics; Oxygen carrying plasma expanders; Blood substitutes. Artificial oxygen carriers;	13
III	Artificial pancreas: Endocrine pancreas & insulin secretion; Diabetes; Insulin therapy; Insulin administration systems; Insulin production systems. Artificial skin: Structure & functions of skin; Characteristics & clinical use of skin substitutes; Two conceptual stages in the treatment of massive skin loss. Skin substitutes: characteristics & uses, types of skin substitutes. Artificial liver, Urological Prosthetic Devices.	12
IV	Cochlear implants: audiometry, air conduction, bone	11

	conduction, masking, functional diagram of an audiometer. Hearing aids, benefits & risks of implantation. Occular implants, dental implants, cosmetic implants, Biocompatibility, local and systemic effects of implants	
V	Rehabilitation Engineering: Impairments, disabilities and handicaps, Prosthetic and Orthopedic devices. The Human Joints - Concept of Total Joint Replacement (arthroplasty), Total Knee prosthesis, Total hip prosthesis . Externally powered and controlled orthotics and prosthetics. Myoelectric hand and arm prostheses.	**11**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**50**	**100**	**3 Hours**

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M30J	ASSISTIVE MEDICAL DEVICES	VAC (MINOR)	4	0	0	4	2022

i) PRE-REQUISITE:

ii) COURSE OVERVIEW:

This course deals with the principle and application of various human assist devices like artificial heart, cardiac assist devices, respiratory devices and hearing aids prosthetic and orthotic devices.

iii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Explain the role and importance of Heart lung machine and artificial Heart.	Understand
CO 2	Describe the principle of various cardiac assist devices.	Understand
CO 3	Discuss the functional parameters and working of artificial kidney.	Understand
CO 4	Describe the functioning of various Prosthetic and Orthotic Devices.	Understand
CO 5	Explain the role of respiratory, hearing and sensory aids.	Understand

iv) SYLLABUS

Heart Lung Machine and Artificial Heart, Cardiac Assist Devices, Artificial Kidney types and functional parameters, Prosthetic and Orthotic Devices, Respiratory And Hearing Aids, Sensory assist devices

v) (a) TEXT BOOKS

1) Biomedical Engineering Hand Book 3rd Edition (Tissue Engineering & Artificial Organs) – Joseph D. Bronzino- CRC- Tylor & Francis-2006.
2) Hand Book of Biomedical Instrumentation -2nd Ed- R.S.Khandpur - TMH 2003.
3) Biomaterials –An Introduction 3rd Ed– Joon Park &R.S.Lakes- Springer- 2007.

(b) OTHER REFERENCES

1) Cardiopulmonary Bypass: Principles and Practice by Glenn P. Gravlee MD , Richard F. Davis , Alfred H. Stammers , 2007

2) Muzumdar A., "Powered Upper Limb Prostheses: Control, Implementation and Clinical Application, "Springer, 2004.

3) John. G. Webster – Bioinstrumentation - John Wiley & Sons (Asia) Pvt Ltd,4th edition.

vi) COURSE PLAN

Module	Contents	No. of hours
I	**Heart Lung Machine and Artificial Heart**: Condition to be satisfied by the H/L System. Different types of Oxygenators, Pumps, Pulsatile and Continuous Types, Monitoring Process, Shunting, The Indication for Cardiac Transplant, Driving Mechanism, Blood Handling System, Functioning and different types of Artificial Heart	**12**
II	**Cardiac Assist Devices**: Synchronous Counter pulsation, Assisted through Respiration Right Ventricular Bypass Pump, Left Ventricular Bypass Pump, Open Chest and closed Chest type, Intra Aortic Balloon Pumping, Arterial Pumping, Prosthetic Cardio Valves, Principle and problem.	**12**
III	**Artificial Kidney**: Indication and Principle of Hemodialyzers,Membrane, Dialysate, Types, Monitoring Systems, Wearable Artificial Kidney, hemodialyzer unit, membrane dialysis, portable dialyzer monitoring and functional parameters.	**12**
IV	**Prosthetic and Orthotic Devices:** Hand and Arm Replacement - Different Types of Models Externally Powered Limb Prosthesis Feedback in Orthotic System, Functional Electrical Stimulation, Haptic Devices.	**12**
V	**Respiratory And Hearing Aids -** Ventilator and its types-Intermittent positive pressure, Breathing Apparatus Operating Sequence, Electronic IPPB unit with monitoring for all respiratory parameters , Nebulizer, Humidifier.Types of Deafness, Hearing Aids, Construction and Functional Characteristics**Sensory assist devices**. Stimulator , Practical applications of Stimulation	**12**
	Total hours	**60**

vii) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	50	100	3 Hours

Continuous Internal Evaluation Pattern:

Attendance	**10 Marks**
Continuous Assessment Tests (2 numbers)	**25 Marks**
Assignment/Quiz/Course project	**15 Marks**

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contain10questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carry 14 marks.

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49A	MINI PROJECT	VAC (MINOR)	0	1	6	4	2022

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system

For enabling the students to gain experience in organisation and implementation of small projects.

Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design

specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

v) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous InternalEvaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**75**	**75**	**1 Hours**

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10

Course Code	Course Name	Category	L	T	P	Credit	Year of Introduction
EC0M 49B	MINI PROJECT	VAC (MINOR)	0	1	6	4	2020

i) COURSE OVERVIEW

The course aims

To estimate the ability of the students in transforming the theoretical knowledge studied in to a working model of an electronic system
For enabling the students to gain experience in organisation and implementation of small projects.
Design and development of Small electronic project based on hardware or acombination of hardware and software for electronics systems.

ii) COURSE OUTCOMES

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

Course Outcomes	Description	Level
CO 1	Practice acquired knowledge within the selected area of technology for project development.	Apply
CO 2	Identify, discuss and justify the technical aspects and design aspects of the project with a systematic approach.	Apply
CO 3	Reproduce, improve and refine technical aspects for engineering projects.	Apply
CO 4	Work as a team in development of technical projects.	Apply
CO 5	Communicate and report effectively project related activities and findings.	Apply

iii) COURSE PLAN

In this course, each group consisting of three/four members is expected to design and develop a moderately complex electronic system with practical applications, this should be a working model. The basic concept of product design may be taken into consideration.

Students should identify a topic of interest in consultation with Faculty/Advisor. Review the literature and gather information pertaining to the chosen topic. State the objectives and develop a methodology to achieve the objectives. Carryout the design/fabrication or develop codes/programs to achieve the objectives. Demonstrate the novelty of the project

through the results and outputs. The progress of the mini project is evaluated based on a minimum of two reviews.

The review committee may be constituted by the Head of the Department. A project report is required at the end of the semester. The product has to be demonstrated for its full design specifications. Innovative design concepts, reliability considerations, aesthetics/ergonomic aspects taken care of in the project shall be given due weight.

vi) ASSESSMENT PATTERN

Mark distribution

Total Marks	Continuous Internal Evaluation Marks	End Semester Evaluation Marks	End Semester Examination Duration
150	**75**	**75**	**1 Hours**

Evaluation

The internal evaluation will be made based on the product, the report and a viva- voce examination, conducted by a 3-member committee appointed by Head of the Department comprising HoD or a senior faculty member, Academic coordinator for that program, project guide/coordinator.

The Committee will be evaluating the level of completion and demonstration of functionality/specifications, presentation, oral examination, work knowledge and involvement.

Split-up of CIE

Component	Marks
Attendance	10
Marks awarded based on guide's evaluation	15
Project Report	10
Evaluation by Committee	40

Split-up of ESE

Component	Marks
Level of completion	10
Demonstration of functionality	25
Project Report	10
Viva-voce	20
Presentation	10