SANT GADGE BABA AMRAVATI UNIVERSITY, AMRAVATI
P. G. DEPARTMENT OF APPLIED ELECTRONICS
Faculty of Science and Technology

Programme: NEP v 23 based M. Sc. (Applied Electronics)

PROGRAMME OUTCOMES (POs)

Upon completion of the M.Sc. Applied Electronics Programme, the student would be able to:

PO1	Deep subject Knowledge and intellectual breadth	Develop extensive knowledge in various areas of Electronics.
PO2	Professional Ethics	Apply ethical principles and commit to professional ethics and responsibilities and norms of the standard practices.
PO3	Creative & Critical Thinking	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives.
PO4	Innovation, Research and Problem Solving	Identify, formulate, review research literature, and analyse problems using the first principles of mathematics and engineering sciences. Apply the knowledge of mathematics, science, engineering fundamentals and electronics to the solution of problems. Design solutions for electronic and allied systems, system modules or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations. Demonstrate the knowledge of, and need for sustainable development.
PO5	Team work and Communication Skills	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings. Present/communicate research at national/international level, write effective articles, reports and design documentation, make effective presentations, and give and receive clear instructions. Communicate disciplinary knowledge to the community and broader public.
PO6	Professionalism and Leadership Readiness	Demonstrate personal accountability and effective work habits, e.g., punctuality, working productively with others, and time as well as workload management. Use the strengths of others to achieve common goals
PO7	Lifelong learning	Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.
PO8	Competence for Digital World	Prepare well for living, learning and working in a Digital Society; Choose and apply appropriate modern tools/frameworks/platforms/instruments, software simulators, techniques, resources, and modern engineering and ICT tools to complex activities with an understanding of the limitations. Use existing digital technologies ethically and efficiently to solve problems, complete tasks, and accomplish goals.
PO9	Global Citizenship	Act with an informed awareness of global issues. Engage in initiatives that encourage equity and growth for all.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

At the end of the two-year M. Sc. Applied Electronics programme, the student would be able to

PSO 1: Analyze specific problems relevant to Applied Electronics by applying the knowledge of Electronic Devices and Circuits, Linear and Digital Integrated Circuits, Communication Engineering, Analog and Digital Electronics, Microprocessors, Microcontrollers, VLSI, Embedded Systems, Smart Sensors, Digital Signal Processing, Microwave Engineering, Embedded System Design, Computer Organization, Optical Fiber Communications, Mobile Communications, etc.

PSO 2: Design systems containing hardware and/or software using the significant analytical knowledge in Electronics and applying modern product development tools/frameworks.

PSO 3: Apply and transfer interdisciplinary systems and Engineering approaches to the various areas, like Communications, Signal processing, VLSI and Smart Sensors.

PSO4: Demonstrate skills by carrying out cost-effective projects with a flexibility to balance between research- and application- oriented work that require innovative approaches.

Employability Potential of the Programme

M. Sc. AE programme focuses on applied Sciences and engineering courses. Initially, it was started in the Faculty of Engineering and Technology with a view to provide exposure to applied sciences, courses relevant to electronics engineering and allied disciplines. In the past, many students have been placed in MNCs including but not limited to Oracle, Tektronix, Infosys, TCS, Cognizant, Persistent, Scientech, IBM, Marvell, BSNL, Tech Mahindra, Syntel, L&T Infotech, Videocon, CDAC, Samsung, Robonics Pvt Ltd., Jindal Saw Ltd., Electronics Art Pvt Ltd., etc.

Further, numerous students have completed their Master of Electronics Engineering as well as Ph.D. in Electronics Engineering and joined esteemed institutions like Indian Institute of Technology, Guwahati, Sant Gadge Baba Amravati University, Amravati as Professors and amongst them, a few have been leading the departments and institutes as HoDs and Principals, respectively. Some other students have been placed in banking sector such as HDFC Bank, ICICI Bank, Equitas Bank, Canara Bank, etc. Moreover, some students have secured jobs in Indian Navy, Merchant Navy, Ministry of Defence, Airport Authority of India, BSNL, etc. In addition, some students have successfully established their small enterprises and now they are self-employed. Nevertheless, they are providing jobs to other students as well.

Applied Electronics contributes to a lot of innovation in the fields of healthcare, automation, automotive, robotics and computer & IT. Because of the stupendous technological growth all over the world, there exist several jobs in electronics sector. Almost, everything runs on electrical devices, gadgets, and control systems, one can't do without electronics graduate in the company. Being an electronics graduate will act as an entrance in varied industries including Automotive Industry, Defence Industry, Real Estate, Construction, Electronics Industry, Marine Industry, Oil and Gas Industry, Power generation industry, Railways, Marine, Telecom industry, and many more.

Student can work in a variety of areas, as electronics are used in many things including but not limited to acoustics, defence, medical instruments, mobile phones, nanotechnology, radio and satellite communication, robotics, etc.

As a responsibility, student will need to:

- discuss proposals with clients
- work with colleagues to design new systems, circuits and devices or develop existing technology
- test theoretical design
- write specifications and technical reports
- follow defined development processes
- systematically improve the detailed design of a piece of electronic equipment
- ensure that a product will work with devices developed by others, can be made again reliably, and will perform consistently in specified operating environments
- create user-friendly interfaces
- ensure safety regulations are met
- carry out project planning and prepare budgets
- supervise technicians, craftspeople and other employees

Popular Job Profiles for Students of M Sc Applied Electronics

Students can work in a variety of manufacturing (product) and service sector organisations, including broadcasting, consulting, data communication, entertainment, research and development, and system support. The following are some of the most common job titles for an electronics and communication engineer. Areas of employment include but not limited to Service Engineer, Electronics Engineer, Electronics Design Engineer, Field Test Engineer, Communications Engineer, Customer Support Engineer, Field Test Engineer, Network Planning Engineer, Electronics and Communications Consultant, Electronics Technician, Research and Development Software Engineer, Senior Sales Manager, Technical Director, Analog applications engineer, Telecom engineer, VLSI and embedded systems (Automation) industries, Data processing industries

Self-Employment / Start-ups/Business Prospects for M Sc Applied Electronics students

Self-employment does cater the best jobs for students. However, establishing a start-up is likely to be risky at the initial stages. But a well-trained student can always try to broaden his/her business prospect by accumulating valuable knowledge. Moreover, gaining appropriate skills during the programme helps one to frame a strategic plan and execute it ideally.

Since in the current scenario, there are not a lot of start-ups in the Electronics industry, so competition would be comparatively less. A start-up in this field could be incorporated in any of the following avenues: Smart sensors, Robotics, VLSI, Optical Communication, Embedded Systems, Digital Electronics and many more.

Why contemplate higher studies after M.Sc. Applied Electronics?

With a degree in higher studies, students can increase the chances of career options. Students can join M.E. or M. Tech. Programmes in Electronics Engineering. Master degrees offer to reinforce fundamental concepts in areas like communication, machine learning, high processing circuits etc. In addition, a higher degree in education can support with greater job opportunities and advanced level training that cannot be acquired during graduation level education.

Additionally, higher studies apart from providing several advantages, job opportunities for electronics and communication engineers, also strengthen the existing knowledge foundation. It permits an individual career aspirant to move across the global landscape to experience professional growth seamlessly.

To summarize, students can explore global career opportunities and switch job roles smoothly. They can grab high salary packages. They can enhance knowledge and skills. Job security is ensured and enormous career advantages are gained. Consequently, this results in building strong networks.

Sant Gadge Baba Amravati University, Amravati

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(Two Years- Four Semesters Master's Degree Programme- NEPv23 with **Exit and Entry Option**

M. Sc. (Applied Electronics) First Year Semester- I

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory +MCQ External	Internal	External		Marks Internal	Marks External	Grade
0	*Pre-Requisite Course(s) if applicable/MOOC/Internship/Field Work cumulatively If students wish to opt Minor Course ofUG as Major for PG, **balance 12 Credits** Course will have to be completed **(As and when applicable)**	**Th-Prq**		**0**	**0**	**0**	**0**	**Additional Credits to be earned = (1) minus(2) (1). Credits from Major DSC Courses in UG (minus) (2).The Credits already earned from the Course as Minor at UG, now to be opted as Major at PG**			**2**	**15**	**35**			**50**	**06**	**14**	**P**
1	Research Methodology and IPR	**Th-Major**		**4**			**4**	**4**		**4**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
2	DSC-I.1 **Electronic Devices &Circuits**	**Th-Major**		**4**			**4**	**4**		**4**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
3	DSC-II.1 **Communication Engg**.	**Th-Major**		**4**			**4**	**4**		**4**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
4	DSC-III.1 **Data Science and NN**	**Th-Major**		**3**			**3**	**3**		**3**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
5	DSE-I /MOOC i)**Digital Instrumentation,ii)Biomedical Engg,iii) EENA**	**Th-Major Elective**		**3**			**3**	**3**		**3**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
																	Minimum Passing Marks		**Grade**
6	DSC-I.1 Lab	**Pr-Major**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
7	DSC-II.1 Lab	**Pr-Major**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
8	DSC-II.1 Lab	**Pr-Major**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
9	DSE-I Laboratory	**Pr-Major Elective**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
10	# On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively**	**Related to DSC**		**120 Hours cumulatively during vacations of Semester I and Semester II**						**4***									**P***
11	**Co-curricular Courses: Health andwellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV**	Generic **Optional**		**90 Hours Cumulatively From Sem I to Sem IV**															
	TOTAL									**22**						**600+50***			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note : # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II. This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.**

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

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M. Sc. (Applied Electronics) First Year Semester- II [Level 6.0]

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory +MCQ External	Internal	External		Marks Internal	Marks External	Grade
1	DSC-I.2 **Analog & Digital ICs**	**Th-Major**		4			4	4		4	3	30	70			100	12	28	P
2	DSC-II.2 **Microcontroller**	**Th-Major**		4			4	4		4	3	30	70			100	12	28	P
3	DSC-III.2 **Digital Communication**	**Th-Major**		3			3	3		3	3	30	70			100	12	28	P
4	DSE-II/MOOC , **i)Smart Sensors ii) Artificial Intelligence iii) Remote sensing**	**Th-Major Elective**		3			3	3		3	3	30	70			100	12	28	P
																	Minimum Passing Marks		
5	DSC-I.2 Lab	**Pr-Major**				2	2		1	1	3			25	25	50	25		P
6	DSC-II.2 Lab	**Pr-Major**				2	2		1	1	3			25	25	50	25		P
7	DSC-III.2 Lab **Electronic Workshop**	**Pr-Major**				2	2		1	1	3			25	25	50	25		P
8	DSE-II Laboratory	**Pr-Major Elective**				2	2		1	1	3			25	25	50	25		P
9	# On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively**	**Related to Major**		**120 Hours cumulatively during vacations of Semester I and Semester II**						**4***									**P***
10	**Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV**	Generic **Optional**		**90 Hours Cumulatively From Sem I to Sem IV**															
	Exit Option with a PG Diploma with 4 Credits On-the-job training/internship in the respective Major subject • **Student has to earn Total minimum 4 Credits cumulatively during Vacations of Semester I and Semester II from internship in order to exit after First Year with PG Diploma (42-44 Credits) after Three Year UG Degree**																		
	TOTAL									**18+4***						**550**			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note : # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major (During vacations of Semester I and Semester II) for duration of 120 hours mandatory to all the students, to be completed during vacations of Semester I and/or II.**

This will carry 4 Credits for learning of 120 hours. Its credits and grades will be reflected in Semester II credit grade report.

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

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M. Sc. (Applied Electronics) Second Year Semester- III

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory+ MCQ External	Internal	External		Marks Internal	Marks External	Grade
1	Contemporary Applied Technological Advancements in Research relevant/supportive to Major DSC-I.3	**Th-Major**		**4**			**4**	**4**		**4**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
2	DSC-II.3 **Digital Signal Processing**	**Th-Major**		**4**			**4**	**4**		**4**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
2	DSC-III.3 **Embedded System Design**	**Th-Major**		**3**			**3**	**3**		**3**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
3	DSE-III /MOOC **i)Machine Learning ,ii) Speech Processing, iii) Text Mining**	**Th-Major Elective**		**3**			**3**	**3**		**3**	**3**	**30**	**70**			**100**	**12**	**28**	**P**
																	Minimum Passing Marks		
4	DSC-I.3 Lab/Pr	**Pr-Major**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
5	DSC-II.3 Lab	**Pr-Major**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
5	DSC-III.3 Lab **CPP lab**	**Pr-Major**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
6	DSE-III Lab	**Pr-Major Elective**				**2**	**2**		**1**	**1**	**3**			**25**	**25**	**50**	**25**		**P**
7	**Research Project Phase-I**	**Major**			**2**	**4**	**6**	**2**	**2**	**4**				**50**	**--**	**50**	**25**		**P**
8	**Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV**	Generic **Optional**		**90 Hours Cumulatively From Sem I to Sem IV**															
	TOTAL									**22**						**500**			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

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M. Sc. (Applied Electronics) Second Year Semester- IV [Level 6.5]

S. N.	Subject	Type of Course	Subject Code	Teaching & Learning Scheme							Duration Of Exam Hours	Examination & Evaluation Scheme							
				Teaching Period Per Week				Credits				Maximum Marks					Minimum Passing		
												Theory		Practical		Total Marks			
				L	T	P	Total	L/T	Practical	Total		Theory Internal	Theory+ MCQ External	Internal	External		Marks Internal	Marks External	Grade
1	DSC-I.4 **Microwave Engineering**	**Th-Major**		4			4	4		4	3	30	70			100	12	28	P
2	DSC-II.4 **VLSI Design**	**Th-Major**		4			4	4		4	3	30	70			100	12	28	P
3	DSC- III.4 **Optical Fiber Communication**	**Th-Major**		3			3	3		3	3	30	70			100	12	28	P
4	DSE-IV /MOOC) **i) Image & Video Processing, ii)Generative Deep Learning, iii) Pattern Recognition**	**Th-Major Elective**		3			3	3		3	3	30	70			100	12	28	P
																	Minimum Passing Marks		
5	DSC-I.4 Laboratory	**Pr-Major**				2	2		1	1	3			25	25	50	25		P
6	DSC-II.4 Laboratory	**Pr-Major**				2	2		1	1	3			25	25	50	25		P
7	DSC-III.4 Laboratory **Python Lab**	**Pr-Major**				2	2		1	1	3			25	25	50	25		P
8	DSE-IV Laboratory	**Pr-Major Elective**				2	2		1	1	3			25	25	50	25		P
9	**Research Project Phase-II**	**Major**			2	8	10	2	4	6	3			75	75	150	75		P
10	**Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV**	Generic **Optional**		**90 Hours Cumulatively From Sem I to Sem IV**															
	TOTAL									24						600			

L: Lecture, T: Tutorial, P: Practical/Practicum

Pre-requisite Course mandatory if applicable: **Prq**, Theory : **Th**, Practical/Practicum: **Pr**, Faculty Specific Core: **FSC**, Discipline Specific Core: **DSC**, Discipline Specific Elective: **DSE**, Laboratory: **Lab**, **OJT:** On Job Training: Internship/ Apprenticeship; Field projects: **FP**; **RM:** Research Methodology; Research Project: **RP, Co-curricular Courses: CC**

Note: **Co-curricular Courses:** In addition to the above, CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.). These can be completed cumulatively during **Semester I, II, III and IV. Its credits and grades will be reflected in semester IV credit grade report.**

Table: Comprehensive Credits distribution amongst the type of Courses over Two Years (Four Semesters) PG Programme and Minimum Credits to be earned for PG Degree [Master in Faculty Science and Technology Major]

Sr. No.	Type of Course		Total Credits Offered	Minimum Credits Required
1	**MAJOR**			
	i. DSC	**56**	**56**	**56**
	ii. DSE	**16**	**16**	**16**
		TOTAL	**72**	**72**
2	**Research Methodology and IPR (FSC/DSC: Major)**	**04**	**04**	**04**
2	On Job Training, Internship/ Apprenticeship; Field projects **Related to Major**	**04**	**(for 120 Hours OJT/FP cum.) 04**	**(Minimum 60 Hours OJT/FP is mandatory) 02**
3	**Research Project**	**10**	**10**	**10**
	OPTIONAL			
4	**Co-Curricular Courses (offline and/or online as applicable): Co-curricular Courses: Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts,** CC also include but not limited to Academic activities like paper presentations in conferences, Aavishkar, start-ups, Hackathon, Quiz competitions, Article published, Participation in Summer school/ Winter School / Short term course, Scientific Surveys, Societal Surveys, Field Visits, Study tours, Industrial Visits, online/offline Courses on Yoga (Yoga for IQ development, Yoga for Ego development, Yoga for Anger Management, Yoga for Eyesight Improvement, Yoga for Physical Stamina, Yoga for Stress Management, etc.).		**Limited to Maximum 03 only (For 90 Hours of CC cumulatively) 03**	**00**
	TOTAL			
	TOTAL		**93**	**88**

Table A: Comprehensive Credit Distribution for CC

S. N.	Activities (offline/online as applicable)	Credits at Levels						Letter Grade
		College	University	State	Zone if exist	National	International if exist	
1	Health and wellness, Yoga* Competitions *If a Course (online/offline) on Yoga is completed for 60 Hours, 2 credits will be awarded to the student (1 Credit = 30 Hours)	1	2	3	4	5	6	P (Pass)
2	Unnat Bharat Abhiyan [UBA]	1	2	3	4	5	6	P (Pass)
3	Sports and fitness activities (see separate **Table B**)	1	1 / 2	2 / 3	3 / 4	4 / 5	5 / 6	P (Pass)
4	Cultural activities, Fine/Applied/Visual/Performing Arts	1	2	3	4	5	6	P (Pass)
5	N.S.S. activities Camps	1	2	3	4	5	6	P (Pass)
6	Academic activities like Research Paper/Article/Poster presentations, Aavishkar, start-up, Hackathon, Quiz competitions, other curricular, co-curricular activities, students exchange programme etc. Research Paper/Article published	1 --	2 1	3 2	4 -	5 4	6 6	P (Pass) P (Pass)
7	Participation in Summer school/ Winter School / Short term course (not less than 30 hours 1 or 2 weeks duration) (not less than 60 hours 2 or 3 weeks duration) Scientific Surveys, Societal Surveys Field Visits, Study tours, Industrial Visits,	2 Credits 4 Credits 2 Credits 1 Credit						P (Pass) P (Pass) P (Pass) P (Pass)
8	NCC Activities	As given in **Table C**						

Table B: Credit Distribution for Sports and Fitness

Sr. No.	Particulars of Sports Status (Individual/ Team)	Credits	Letter Grade
1	College Level Participation	1	P (Pass)
2	University Level Participation	1	P (Pass)
3	University Level Rank 1, 2, 3	2	P (Pass)
4	State Level Participation	2	P (Pass)
5	State Level Rank 1, 2, 3	3	P (Pass)
6	Zonal Level Participation	3	P (Pass)
7	Zonal Level Rank 1, 2, 3	4	P (Pass)
8	National Level Participation	4	P (Pass)
9	National Level Rank 1, 2, 3	5	P (Pass)
10	International Level Participation	5	P (Pass)
11	International Level 1,2,3	6	P (Pass)

Table C: Credit Distribution for NCC activities

Sr. No.	Particulars of NCC Activities	Credits	Letter Grade
1	Participation in NCC activities	1	P (Pass)
2	'B' Certificate obtained	2	P (Pass)
3	'C' Certificate obtained	3	P (Pass)
4	State Level Participation	4	P (Pass)
5	National level Participation	5	P (Pass)
6	International Level Participation	6	P (Pass)

Sant Gadge Baba Amravati University, Amravati
FACULTY : Science and Technology

Scheme of Teaching, Learning, Examination & Evaluation leading to Two Years PG Degree Master of Science (Applied Electronics) following Three Years UG Programme wef 2023-24

(Two Years- Four Semesters Master's Degree Programme- NEPv23 with **Exit and Entry Option**

M. Sc. (Applied Electronics) First Year Semester- I

1AE1 Research Methodology and IPR

Upon completion of this course satisfactorily, students would be able to:

1. To understand the role of research methodology in Science and Engineering
2. To understand literature review process and formulation of a research problem
3. To understand data collection methods and basic instrumentation
4. To learn various statistical tools for data analysis
5. To learn technical writing and communication skills required for research
6. To create awareness about intellectual property rights and patents

Unit I: Introduction to Research

Characteristics of good research, Types of research- Descriptive vs. Analytical, Applied vs. Fundamental, Quantitative vs. Qualitative, Conceptual vs. Empirical. Introduction to problem solving, basic research terminology such as proof, hypothesis, lemma etc. (10 Hrs.)

Unit II: Research Problem Formulation and Methods Literature review, sources of literature, various referencing procedures, Identifying the research areas from the literature review and research database, Problem Formulation, determining the scope, objectives, limitations and or assumptions of the identified research problem, Justify basis for assumption, Formulate time plan for achieving targeted problem solution. (10 Hrs.)

Unit III: Data Collection

Sampling methods, methods of data collection, data collection, analysis, interpretation, Necessary instrumentations, Data preparation, exploration, examination and display. (10 Hrs.)

Unit IV: Experimental and Modelling skills , Role of hypothesis in experiment /simulation, dependent /independent variables, design experiments, Applied statistics: Regression analysis, Parameter estimation, Multivariate statistics, Principal component analysis Software tools for modelling, Simulation, result and analysis. (10Hrs.)

Unit V: Research reports and Thesis writing Preparation of research article/report, developing research proposal. Thesis writing, Illustrations and tables, bibliography, referencing and footnotes,

(10 Hrs.)

Unit VI: Research Ethics, IPR and Publishing ,Ethics: Ethical issues. citation and acknowledgement, plagiarism tools.

IPR: intellectual property rights and patent law, techniques of writing a Patent, filing procedure, technology transfer, copy right, royalty, trade related aspects of intellectual property rights (10 Hrs.)

Reference Books:

1. Ranjit Kumar, "Research Methodology: A Step by Step Guide for Beginners",SAGE Publications Ltd., 2011.
2. Wayne Goddard, Stuart Melville, "Research Methodology: An Introduction"JUTA and Company Ltd, 2004.
3. C.R. Kothari ,"Research Methodology: Methods and Trends",New Age International,2004
4. B.L. Wadehra,"Law Relating to Patents,Trademarks, Copyright Designs and Geographical Indications", Universal Law Publishing, 2014.
5. Paneerselvam , "Research Methodology", Prentice Hall of India, 2012
6. Day R.A., How to Write and Publish Scientific Paper , Cambridge University Press, 1989
7. https://nptel.ac.in/courses/106/105/106105077/

1AE2 DSC-1.1 ELECTRONIC DEVICES AND CIRCUITS

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Apply the knowledge of diode and its applications in rectifier and regulator circuits.
2. Understand basics of BJT, JFET, MOSFET, UJT and their operational parameters.
3. Understand feedback concept, topologies and their applications.
4. Implement and analysis of various electronic circuits such as oscillators, multistage amplifiers and power amplifiers using BJT.
5. Design and analyse electronic circuits.
6. Compare working of various diodes and their applications

Unit I : P-N Junction diode theory, Rectifiers - Half wave, full wave and bridge, Filters-C, LC and their analysis, analysis of clipping and clamping circuits using diodes, Zener diode and its application. (10 Hrs)

Unit II : Theory and Analysis of Bipolar Junction transistor, Configurations, transistor as a switch,'Q' and stability factor, Methods of biasing, their needs, 'h' Parameter (CE, CB, CC analysis) (10 Hrs)

Unit III : FETs (JFET & MOSFET): Types, Characteristics and parameters (μ , gm, Rds), Biasing of FET, MOS capacitor, Equivalent circuits of JFET and MOSFETs, CMOS characteristics. (10 Hrs)

Unit IV : Study of typical transistor amplifier circuits: BJT: RC coupled amplifier, Transformer coupled amplifier, Direct coupled amplifier, Cascode stage, Emitter follower, Darlington emitter follower, Bootstrap emitter follower, Feedback amplifiers. FET Amplifier-Common Source & Common Drain. (10 Hrs)

Unit V : Class 'A', 'B', 'AB' and 'C' amplifiers, Calculations of power gain, efficiency, power dissipation and distortion, Oscillators, their criteria, Hartley, Colpitts and R-C Oscillators, Crystal Oscillator. (10 Hrs)

Unit VI : Theory, Construction and applications of Schottky diode, Tunnel diode, Varactor diode, LED, Photo diode, Phototransistor, PIN diode. (10 Hrs)

Text Books:

1) Electronic Devices and	:	David A.Bell, Oxford University Press
2) Electronic Devices and Circuits	:	Millman and Halkias, TMGH
3) Integrated Circuits	:	Millman and Halkias, TMGH
4) Microelectronics	:	Millman and Halkias, TMGH
5) Millman and Taub (TMGH,	:	Pulse, Digital and Switching wave forms

Reference Books:

1) Microelectronic Circuits	:	Sedra/Smith,5e,Oxford University Press
2) Electronic Devices & Circuit Theory	:	R.L.Baylestad & L.Nashlsky (6^{th} Edition), Pearson Education
3) Semiconductor Devices and Circuits	:	Aloke K.Dutta, Oxford University, Press

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1AE3 DSC-II.I COMMUNICATION ENGINEERING

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand the necessity of modulation and identify the various components of analog communication systems.
2. Analyse different modulation and demodulation schemes in analog and pulse communication systems.
3. Analyze the performance of analog communication systems in presence of noise.
4. Develop the ability to compare and contrast the strengths and weaknesses of various communication systems.
5. Compare the performance various AM receivers
6. Draw block diagram and explain working of FM transmitter and Receiver

Unit I : Basics of Electronic Communication

The importance of electronic communication, Definition: Analog signal, Digital signal, Baseband signal, block diagram of basic electronic communication system and explanation of each block, Noise in communication system and types, The electromagnetic spectrum, Concept of transmission bandwidth, modulation, need for modulation, different modulation techniques, Difference between CW and pulse modulation techniques. (Fundamental concepts) (10 Hrs)

Unit II : Wave Propagation

Fundamentals of Electromagnetic waves, ground waves, space waves propagation, ionosphere layer, sky waves propagation, concept of actual and virtual height, Definitions of critical frequency, maximum usable frequency, skip distance and skip zone, concept of fading. (10 Hrs)

Unit III: Antennas

Antenna fundamentals, concept of Radiation pattern, polarization, bandwidth, beam width, antenna resistance, directivity, power density, antenna gain, Structure, radiation pattern & applications of -Half wave dipole antenna (resonant antenna), folded dipole antenna, Yagi-Uda antenna. (10Hrs)

Unit IV : AM transmitters

Amplitude Modulation, Modulation index-definition, its effect on modulated signal, Mathematical representation of amplitude modulated wave & its meaning, concepts of side band (SSB,DSB), Power relations in AM wave, simple numerical, Circuit and operation of AM modulator using FET, Block diagram of AM transmitter and its operation, advantages, disadvantages,

applications of AM. (10 Hrs.)

Unit V : AM receivers

Block diagram of Tuned Radio Frequency receiver and its working, Block diagram of AM super heterodyne receiver and its working, Characteristics of AM radio receiver- Sensitivity, selectivity, fidelity definitions, Image frequency and its rejection, Demodulation of AM signal, Diode detector, Need of AGC & its types – simple, delayed. (10 Hrs)

Unit VI : FM transmitter and Receiver

Frequency Modulation, mathematical representation of FM & its meaning, direct FM Generation using FET, Armstrong circuit diagram and its working, Concept of Pre-emphasis & De-emphasis

FM receiver: Block diagram and explanation of FM Super heterodyne radio receiver, Balanced slope detector. (10 Hrs)

Text Books: 1) Kennedy G. : Electronic communication system (Mc-Graw Hill) 4th Ed

2) Dennis Roddy & John Coolen : Electronic communication (PHI) 2ND Ed

1AE4 DSC-III.IDATA SCIENCE AND NEURAL NETWORKS

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. To understand core concepts of data science
2. To collect and manage data
3. To analyse data
4. To visualize data
5. To apply MLP neural networks for classification and recognition problems.
6. To design, train and test FFNNs for classification problems

Unit I

data science process, Types of data, Example applications, Mathematical Foundations for Data Science, Concepts of statistics in solving problems arising in data science. (9Hrs)

Unit II

Data collection and management: Introduction, Sources of data, Data collection and APIs, Exploring andfixing data, Data storage and management, using multiple data sources (7Hrs)

Unit III

Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Linear regression, Naive Bayes. (7Hrs)

Unit IV

Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings. (7Hrs)

Unit V

Neural Network, knowledge representation, learning processes, Basics of artificial neural networks (ANN), Computational models of neurons, Perceptron, Multilayer Perceptrons, Backpropagation Algorithm, Functional units of ANN for pattern recognition tasks (8 Hrs)

Unit VI

Feedforward neural networks, Regression and classification, Pattern classification using Multilayer feedforward neural networks (FFNNs), Radial Basis Function Networks (7 Hrs)

Textbooks:

1. Cathy O'Neil, Rachel Schutt, Doing Data Science, Straight Talk from The Frontline. O'Reilly,2013.
2. Introducing Data Science, Davy Cielen, Arno D. B. Meysman, Mohamed Ali, Manning PublicationsCo., 1st edition, 2016
3. An Introduction to Statistical Learning: with Applications in R, Gareth James, Daniela Witten,Trevor Hastie, Robert Tibshirani, Springer, 1st edition, 2013
4. S. Haykin, Neural Networks and Learning Machines , Prentice Hall of India, 2010

1AE5 DSE-I/ MOOC

i) 1AE 51 Digital Instrumentation

COs(Course Outcomes):

Upon completion of this course satisfactorily, students would be able to:

1. Understand various types of Analog and Digital instruments.
2. Understand data acquisition and conversion systems.
3. Convert data from analog to digital and Digital to Analog.
4. Measure parameters using techniques used in industrial process.
5. use various electrical / electronic instruments
6. Develop basic skills in the design of electronic equipment.

Unit I ANALOG & DIGITAL INSTRUMENTS

Introduction, Electrical indicating instruments, Advantages of Digital instruments, Digital versus Analog Instruments, Cathode Ray Oscilloscope – Operation, observation of waveform on CRO, measurement of voltages and currents, Analog storage oscilloscope –principle of operation, Sampling oscilloscope-operation, Digital Storage Oscilloscope – operation, signal & function generation. (9 Hrs)

Unit II DATA ACQUISITION AND CONVERSION

Introduction, Objective of Data acquisition and Conversion, Signal Conditioning of the Inputs, Single Channel Data Acquisition Systems, Multi Channel Data Acquisition Systems, (7 Hrs)

Unit-III Data Conversion, Digital to Analog Converter(DAC), Analog to Digital

Converter(ADC), Data Loggers, Digital Transducer. (7 Hrs)

Unit-IV DIGITAL METHODS OF MEASUREMENTS

Voltage to time and Voltage to Frequency conversion techniques, Digital Multimeters -Analog to digital conversion in practical multimeters, four wire technique for low resistance measurement in multimeter, Digital Frequency meter, time period measurements, Universal Counter, Digital tachometers, Resolution and Sensitivity of Digital Meters (8Hrs)

Unit-V DIGITAL DISPLAY AND RECORDING DEVICES

Digital Printers/Plotters, Bar graph display, Seven segment and dot matrix display , Signal recorders, XY recorders, Digital magnetic tape recorders, Methods of recording-Direct, Frequency Modulated, Pulse Duration Modulation Recordings. (7 Hrs)

Unit-VI SIGNAL CONDITIONING

Instrumentation Amplifiers, AC Amplifiers, Direct Coupled Amplifiers, Chopped and Modulated D.C. Amplifiers, Operational Amplifiers, Inverter, Integrator, Differentiator, Buffer Amplifier, Differential Amplifier, Amplitude Modulation and Demodulation circuits for measurement, Filters, Types of Filters. (7 Hrs)

TEXT BOOK:

1. A.K. Sawhney, Dhanpat Rai & Sons, “A course in Electrical and Electronic Measurements and Instrumentation”, 4 th Edition, 2012.

REFERENCES:

1. Ernest O. Doebelin, “Measurement System, Application & Design”, 7th Edition, McGraw-Hill Education, 2019.
2. H.S. Kalsi, “Electronic Instrumentation”, Tata McGraw-Hill Education, 3rd Edition, 2012.
3. Nihal Kularatna, “Digital and Analogue Instrumentation-testing and measurement”, IET Publication, First published 2003, Reprint 1st Edition2008.
4. C.S. Rangan, G R Sarma, V S V Mani, “Instrumentation Devices and Systems”, 2nd Edition, TataMcGraw Hill, 2001.
5. Albert D. Helfrick, William D. Cooper, “Modern Electronic instrumentation and measurement techniques”, Prentice Hall India Learning Pvt. Ltd, First published 1989, Reprint 1st Edition2016.
6. A.J. Bouwens, “Digital Instrumentation”, McGraw Hill Education, First published 1984, Reprint 1st Edition2004.

ii) 1AE52 Biomedical Engineering

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand the importance and association of engineering with medical field.
2. Measure the biomedical parameters.
3. Explain the medical imaging system

4. Illustrate therapeutic equipment
5. Understand the conceptualization of patient care & safety requirements and its importance
6. Explain computerized biomedical systems..

UNIT-I: INTRODUCTION TO BIOMEDICAL ENGINEERING

Physiological system of heart, Man instrument system, Sources of bioelectric potentials, Different bioelectric signals like ECG, EMG and EEG, Biopotential Electrode theory, Basic electrode, Electrodes for EEG, ECG, EMG, Biochemical electrodes. Skin contact Theory : skin contact impedance measurement of skin con tact impedance, motion artifacts, nearest equation Nernst Equation . (9Hrs)

UNIT-II : BIOMEDICAL RECORDER AND MEASUREMENT

Biomedical recorders for EEG, ECG, EMG, Blood pressure variation as a function of time, relationship of heart sounds to a function of the cardio vascular system, Measurement of Blood Pressure (Direct & Indirect), Blood flow, Heart sound. (7Hrs)

UNIT-III : MEDICAL IMAGING SYSTEM

Instrumentation for diagnostics X-ray , X- ray basics properties , X-ray machine , Special imaging technique. Ultrasonic imaging system : Physics of Ultrasound, Biological effect of ultrasound. Ultrasonic A-scan, M-scan, B-scan, Real-time ultrasonic imaging systems. (7Hrs)

UNIT-IV : THERAPEUTIC EQUIPMENTS

Need of Physiological and electrotherapy equipment. Cardiac pacemaker machine, Cardiac Defibrillators, Nerve and Muscle stimulators. Diathermy : short wave, microwave, ultrasonic. (7Hrs)

UNIT-V : PATIENT CARE AND MONITORING AND SAFETY

System concepts, Bedside patient monitors, central monitors, Average reading heart monitor, Intensive care monitoring, Ambulatory monitoring. Biotelemetry : Single channel and Multichannel biotelementry, telephonic data transmission. PATIENT SAFETY : Electric shock hazards, leakage current. Types of Leakage current, measurement of leakage current, methods of reducing leakage current, precautions to minimize electric shock hazards. Telemedicine. (8Hrs)

UNIT-VI : COMPUTERS IN BIOMEDICAL ENGINEERING

Computerized Axial Tomography (CAT) Computerized Aided ECG analysis Computerized patient monitoring system. Computerized Catheterization. (7Hrs)

TEXT BOOKS:

1. Khandpur R.S. : "Handbook of Biomedical Instrumentation", Tata Mc-Graw Hill, New Delhi.
2. Cromwell L. & Weibell F.J. : "Biomedical Instrumentation and Measurement", Prentice Hall of India.

REFERENCE BOOKS:

1. Dr. Lele R.D. : "Computer Applications of Medicine", Tata Mc-Graw Hill, New Delhi.
2. Webstar J.G. : "Medical Instrumentation", III ed., John Wiley & Sons.
3. Carr and Brown : Biomedical Equipment Technology.

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iii) 1AE53 ELECTRICAL ENGINEERING AND NETWORK ANALYSIS

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Analyze electrical circuits using mesh and node analysis.
2. Apply suitable network theorems to analyze electrical circuits.
3. Apply Laplace Transform for circuit analysis.
4. Draw oriented graph of network to determine their currents and voltages.
5. Understand the theory for network analysis
6. Apply two-port network analysis in the design and analysis of filter and attenuator networks

Unit I : Fundamentals of Electrical Engineering

Basic concept of voltage, current, work, power and energy, relationships between them, Resistance, resistivity, conductivity, Ohm's law, series and parallel connections of resistors, voltage and current division, Star to delta and delta to star transformations, Kirchhoff's laws applied to dc circuits, single phase AC Circuits (sinusoidal waveforms only), R-L-C series circuits and parallel circuits, phasor diagram, impedance triangle, active reactive power. (8 Hrs)

Unit II : Single phase transformer

Principle of operation, construction, EMF equation of transformer, voltage transformation ratio, transformer on no load, transformer on load, losses in transformer, voltage regulation of transformer, efficiency of transformer, condition for maximum efficiency. Basic Network Elements and sources Network elements, circuit components, assumptions for circuit analysis, voltage and current sources, Standard input signals, source transformations, mesh and node analysis. (8 Hrs)

Unit III : Graph theory and network equations

Graph of a network, Trees, co trees and loops, Incidence matrix, Cut-set matrix, Tie set matrix and loop currents, possible trees, analysis of a network using Kirchoff's laws, network equilibrium equation and Duality network transformations. (7 Hrs)

Unit IV : Laplace Transformation and its applications

Laplace transformations, basic theorems, Laplace transform of some important functions, initial and final value theorem, gate function, impulse function, Solutions of linear differential equations with constant coefficients, Heaviside's partial fraction expansion. (8 Hrs)

Unit V : Network Theorems

Introduction, Superposition theorem, Reciprocity theorem, Thevenin's theorem, Norton's theorem, Maximumpower transfer theorem applied to DC and AC circuits. (7 Hrs)

Unit VI : Two-Port Network

Open circuit impedance parameters, short circuit admittance parameters, Transmission or chain parameters, Hybrid parameters, Interrelationships

between the parameters, Interconnection of two port networks, Input impedance in terms of two port parameters, Output impedance in terms of two port parameters. (7 Hrs)

Text Books:

1) De Carlo Lin : Linear Circuit Analysis, 2e, Oxford University Press
2) D. Roy Choudhary : Network and Systems (New Age International/ Wiley eastern ltd)
3) V.N. Mittle : Basic Electrical Engineering, (TMGH)

Reference Books:

1) M.E. Van Valkenburg : Network analysis 3rd Ed. (PHI)
2) Iskv Iyer : Circuit Theory, (TMGH)
3) Edminister : Electric Circuits, Schaum Outline Series

1AE 6 DSC-I.1 EDC Laboratory

Minimum 12experiments based on the syllabus of DSC-I.1 Lab , that are preferably uniformly distributed over the syllabus

1AE 7 DSC-II.I. Communication Engineering Laboratory

Minimum 12 experiments based on the syllabus of DSC-II.I. Lab , that are preferably uniformly distributed over the syllabus

1AE 8 DSCIII.1 Data Science and Neural network Laboratory

Minimum 12 experiments based on the syllabus of DSCIII.1 Lab , that are preferably uniformly distributed over the syllabus

1AE 9 DSE-I Laboratory

Minimum 12 experiments based on the syllabus (Electives mentioned) of DSCIII.1 Lab, that are preferably uniformly distributed over the syllabus

1AE10 # On Job Training, Internship/ Apprenticeship; Field projects **Related to Major @ during vacations cumulatively Related to DSC (120 Hrs cumulatively during vacations of Semester I and Semester II)**

1AE11 Co-curricular Courses (Optional) : Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC,Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV 90 Hrs Cumulatively From Sem I to Sem IV)

M.Sc. Applied Electronics First Year SEM II

2AE1 DSC-I.2 Analog and Digital integrated Circuits

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Comprehend the knowledge of basic concepts and performance parameters of Op-Amp.
2. Analyze and design electronic circuits for various linear and non-linear applications
3. Comprehend the knowledge of PLL, its applications and data converters.
4. Use Boolean algebra to solve logic functions, number systems and its conversion.
5. Understand digital logic families and their characteristics.
6. Identify, analyze and design combinational and sequential circuits.

Unit I : Operational Amplifier: Differential amplifier: gain expression using H parameters, transfer-characteristics, constant current source, level shifting, block diagram of op-amp, frequency response, frequency compensation methods, study of IC , measurement of parameters of op-amp, off set nulling and their importance. (10 Hrs)

Unit II : Linear Applications of Op-amp Inverting and non-inverting amplifiers, voltage followers, integrator, differentiator, Differential amplifier, bridge amplifier, Instrumentation amplifiers, precision rectifier. Non-Linear Applications of Op-Amp and Filter Circuits Clipping and clamping circuits, comparator, astable, monostable and bistable multivibrator, Schmitt Trigger, voltage sweep generator, active filters: Butterworth, Chebyshev filters using op-amp, (10 Hrs)

Unit III : Timers: Block schematic of regulator IC 555, application of timer 555 as astable, monostable and bistable multivibrator, Delayed timer, sawtooth generators, function generator using 8038, Sample & Hold circuit
Phase Locked Loops Operation of phase lock loop system, transfer characteristics, lock range and capture range, study of PLL IC-LM 565 (10 Hrs)

Unit IV : Number systems, Gray code , Arithmetic operations, 2's complements, Logic gates, Boolean algebra, standard form of logical function, K-map, Quine Mc-Clusky method,Synthesis using AND- OR gates, Study and analysis of digital logic families: TTL, ECL, MOS, CMOS and their characteristics, TTL and CMOS IC series (10 Hrs)

Unit V: Adders and subtractors using logic gates. Combinational Logic Design using 74/54 MSI chip series concerning to multiplexers, De-multiplexers, comparators, code converters, priority encoders, parity generator/ checker & BCD-to-seven segment decoder. Combinational Logic Design using ROM

array, PLA, PAL, Preliminary design concepts using FPGAs (10 Hrs)

Unit VI : Sequential Circuits Design Latches, Flip-Flops R-S, J-K, Master slave J-K, D-type, T-type, , Conversion of Flip-Flops, Design of Synchronous, Asynchronous Counters and Shift Register Counters. Finite State Machine, Sequential machine: Mealy and Moore Model. (10 Hrs)

Text Books:

1) Gayakwad R.A. : Op-Amps and Linear Integrated Circuits, Prentice Hall of India Pvt. Ltd., New Delhi (2nd edition)
2) Robert F. Coughlin : Operational Amplifiers & Linear Integrated Circuits, and F.F.Driscoll Pearson Education
3) M. Mano. : Digital Design 3rd ed (Pearson Education)
4) R.P.Jain : Modern Digital Electronics 3rd ed (TMH)
3) Ken Martin : Digital Integrated Circuit Design, Oxford University Press

Reference Book:

1) Sedra/Smith : Microelectronics Circuits, 5e, Oxford University Press

2AE2 DSC-II.2 Microcontroller

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Thoroughly understand the individual components of internal architecture of Microcontroller intel's 8051 and implement the physical application of corresponding microcontroller
2. Apply knowledge to interface the external memory to enhance the storing capacity of MCS 8051 microcontroller. Program the Timers in various modes to perform serial data communication.
3. Develop programming proficiency using the various addressing modes, data transmission instructions, perform arithmetic and logical operations using various instruction set of the target microcontroller.
4. Evaluate and implement the programming concepts of microcontrollers available interrupts, timers and counters to achieve serial communication with other real time devices.
5. Interface programmable peripheral interface PPI 8255 with 8051 microcontrollers in different operating modes of PPI 8255.
6. Design and develop the advanced applications using assembly language programs and provide solutions real-world control problems through external memory interface, Analog to Digital converters, AC/ DC motors and digital displays.

Unit I: An introduction to 8051: Overview of the 8051 family, Pin Diagram of 8051, Architecture of 8051, Signal description of 8051, 8051 architecture, I/O port structure, Memory Organization memory, Register Banks and their Addressing. (10 Hrs)

Unit II: Internal Memory, Internal RAM, External Memory, Register structure, stack and stack pointer, Special Function Registers and their addressing, Timer structure and their modes. Serial data input and output, serial data transmission and reception. (10 Hrs)

Unit III: Instruction set of 8051, Addressing modes of 8051, Data transfers, PUSH, POP, and Data

exchange instruction, Arithmetic operation, Logical bit and Byte level operation, Jump and Call instruction, time delay generation and calculation (10 Hrs)

Unit IV: Programming using 8051, interrupts structure in 8051 microcontrollers. Timer / counter programming, serial communication programming & Interrupt programming. (10 Hrs)

Unit V: Architecture, modes, and programming of PPI 8255: Internal architecture of Programmable Peripheral Interface PPI 8255, Modes of operation, Simple I/O, handshaking Mode, Bidirectional Data Transfer Mode, Bit Set/Reset Mode, Interfacing of 8255 with 8051 (10 Hrs)

Unit VI: 8051 interfacing to external memory, ADC and DAC interfacing, Interfacing LCD & stepper motor with 8051, Servo motor interfacing, interfacing of seven segment displays to 8051. (10 Hrs)

TEXTBOOKS:

1) Han-Way Huang, Using the MCS-51 Microcontroller, Oxford University Press

2) Mazidi & Mazidi: "8051 Micro-controller & Embedded System", Pearson Edu., 2nd Edition.

3) Ayala Kenneth J: "The 8051 Microcontroller: Architecture, Programming and Application", WEST Publication Company, USA 1998

4) Rajkamal: Arch. Prog. Interfacing & system design. Pearson Edu.

REFERENCE BOOKS :

1) A. K. Ray and K. M. Bhurchandi : Advanced Microprocessor and Peripherals, Architecture Programming and Interfacing, Tata McGraw Hill Publishing Co. Ltd., New Delhi (TMH)

2AE3 DSC-III.2 Digital Communication

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Understand basic building blocks of digital communication system
2. Solve problems on information theory and channel coding
3. Analyze performance of different digital modulation techniques.
4. Implement different error control coding schemes for the reliable transmission.
5. Understand methods to mitigate inter symbol interference in baseband transmission system.
6. Understand various multiple access schemes and spreading techniques.

Unit I : DIGITAL COMMUNICATION SYSTEM

Comparison of analog and digital communication System, advantages-disadvantages of digital communication System, block diagram of digital communication System, source encoder, decoder, Channel encoder, decoder, modulator, demodulator and their important parameters, Concepts of synchronization. (7Hrs)

Unit II : INFORMATION THEORY AND CHANNEL CODING

Signal, Bits, bit rate and baud rate, Probability, laws of probability, joint and conditional probability, information content, rate of information, entropy, joint entropy & conditional entropy, Theoretical Concepts of Binary communication channel, discrete communication channel, Channel capacity, Shannon's theorem on channel capacity, Hartley's law, Source coding, Huffman coding algorithm, and simple numerical. (8Hrs)

Unit III : DIGITAL MODULATION TECHNIQUES

Digital carrier modulation Schemes, fundamental concepts of coherent

Amplitude Shift Keying (ASK), Frequency shift keying (FSK), Phase shift keying (PSK), their transmitter and receiver block diagram and working, bandwidth and probability of errors (only theoretical concepts), comparison of digital modulation systems, block diagram of Differential Phase shift keying (DPSK) transmitter - receiver and working. (7Hrs)

Unit IV: **ERROR CONTROLLING AND CODING**

Introduction to error controlling and coding, Methods of controlling errors, type of errors and codes, linear block codes, Matrix description of linear block code, error detection and error correction capabilities of linear block code and simple numerical. (7Hrs)

Unit V : **BASE BAND TRANSMISSION**

Concept of Base band signals, Sampling process, Nyquist sampling theorem, Base band PAM system, inter symbol interference, Nyquist criterion, pulse shaping, eye diagram (Theoretical concepts only), scrambler and unscramble concepts and design. (7Hrs)

Unit VI : **MODERN TECHNIQUES OF COMMUNICATION**

Access techniques: Need of Multiplexing, Time Division Multiple Access (TDMA) and Frequency Division multiple Access (FDMA), Code Division Multiple access (CDMA), comparison of TDMA, FDMA, CDMA.
Introduction to spread spectrum (SS), Pseudo Noise (PN) sequence: definition, generation, Model of Spread Spectrum digital Communication system, D.S. spread spectrum transmitter, receiver and frequency hopping spread spectrum transmitter, receiver, **Theoretical concepts only**
(9Hrs)
.

Text Books:

1) Shanmugam K.S. Digital & analog Communication Systems, John Willey & Sons, New York
2) Lathi B. P. Modern Digital and Communication Systems, Oxford University Press

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2AE4 DSE-II/MOOC

2AE4.1 SMART SENSORS

COs (Course Outcomes)

Upon completion of this course satisfactorily, students would be able to:

1. Describe the principles of smart sensors
2. Analyze intelligent systems by interfacing the smart sensors to MCUs and DSPs.
3. Analyze the use of smart sensors in communication
4. Justify various control techniques for smart sensors
5. Evaluate smart sensors by the assessment of reliability testing and packaging.
6. Evaluate standards of smart sensors

Unit I: Smart Sensor basics: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, wearable sensors, integration of micromachining and microelectronics,
(7Hrs)

Unit II: Using MCUs/DSPs : MCU Control , MCUs for Sensor Interface Peripherals, ,Memory , Input/Output ,Onboard A/D Conversion , Power- Saving Capability ,

Local Voltage or Current Regulation, Modular MCU Design, DSP Control, Software, Tools, and Support, Sensor Integration (7Hrs)

Unit III: Communications for Smart Sensors: Introduction, Definitions, Sources (Organizations) and Standards, Automotive Protocols, Industrial Networks, office and building automation, home automation, Protocols in Silicon, Transitioning Between Protocols (7 Hrs)

Unit IV: Control Techniques: Programmable Logic Controllers , Open-Versus Closed-Loop Systems, PID Control, Fuzzy Logic, Neural Networks , Combined Fuzzy Logic and Neural Networks ,Adaptive Control, The Impact of Artificial Intelligence on sensors (8Hrs)

Unit V: Energy harvesting for wireless sensor nodes, application driven technology implementation and development, EH technologies, Energy storage, Sensor Fusion, packaging, testing and reliability implications of smarter sensors (8 Hrs)

Unit VI: Setting Standards for Smart Sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, Networked smart sensors, More standards impacting sensors: sensor plug and play, Future sensing system requirements, sensor apps, cloud sensing, alternate views of smart sensing, the Smart Loop (8 Hrs)

Textbook:
Understanding Smart Sensors, Randy Frank, 3e, Artech House, 2013

Reference Books:
1. WEARABLE SENSORS Fundamentals, Implementation and Applications, SECOND EDITION, Edited by EDWARD SAZONOV, Academic Press, Elsevier, 2021
2. Smart Sensors and MEMS Intelligent Sensing Devices and Microsystems for Industrial Applications, Second Edition, Edited by Stoyan Nihtianov and Antonio Luque, Woodhead Publishing, Elsevier, 2018
3. Micro and Smart Systems: Technology and modeling by G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat and V. K. Aatre, Wiley Publications, 2012

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2AE4.2 Artificial Intelligence

COs (Course Outcomes):

Upon completion of this course satisfactorily, students would be able to:

1. Understand artificial intelligence
2. Solve problems by searching
3. Analyse machine learning systems
4. Represent the knowledge in learning
5. Apply deep learning for problem solving
6. Classify images and detect objects using computer vision

Unit I : Introduction, What Is AI?, The Foundations of Artificial Intelligence, The History of Artificial Intelligence, The State of the Art , Risks and Benefits of AI , Intelligent Agents, philosophy, ethics and safety of AI, limits of AI, future of AI: AI components, AI architectures (8Hrs)

Unit II : Solving Problems by Searching, Problem-Solving Agents, Search Algorithms, Uninformed

Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions, Local Search and Optimization Problems, Hill climbing search, simulated annealing, local beam search (8Hrs)

Unit III: Machine Learning, Learning from Examples, Forms of Learning, Supervised Learning, Learning Decision Trees, Model Selection and Optimization, Linear Regression and Classification, Nonparametric Models, Ensemble Learning, Developing Machine Learning Systems (8Hrs)

Unit IV: Knowledge Representation, Ontological Engineering, Categories and Objects, Events, Mental Objects and Modal Logic, Reasoning Systems for Categories, Reasoning with Default Information . (7Hrs)

Unit V: Deep Learning, Simple Feedforward Networks, Computation Graphs for Deep Learning, Convolutional Networks, Learning Algorithms, Generalization, Recurrent Neural Networks, Unsupervised Learning and Transfer Learning, Applications (7Hrs)

Unit VI: Computer Vision: Introduction, Image Formation, Simple Image Features, Classifying Images, Detecting Objects, The 3D World, Using Computer Vision (7Hrs)

Text book:
Artificial Intelligence: A Modern Approach, Fourth Edition, Global Edition by Stuart J. Russell and Peter Norvig, Pearson, 2022

Reference Books:

1. Artificial Intelligence by John Paul Mueller and Luca Massaron, John Wiley & Sons, Inc, 2018
2. Introduction to Artificial Intelligence, Second Edition by Wolfgang Ertel, Springer, 2017

2AE4.3 Remote Sensing

COs (Course Outcomes)
Upon successful completion of the course, students would be able to

1. Comprehend the basics of remote Sensing
2. obtain knowledge of the sensor characteristics of various RS Systems and imaging
3. Interpret and analyze remote sensing
4. Develop visual interpretation skills
5. Analyse & Process the digital images using various techniques
6. Describe the applications of remote sensing

Unit I: Concept of Remote Sensing: Introduction, Definition of Remote Sensing, Data, Remote Sensing Process, Advantages and limitations of Remote Sensing,

Types of Remote Sensing, Characteristics of Images, Orbital Characteristics of Satellite, Remote Sensing Satellites, History of Remote Sensing and Indian Space Programme, (8Hrs)

Unit II: Photographic Imaging : Introduction, Camera Systems , Types of Camera , Filter , Film, Geometry of Aerial Photography,

Digital Imaging : Introduction , Sensors, Detectors, Imaging by Scanning Technique ,

Thermal Remote Sensing: Thermal Imaging, Thermal Image and Temperature Mapping, Thermal Remote Sensing Sensors, (8Hrs)

Unit III: Microwave remote sensing: Introduction, RADAR imaging, Airborne Versus Space-Borne Radars, Ground-Truth Data and Global Navigation Satellite System,

Photogrammetry Introduction, Photogrammetric Process, Acquisition of Imagery and its Support Data , Orientation and Triangulation , Stereo Model Compilation (7Hrs)

Unit IV: Visual Image Interpretation: Introduction, Information Extraction by Human and Computer, Remote Sensing Data Products, Image Interpretation, Elements of Visual Image Interpretation, Interpretation Keys, Generation of Thematic Maps, Thermal Image Interpretation, Radar Image Interpretation (7Hrs)

Unit V: Digital Image Processing: Introduction, Image Processing Systems, Pre-processing, Image Enhancement, Contrast and Brightness Enhancement, Filtering, Image Transformation, Fourier Transformation , Image Classification Supervised Classification, Unsupervised Classification (8Hrs)

Unit VI: Applications of remote sensing: Introduction, land cover and land used, agriculture, forestry, geology, mapping, oceans and coastal monitoring , monitoring of atmospheric constituents . (7Hrs)

Text Book: B. Bhatta- REMOTE SENSING AND GIS, Oxford university press higher education

2AE5 DSC-I.2 Analog & Digital ICs Laboratory

Minimum 12 experiments based on the syllabus of DSC-I.2 Analog & Digital ICs Lab, that are preferably uniformly distributed over the syllabus

2AE6 DSC-II.2 Microcontroller Laboratory

Minimum 12 experiments based on the syllabus of DSC-II.2 **Microcontroller Laboratory**, that are preferably uniformly distributed over the syllabus

2AE7 DSC-III.2 Electronic Workshop Laboratory

Minimum 12 experiments based on the syllabus of DSC-III.2 Electronic Workshop Laboratory, that are preferably uniformly distributed over the syllabus

2AE8 DSE-II Laboratory

Minimum 12 experiments based on the syllabus of (Electives specified) DSC-II Laboratory, that are preferably uniformly distributed over the syllabus

2AE9 # On Job Training, Internship/ Apprenticeship; Field projects Related to Major @ during vacations cumulatively 120 Hours cumulatively during vacations of Semester I and Semester II

At least 60 Hours (2 Credits) of OJT/ Internship/ Apprenticeship/ Field projects is mandatory for every student in order to earn a degree

2AE 10 Co-curricular Courses (Optional) : Health and wellness, Yoga Education, Sports and Fitness, Cultural Activities, NSS/NCC, Fine/Applied/Visual/Performing Arts During Semester I, II, III and IV 90 Hours (3 Credits) Cumulatively From Sem I to Sem IV