VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI

Scheme of Teaching and Examination and Syllabus

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING

III-VIII SEMESTER

(Effective from Academic year 2018-19)

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

Programme: ELECTRONICS AND INSTRUMENTATION ENGINEERING

III SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT31	Transform Calculus, Fourier Series and Numerical Techniques	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18EI32	Electronic Instrumentation and Measurements	EI	2	2	--	03	40	60	100	3
3	PCC	18EI33	Analog Electronic Circuits	EI	2	2	--	03	40	60	100	3
4	PCC	18EI34	Digital Design and HDL	EI	2	2	--	03	40	60	100	3
5	PCC	18EI35	Transducers and Instrumentation	EI	2	2	--	03	40	60	100	3
6	PCC	18EI36	Network Analysis	EI	3	2	--	03	40	60	100	4
7	PCC	18EIL37	Analog Electronic Circuits Lab	EI	--	2	2	03	40	60	100	2
8	PCC	18EIL38	Digital Design and HDL Lab	EI	--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39/49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**13**	**16**	**04**	**24**	**420**	**480**	**900**	**24**
					OR	**OR**		**OR**	**OR**	**OR**		
					14	**18**		**26**	**360**	**540**		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39 Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP31	Additional Mathematics - I	Mathematics	02	01	--	03	40	60	100	0

(a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech. programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfill the requirements during subsequent semester/s to appear for SEE.

(b)These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B. Sc. degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE Activity Points to be earned by students admitted to BE/B.Tech/B.Plan day college programme (For more details refer to Chapter 6,AICTE Activity Point Programme, Model Internship Guidelines):

Over and above the academic grades, every Day College regular student admitted to the 4 years Degree programme and every student entering 4 years Degree programme through lateral entry, shall earn 100 and 75 Activity Points respectively for the award of degree through AICTE Activity Point Programme. Students transferred from other Universities to fifth semester are required to earn 50 Activity Points from the year of entry to VTU. The Activity Points earned shall be reflected on the student's eighth semester Grade Card.

The activities can be spread over the years, anytime during the semester weekends and holidays, as per the liking and convenience of the student from the year of entry to the programme. However, minimum hours' requirement should be fulfilled. Activity Points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression.

In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

Programme: ELECTRONICS AND INSTRUMENTATION ENGINEERING

IV SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	BSC	18MAT41	Complex Analysis, Probability and Statistical Methods	Mathematics	2	2	--	03	40	60	100	3
2	PCC	18EI42	Signal Conditioning and Data Acquisition Circuits	EI	2	2	--	03	40	60	100	3
3	PCC	18EI43	Embedded Controllers	EI	2	2	--	03	40	60	100	3
4	PCC	18EI44	Control Systems	EI	3	2	--	03	40	60	100	4
5	PCC	18EI45	Process Instrumentation	EI	2	2	--	03	40	60	100	3
6	PCC	18EI46	Scientific and Analytical Instrumentation	EI	2	2	--	03	40	60	100	3
7	PCC	18EIL47	Embedded Controllers Lab	EI	--	2	2	03	40	60	100	2
8	PCC	18EIL48	Instrumentation and Measurements Lab	EI	--	2	2	03	40	60	100	2
9	HSMC	18KVK39/49	Vyavaharika Kannada (Kannada for communication)/	HSMC	--	2	--	--	100	--	100	1
		18KAK39/49	Aadalitha Kannada (Kannada for Administration)									
		OR										
		18CPC39/49	Constitution of India, Professional Ethics and Cyber Law		1	--	--	02	40	60		
					Examination is by objective type questions							
				TOTAL	**13**	**16**	**04**	**24**	**420**	**480**	**900**	**24**
					OR	**OR**		**OR**	**OR**	**OR**		
					14	**18**		**26**	**360**	**540**		

Note: BSC: Basic Science, PCC: Professional Core, HSMC: Humanity and Social Science, NCMC: Non-credit mandatory course.

18KVK39/49Vyavaharika Kannada (Kannada for communication) is for non-Kannada speaking, reading and writing students and 18KAK39/49 Aadalitha Kannada (Kannada for Administration) is for students who speak, read and write Kannada.

Course prescribed to lateral entry Diploma holders admitted to III semester of Engineering programs

10	NCMC	18MATDIP41	Additional Mathematics - II	Mathematics	02	01	--	03	40	60	100	0

((a)The mandatory non – credit courses Additional Mathematics I and II prescribed for III and IV semesters respectively, to the lateral entry Diploma holders admitted to III semester of BE/B.Tech programs, shall attend the classes during the respective semesters to complete all the formalities of the course and appear for the University examination. In case, any student fails to register for the said course/fails to secure the minimum 40 % of the prescribed CIE marks, he/she shall be deemed to have secured F grade. In such a case, the students have to fulfill the requirements during subsequent semester/s to appear for SEE.

(b)These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

Courses prescribed to lateral entry B.Sc. degree holders admitted to III semester of Engineering programs

Lateral entrant students from B.Sc. Stream, shall clear the non-credit courses Engineering Graphics and Elements of Civil Engineering and Mechanics of the First Year Engineering Programme. These Courses shall not be considered for vertical progression, but completion of the courses shall be mandatory for the award of degree.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

Programme: ELECTRONICS AND INSTRUMENTATION ENGINEERING

V SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18ES51	Technological Innovation Management & Entrepreneurship	HSMC / EI	2	2	--	03	40	60	100	3
2	PCC	18EI52	Fundamentals of Signals & DSP	EI	3	2	--	03	40	60	100	4
3	PCC	18EI53	Process Control Systems	EI	3	2	--	03	40	60	100	4
4	PCC	18EI54	Biomedical Instrumentation	EI	2	2	--	03	40	60	100	3
5	PCC	18EI55	Lasers and Optical Instrumentation	EI	2	2	--	03	40	60	100	3
6	PCC	18EI56	VLSI Design	EI	2	2	--	03	40	60	100	3
7	PCC	18EIL57	Signal Conditioning Circuits and Data Acquisition Lab.	EI	--	2	2	03	40	60	100	2
8	PCC	18EIL58	Digital Signal Processing Lab.	EI	--	2	2	03	40	60	100	2
9	HSMC	18CIV59	Environmental Studies	Civil/ Environmental [Paper setting: Civil Engineering Board]	1	--	--	02	40	60	100	1
				TOTAL	**15**	**16**	**4**	**26**	**360**	**540**	**900**	**25**

Note: PCC: Professional Core, HSMC: Humanity and Social Science.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

Programme: ELECTRONICS AND INSTRUMENTATION ENGINEERING

VI SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18EI61	Analog and Digital Communication Systems	EI	4	--	--	03	40	60	100	4
2	PCC	18EI62	Power and Industrial Electronics	EI	4	--	--	03	40	60	100	4
3	PCC	18EI63	Java Programming	EI	4	--	--	03	40	60	100	4
4	PEC	18EI64X	Professional Elective -1	EI	2	2	--	03	40	60	100	3
5	OEC	18EI65X	Open Elective -A	EI	2	2	--	03	40	60	100	3
6	PCC	18EIL66	Power Electronics, Controls and Communication Lab	EI	--	2	2	03	40	60	100	2
7	PCC	18EIL67	Java Programming Lab	EI	--	2	2	03	40	60	100	2
8	MP	18EIMP68	Mini-project	EI	--	--	2	03	40	60	100	2
9	Internship	--	Internship	To be carried out during the vacation/s of VI and VII semesters and /or VII and VIII semesters.								
				TOTAL	**16**	**08**	06	**24**	**320**	**480**	**800**	**24**

Note: PCC: Professional core, PEC: Professional Elective, OEC: Open Elective, MP: Mini-project.

Professional Elective -1

Course code under18EI64X	Course Title
18EI641	Aeronautical Instrumentation
18EI642	Digital Image Processing
18EI643	Operating Systems
18EI644	Robotics and Automation

Open Elective -A

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (Please refer to the list of open electives under 18XX65X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Mini-project work:
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the Mini-project work shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.
The CIE marks awarded for the Mini-project shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:
(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.
(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

Programme: ELECTRONICS AND INSTRUMENTATION ENGINEERING

VII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18EI71	Automation in Process Control		2	2	--	03	40	60	100	3
2	PCC	18EI72	ARM Processor		2	2	--	03	40	60	100	3
3	PEC	18EI73X	Professional Elective - 2		2	2	--	03	40	60	100	3
4	PEC	18EI74X	Professional Elective - 3		2	2	--	03	40	60	100	3
5	OEC	18EI75X	Open Elective -B		2	2	--	03	40	60	100	3
6	PCC	18EIL76	Process Control and Virtual Instrumentation Lab		--	2	2	03	40	60	100	2
7	PCC	18EIL77	ARM Processor Lab		--	2	2	03	40	60	100	2
8	Project	18EIP78	Project Work Phase - 1		--	--	2	--	100	--	100	1
9	Internship	--	Internship	(If not completed during the vacation of VI and VII semesters, it shall be carried out during the vacation of VII and VIII semesters)								
				TOTAL	**10**	**14**	**06**	**21**	**380**	**420**	**800**	**20**

Note: PCC: Professional core, PEC: Professional Elective, OEC: Open Elective

Professional Elective - 2

Course code under 18EI73X	Course Title
18EI731	Mechatronics
18EI732	Power Plant Instrumentation
18EI733	Advanced Control Systems
18EI734	Electrical Machines and Drives

Professional Electives - 3

Course code under 18EI74X	Course Title
18EI741	Smart Sensors and Intelligent Instrumentation
18EI742	Biomedical Signal Processing
18EI743	Computer Communication Networks
18EI744	Internet of Things

Open Elective -B

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (Please refer to the list of open electives under 18XX75X).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Project work:
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinaryproject can be assigned to an individual student or to a group having not more than 4 students. In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

CIE procedure for Project Work Phase - 1:
(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.
(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.
The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report(covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI
Scheme of Teaching and Examination 2018 – 19
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
(Effective from the academic year 2018 – 19)

Programme: ELECTRONICS AND INSTRUMENTATION ENGINEERING

VIII SEMESTER

Sl. No	Course and Course code		Course Title	Teaching Department	Teaching Hours /Week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P					
1	PCC	18EI81	Neural Network and Fuzzy Logic Systems	EI	2	2	--	03	40	60	100	3
2	PEC	18EI82X	Professional Elective - 4	EI	2	2	--	03	40	60	100	3
3	Project	18EIP83	Project Work Phase - 2	EI	--	--	2	03	40	60	100	8
4	Seminar	18EIS84	Technical Seminar	EI	--	--	2	03	100	--	100	1
5	Internship	18EII85	Internship	Completed during the vacation/s of VI and VII semesters and /or VII and VIII semesters.)				03	40	60	100	3
				TOTAL	**04**	**04**	**04**	**15**	**260**	**240**	**500**	**18**

Note: PCC: Professional Core, PEC: Professional Elective.

Professional Electives - 4

Course code under 18EI82X	Course Title
18EI821	Medical Imaging Techniques
18EI822	Industrial Process Instrumentation
18EI823	Instrumentation Buses and Industrial Data Networks
18EI824	Artificial Intelligence and Machine Learning

Project Work

CIE procedure for Project Work Phase - 2:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -2, shall be based on the evaluation of project work phase -2 Report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Project Work Phase - 2:

(i) Single discipline: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belongs to.

Internship: Those, who have not pursued /completed the internship, shall be declared as fail and have to complete during subsequent University examination after satisfying the internship requirements.

AICTE activity Points: In case students fail to earn the prescribed activity Points, Eighth semester Grade Card shall be issued only after earning the required activity Points. Students shall be admitted for the award of degree only after the release of the Eighth semester Grade Card.

Activity points of the students who have earned the prescribed AICTE activity Points shall be sent the University along with the CIE marks of 8th semester. In case of students who have not satisfied the AICTE activity Points at the end of eighth semester, the column under activity Points shall be marked NSAP (Not Satisfied Activity Points).

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (EI)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VI

OPEN ELECTIVE - A

Course Code	18EI65X	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Sl.NO.	Board and the Department offering the Electives		Course Sl. No.	Course code under 18EI65X	Course Title
	EI/ BM/ ML	Electronics and Instrumentation Engineering	1	18EI651	**Transducers and Process Instrumentation**
			2	18EI652	**Analytical Instrumentation**
			3	18EI653	**Optical Instrumentation**

B.E. ELECTRONICS AND INSTRUMENTATION ENGINEERING (EI)
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - VII

OPEN ELECTIVE - B

Course Code	18EI75X	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Sl. NO.	Board and the Department offering the Electives		Course Sl. No.	Course code under 18EI75X	Course Title
	EI/ BM/ ML	Electronics and Instrumentation Engineering	1	18EI751	**Medical Instrumentation**
			2	18EI752	**Robotics and Industrial Automation**
			3	18EI753	**Smart Sensors**

III SEMESTER

B. E. Common to all Programmes
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

TRANSFORM CALCULUS, FOURIER SERIES AND NUMERICAL TECHNIQUES

Course Code	**18MAT31**	CIE Marks	40
Teaching Hours/Week (L: T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To have an insight into Fourier series, Fourier transforms, Laplace transforms, Difference equations and Z-transforms.
- To develop the proficiency in variational calculus and solving ODE's arising in engineering applications, using numerical methods.

Module-1

Laplace Transform: Definition and Laplace transforms of elementary functions (statements only). Laplace transforms of Periodic functions (statement only) and unit-step function – problems.
Inverse Laplace Transform: Definition and problems, Convolution theorem to find the inverse Laplace transforms (without Proof) and problems. Solution of linear differential equations using Laplace transforms.

Module-2

Fourier Series: Periodic functions, Dirichlet's condition. Fourier series of periodic functions period 2π and arbitrary period. Half range Fourier series. Practical harmonic analysis.

Module-3

Fourier Transforms: Infinite Fourier transforms, Fourier sine and cosine transforms. Inverse Fourier transforms. Problems.
Difference Equations and Z-Transforms: Difference equations, basic definition, z-transform-definition, Standard z-transforms, Damping and shifting rules, initial value and final value theorems (without proof) and problems, Inverse z-transform and applications to solve difference equations.

Module-4

Numerical Solutions of Ordinary Differential Equations(ODE's):
Numerical solution of ODE's of first order and first degree- Taylor's series method, Modified Euler's method. Runge -Kutta method of fourth order, Milne's and Adam-Bash forth predictor and corrector method (No derivations of formulae)-Problems.

Module-5

Numerical Solution of Second Order ODE's: Runge-Kutta method and Milne's predictor and corrector method. (No derivations of formulae).
Calculus of Variations: Variation of function and functional, variational problems, Euler's equation, Geodesics, hanging chain, problems.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Use Laplace transform and inverse Laplace transform in solving differential/ integral equation arising in network analysis, control systems and other fields of engineering.
- CO2: Demonstrate Fourier series to study the behaviour of periodic functions and their applications in system communications, digital signal processing and field theory.
- CO3: Make use of Fourier transform and Z-transform to illustrate discrete/continuous function arising in wave and heat propagation, signals and systems.
- CO4: Solve first and second order ordinary differential equations arising in engineering problems using single step and multistep numerical methods.
- CO5:Determine the externals of functionals using calculus of variations and solve problems arising in dynamics of rigid bodies and vibrational analysis.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.

The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2016
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	44th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition, 2016
Reference Books				
1	Advanced Engineering Mathematics	C. Ray Wylie, Louis C. Barrett	McGraw-Hill Book Co	6th Edition, 1995
2	Introductory Methods of Numerical Analysis	S.S.Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B.V. Ramana	McGraw-Hill	11th Edition,2010
4	A Textbook of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	6th Edition, 2014
5	Advanced Engineering Mathematics	Chandrika Prasad and Reena Garg	Khanna Publishing,	2018

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

Semester - III			
Electronic Instrumentation and Measurements **(Common to EI, BM & ML)**			
Subject Code	**18EI/BM/ML32**	CIE Marks	: 40
Number of Lecture Hours/Week (L:T:P)	2:2:0	SEE Marks	: 60
Credits	03	Exam Hours	: 03

Course Learning Objectives: This course will enable the students to

- Impart with the knowledge of generalized measurement systems.
- Learn the characteristics of various types of measurement systems and errors in measuring instruments.
- Analyze the circuits for the measurement of Resistance, Capacitance, Inductance, and Frequency.
- Impart with the basic concepts of CRO and its usage for the measurement of various parameters.
- Understand the concepts of Ammeters, Voltmeter and Multimeters
- Understand the importance of Display Devices and Recorders in practical fields

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Measurements:** Introduction, Significance of measurements, methods of measurements, instruments and measurement systems, Functions of instruments and measurement systems, Applications of measurement systems.(Verify) **Measurement Errors:** Introduction Gross errors and systematic errors, Absolute and relative errors, basic concepts of accuracy, Precision, Resolution and Significant figures, Measurement error combinations. (relevant problems)	8 Hours	L1,L2
Module -2 **Ammeters, Voltmeter and Multimeters:** Introduction, DC ammeter principle only, DC voltmeter, Multi-range voltmeter, Extending voltmeter ranges, Loading, Peak responding and True RMS voltmeters. (relevant problems) **Digital Voltmeters:** Introduction, Ramp type, Dual slope integrating type (V–T), integrating type (V–F) and Successive approximation type (relevant problems). **Digital Instruments**: Introduction, Block diagram of a Basic Digital Multi-meter. Digital frequency meters: Basic circuit of a Digital frequency meter, Basic circuit for frequency measurement.	8 Hours	L1,L2,L3, L5
Module -3 **Oscilloscopes :** Introduction, Basic principles, CRT features, Block diagram and working of each block, Typical CRT connections, Dual beam and dual trace CROs, Electronic switch. **Analog storage oscilloscopes**: Need for trace storage, bistable storage CRT, Variable persistence storage CRT. **Digital storage oscilloscopes**: Basic DSO operation only.	8 Hours	L1,L2,L3, L4

Module -4 **Signal Generators :** Introduction, Fixed and variable AF oscillator, Standard signal generator, Modern laboratory signal generator, AF sine and Square wave generator, Function generator, Square and Pulse generator. **Bridge Circuits for Measurement of R, L & C:** **DC bridges**: Introduction, Wheatstone bridge, Kelvin Bridge **AC bridges**: Capacitance Comparison Bridge, inductance Comparison Bridge, Maxwell's bridge, Schering Bridge. (relevant problems)	8 Hours	L1,L2,L3,L5 ,L6
Module -5 **Display Devices and Recorders:** Introduction, electrical indicating instruments, digital instruments, digital display methods, digital display unit. Segmental Displays: Seven segmental display, dot matrices, LED, LCD, decade counting assemblies, display systems. Recorders: Recording requirements, analog recorders- Graphic recorders, strip chart recorders & its types, X-Y recorder, Magnetic & Digital tape recorders.	8 Hours	L1,L2,L3,L5

Course Outcomes: After studying this course, students will able to:

- Analyze instrument characteristics, errors and generalized measurement system.
- Analyze and use the circuit for the measurement of R, L, C, F, I, V etc
- Use of Ammeters, Voltmeter and Multimeters and CRO for measurement
- Analyze and interpret different signal generator circuits for the generation of various waveforms
- Understand and use different display devices and recorders

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Modern tool usage

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. "Electronic Instrumentation", H. S. Kalsi, TMH, 2004 (Module- 2,3 & 4)
2. "Electronic Instrumentation and Measurements", David A Bell, PHI / Pearson Education2006/ Oxford Higher Education, 2013. (Module 1 & 3)
3. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), Dhanpat Rai & Co. Pvt. Ltd., 2004.(Module- 1 & 5)

Reference Books:

1. "Principles of Measurement Systems", John P. Beately, 3rd Edition, Pearson Education, 2000
2. "Modern Electronic Instrumentation and Measuring Techniques", Cooper D & A D Helfrick, PHI, 1998.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Analog Electronic Circuits

(Common to EI, BM & ML)			
Subject Code	**18EI/BM/ML33**	CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	02+02	SEE Marks	: 60
Total Number of Lecture Hours	40	Exam Hours	: 03

Credits - 3

Course Learning Objectives: This course will enable the students to

- Describe the types of BJT/ FET biasing, and Demonstrate use of BJT/FET amplifiers
- Understand the modeling of BJT/FET for analysis and to Design of BJT/FET Amplifier,
- Understand and Demonstrate Generalize Frequency response of BJT and FET amplifiers.
- Design and analyze Power amplifier circuits.
- Understand the concept of Feedback and its effect on amplifier circuits and Oscillator circuits.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	(RBT)Level
Module -1 **DC Biasing – BJT's** Introduction, operating point, Fixed-Bias configuration, Emitter-bias configuration, Voltage-Divider Biasing, Emitter Follower Configuration. Relevant problems. **DC Biasing – FET's** Introduction, Fixed-Bias Configuration, Self-Bias Configuration, Voltage-Divider biasing, Numerical.	8 Hours	**L1 L2**
Module -2 BJT AC Analysis BJT modeling, re transistor model: Common Emitter fixed Configuration, Voltage-Divider Bias, CE Emitter-Bias Configuration (Excluding P-spice Analysis), Emitter Follower Configuration, Cascaded Systems. The Hybrid Equivalent model, Approximate Hybrid Equivalent Circuit, Fixed bias configuration, Voltage-Divider configuration. Hybrid π Model.	8 Hours	**L1 L2**
Module -3 **FET Amplifiers** Introduction, JFET Small Signal Model, JFET AC equivalent Circuit, Fixed-Bias Configuration, Self-Bias Configuration (with bypassed Rs only), Voltage-Divider Configuration, Source Follower Configuration. **BJT and JFET Frequency Response:** Introduction, General Frequency Considerations, Low Frequency Response of BJT Amplifier, Low Frequency Response of FET Amplifier, Miller Effect Capacitance, Multistage frequency effects.	8 Hours	**L1, L2, L3**
Module -4 **Power Amplifiers:-** Introduction: Definitions and Amplifier Types, Series Fed Class A Amplifier, Transformer Coupled Class A Amplifier, Class B Amplifier operation. Class B amplifier circuits:-Transformer-Coupled Push-Pull Circuits, Complementary–Symmetry Circuits only, Amplifier Distortion, Class C and Class D Amplifier.	8 Hours	**L1,L2, L3,L4**
Module -5	8 Hours	**L2, L3**

Feedback and Oscillator Circuits:- Feedback concepts, Feedback connection types, effects of negative feedback, practical feedback circuits: - FET based voltage series Feedback, BJT based current series, and FET based voltage shunt feedback. **Oscillator operation: -**Barkhaunsen's criteria, Tunedoscillator Circuits: BJT based Colpitts, Hartley and Crystal oscillator. Unijunction transistor oscillator		

Note:- **Relevant problems on all topics**

Course Outcomes: After studying this course, students will able to:

- Explain the biasing of BJT and FET
- Model BJT/FET for ac/dc analysis
- Design Single stage, Multistage amplifier, with and without feedback
- Analyze Frequency response of BJT and FET.
- Acquire the knowledge of classifications of Power amplifier, operation, and able to design power amplifier.
- Apply the knowledge gained in designing of BJT/FET/UJT based Oscillators.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions (partly)
- Interpretation of data

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Book:

Robert L. Boylestad and Louis Nashelsky, "Electronics devices and Circuit theory", Pearson, 10th Edition, 2009, ISBN:9788131727003

Reference Book:

David A. Bell, "Electronic Devices and Circuits", Oxford University Press

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Digital Design and HDL

(Common to EI, BM &ML)

Subject Code	: **18EI/BM/ML34**	IA Marks	: 40

Number of Lecture + Tutorial Hours/Week	: 02+02	Exam Marks	: 60
Total Number of Lecture Hours	:40	Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Course Learning Objectives: This course will enable the students to

- To impart the concepts of simplifying Boolean expression using K-map techniques and Quin-McCluskey minimization techniques.
- To impart the concepts of designing and analyzing combinational logic circuits.
- To impart design methods and analysis of sequential logic circuits.
- To impart the concepts of HDL-Verilog data flow and behavioral models for thedesign of digital systems.

Modules	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Principles of Combinational Logic:** Definition of combinational logic, Canonical forms, Generation of switching equations from truth tables, Karnaugh maps- up to 4 variables, Quine-McCluskey Minimization Technique.Quine-McCluskey using Don't Care Terms. (Text 1, Chapter 3).	L2 L3 L4
Module -2 **Logic Design with MSI Components and Programmable Logic Devices:** Binary Adders and Subtractors, Comparators, Decoders, Encoders, Multiplexers, Programmable Logic Devices (PLDs), Programmable Read only Memories (PROMS). (Text 2, Chapter 5)	L1 L2 L3
Module -3 **Flip-Flops:** Basic Bistable Elements, Latches, Timing Considerations, The Master-Slave Flip-flops (Pulse-Triggered flip-flops): SR flip-flops, JK flip flops, Edge Triggered Flip-flops, Characteristic equations. (Text 2, Chapter 6)	L1 L2 L3
Module -4 **Simple Flip-Flops Applications:** Registers, Binary Ripple Counters, Synchronous Binary Counters, Counters based on Shift Registers, Design of Synchronous mod-n Counter using clocked T , JK , D and SR flip-flops. (Text 2, Chapter 6)	L2 L3 L4
Module -5 **Introduction to Verilog:** Structure of Verilog module, Operators, Data Types, Styles of Description- Data flow description, Behavioral description. Implementation of half adder and full adder using Verilog data flow description. **Verilog Behavioral description:** Structure, Variable Assignment Statement, Sequential Statements, Loop Statements, Verilog Behavioral Description of Multiplexers (2:1,4:1,8:1). (Text 3, Chapters:1, 2, 3)	L3 L4 L5

Course Outcomes: After studying this course, students will able to:

- Simplify Boolean functions using K-map and Quine-McCluskey minimization technique
- Analyze and design for combinational logic circuits.
- Analyze the concepts of Latches and Flip Flops. (SR, D, T and JK).
- Analyze and design the synchronous sequential circuits.
- Implement Combinational circuits(adders, subtractors, multiplexers) using Verilog descriptions.

Graduate Attributes (as per NBA)

- Engineering knowledge

- Problem analysis
- Design & Development of Solutions
- Modern tool usage

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Book:

1. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001
2. Digital Principles and Design by Donald D. Givone, McGraw Hill, 2002.
3. HDL Programming VHDL and Verilog by Nazeih M. Botros, 2009 reprint, Dreamtech press.

Reference Books:

1. Fundamentals of logic design, by Charles H Roth Jr., Cengage Learning
2. Digital Principles and Design – Donald D Givone,12th reprint, TMH,2008
3. Logic Design, Sudhakar Samuel, Pearson/ Saguine, 2007
4. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010

Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Transducers and Instrumentation

Subject Code	**18EI35**	CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	02+02	SEE Marks	: 60
Total Number of Lecture Hours	40	Exam Hours	: 03

Credits - 3

Course Learning Objectives:

- To provide the fundamental knowledge of transducers, instrumentation and measurement

systems.

- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analysing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Classification and Functional Elements of Instrument/ measurement system:** Measurement, significance of measurement, instruments and measurement systems, mechanical, electrical and electronic instruments (Common to EIM), Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs. Transducers, Classifications of transducers-primary & secondary, active & passive, analog and digital transducers.	8 Hours	L1, L2
Module -2 **Static and Dynamic Characteristics:** Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, sensitivity, linearity, hysteresis, threshold, dead zone and dead time, resolution, signal to noise ratio, factors influencing the choice of transducers/instruments. Dynamic response – dynamic characteristics, time domain analysis &different types of inputs, frequency domain analysis. Time domain response – zero order system, first order system, response of a first order system to step & ramp input, frequency response of first order system.	8 Hours	L1, L2, L3, L4
Module -3 **Measurement of Displacement:** Introduction, Principles of Transduction, Variable resistance devices, variable Inductance Transducer, Variable Capacitance Transducer, Hall Effect Devices, Proximity Devices, Digital Transducer **Measurement of Level:** Capacitance probes, conductivity probes, differential pressure level detector, float level devices, optical level switches, ultrasonic level detector, thermal level sensors	8 Hours	L1, L2, L3, L4
Module -4 **Measurement of Strain:** Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, semiconductor strain gauges (principle, types & list of characteristics only), Strain gauge Circuits	8 Hours	L1, L2, L3, L4

– Wheatstone bride circuit, Applications. **Measurement of Force & Torque**: Introduction, Force measuring sensor – Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, Electronic weighing system. Torque measurement: Absorption type, transmission type, stress type & deflection type.		
Module -5 **Measurement of Pressure**: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle & working, no derivation), force balance transducer with analysis, piezoelectric pressure transducer, pressure multiplexer, pressure calibration. **Miscellaneous Sensors**: Noise (sound) Sensors, Speed Sensors, Thickness Measurement.	8 Hours	L1, L2, L3, L4

Course Outcomes: After studying this course, students will able to:

- Define the transducer, instrument, measurement and classify different types of transducers
- Explain the functional elements of instrumentation / measurement systems
- Discuss the input-output configuration of measurement systems
- Define, interpret and analyze the static and dynamic characteristics of instruments
- Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Engineer and society
- Environment & sustainability
- Lifelong learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question fromeachmodule.

Text Books:

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd., 2004. (Module 1 & 2)
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3-Displacement measurement, Module 4, Module 5 – Measurement of pressure)
3. Process Measurement Instrument Engineers Handbook- BelaG.Liptak, Revised Edition, Chilton Book Company, 1982. (Module 3 – Level measurement, Module 5- Miscellaneous Sensors)

Reference Books:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
3. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.

4. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik, 5th Edition, McGraw Hill, 2007

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester – III				
Network Analysis **(Common to EI, BM & ML)**				
Subject Code	: 18EI/BM/ML36		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 03+02		SEE Marks	: 60
Total Number of Lecture Hours	: 50		Exam Hours	: 03
Credits –4 (Each module 10 Hrs)				
Course Learning Objectives: This course will enable the students to • To introduce the Basic circuit laws, Network theorems and analyze the networks. • To analyze the networks by using optimized methods				

- To analyze the network behavior during switching states.
- To realize the network parameters.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Basic concepts**: Sources of electrical energy, Source transformation, Loop and node analysis with dependent & independent sources for DC networks, concept of super node and super mesh analysis for only independent sources for DC networks. Numerical on all Topics	10 Hours	L1, L2, L3, L4
Module -2 **Network theorems**: Super position, reciprocity, Millman's theorem Thevinin's& Norton's theorem (for DC networks only), Maximum power transfer theorem (for AC & DC networks) Numerical on all Topics	10 Hours	L1, L2, L3, L4
Module -3 **Transient behavior and initial conditions**: Behavior of circuit elements under switching condition and their representation, evaluation of initial & final conditions in RL, RC &RLC circuits for DC excitations. **Two port network parameters**: Definitions and modeling of Z, Y, H & transmission parameters Numerical on all Topics	10 Hours	L1, L2, L3, L4
Module -4 **Resonant Circuits**: Series resonance: Variation of current and voltage with frequency, Selectivity & Bandwidth, Q-factor Parallel resonance: General case-resistance present in both branches, Selectivity & Bandwidth. Numerical on all Topics	10 Hours	L1, L2, L3, L4
Module -5 **Network topology**: Graph of a network, concepts of: tree & co-tree, incidence matrix, tie-set & cut-set schedules,Principle of duality. Numerical on all Topics	10 Hours	L1, L2, L3, L4

Course Outcomes: After studying this course, students will able to:

- Apply the basic concepts (Laws, theorems) of networks to obtain solution.
- Choose the appropriate/specific technique to analyze the networks.
- Realize and Analyze the network behavior

Graduate Attributes (as per NBA)

- Applying the Engineering concepts to analyze the networks
- Realizing and solving the complex circuits

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- In each full question, preferably 40% should be related to theoretical concepts/derivations and 60% should be related problems/solutions.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.

- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Engineering Circuit Analysis, William H Hayt et al, McGraw Hill, 8th Edition.
2. Networks and Systems, D Roy Choudhury, New Age International Publishers, 3rd Edition.
3. Network Analysis, M.E. Van Valkenburg, Prentice-Hall, 3rd Edition.

Reference Books:

1. Introduction to Electric circuits, Richard C Dorf & James A Svoboda, Wiley, 9th Edition.
2. Electric Circuits, Mahmood Nahvi, McGraw Hill, 9th Edition

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Analog Electronic Circuits Lab

(Common to EI, BM & ML)

Subject Code	**18 EI/BM/ML L37**	CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	02+02	SEE Marks	: 60
Total Number of Practical Hours	42	Exam Hours	: 03

Credits - 2

Course Learning Objectives:

This laboratory course enables students to get practical knowledge & experience in design, assembly and evaluation/testing of

- Rectifier circuits without and with filter
- BJT as Amplifier without and with feedback
- JFET Characteristics and as Amplifier.
- MOSFET Characteristics
- BJT as Power Amplifiers
- Oscillators using BJT and FET for frequency generation
- UJT characteristics
- Verification of Theorems and applications in practical fields

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Laboratory Experiments NOTE: The experiments are to be carried using discrete components only	**Revised Bloom's Taxonomy (RBT)Level**
1. To design and test Full Wave Rectifier (with center tap transformer) with and without filters.	L3, l4, L5, L6
2. To design and test Full Wave Bridge Rectifier with and without filters.	L3, l4, L5, L6
3. To plot characteristics of UJT and to determine its intrinsic stand-off ratio.	L1, L2, L3, L4
4. To design and test the common emitter amplifier (voltage divider bias) without feedback and determine input, output impedance, gain and bandwidth.	L3, l4, L5, L6
5. To design and test the Emitter follower amplifier (BJT) using voltage divider bias and determine input, output impedance, gain and bandwidth.	L3, l4, L5, L6
6. To plot the Drain and Transfer characteristic for the given FET and to find the Drain Resistance and Trans-conductance.	L1, L2, L3, L4
7. To plot the input and output characteristics of n-channel MOSFET and calculatedrain resistance, mutual conductance and amplification factor.	L3, l4, L5, L6
8. To design, test and plot the frequency response of Common Source JFET/MOSFET amplifier, and to determine its bandwidth.	L1, L2, L3, L4
9. Wiring and testing of Complimentary symmetry class B push pull power amplifier and calculation of efficiency.	L1, L2, L3, L4
10. To design and test the RC-Phase shift Oscillator using BJT for the given frequency.	L3, L4, L5, L6
11. To design and test the following tuned oscillator circuits for the given frequency. (a) Hartley Oscillator using BJT (b) Colpitts Oscillator using FET.	L3, L4, L5, L6
12. Testing of crystal oscillator and to determine its frequency of oscillation.	L1, L2, L3, L4

Course Outcomes: After studying this course, students will able to:

- Able to design Single stage, Multistage amplifier, with and without feedback
- Able to analyze Frequency response of BJT and FET.
- Acquire the knowledge of Power amplifiers, operation, and able to design power amplifier.
- Apply the knowledge gained in the design of BJT/FET circuits in Oscillators

- Knowledge of UJT characteristics and its application.
- Applications of theorems in various practical fields.

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.
- Design / development of solutions (partly)

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

1. Electronics Lab Manual by K. A. Navas, Volume I, PHI, 5th Edition, 2017, ISBN:9788120351424.
2. Electronics Laboratory Primer - A Design Approach by S.Poorna Chandra, B.Sasikala, S Chand Pub.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - III

Digital Design and HDL Lab

(Common to EI, BM & ML)

Subject Code	: **18 EI/BM/ML L38**	CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	: 02+02	SEE Marks	: 60
Total Number of Practical Hours	: 42	Exam Hours	: 03

Credits - 2

Course Learning Objectives: This course will enable the students to

- The operation of various logic gates and digital circuits and write the Verilog code.

- Design of logic circuits for combinational and sequential circuits and write Verilog code.
- Synthesis of digital circuits, FFs, shift registers and counters using ICs.
- To use FPGA/CPLD kits for downloading the Verilog code and test the output.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Laboratory Experiments: **Note:** **(1)** Use discrete components to test and verify the logic gates. (2) Use FPGA/CPLD kits for down loading the Verilog code and test the output.	**Revised Bloom's Taxonomy (RBT) Level**
1. Simplification, realization of Boolean expressions using logic gates/Universal gates	L1,L2,L3
2. To design and implement a) Adder/Subtractor – Full/half using logic gates. b) 4-bit Parallel Adder/ subtractor using IC 7483.	L3, L4, L5,L6
3. To realize a) BCD to Excess-3 code conversion and vice versa b) Binary to Gray code conversion and vice versa	L2,L3, L4
4. To realize a) 4:1 Multiplexer using gates b) 1:8 Demux c) Priority encoder and 3:8 Decoder using IC74138 d) One / Two bit comparator	L2, L3, L4
5. To realize the following flip-flops using NAND Gates (a) T type (b) JK Master slave (c) D type	L2, L3, L4
6. To realize the 3-bit counters as a sequential circuit and Mod-N Counter design (7476, 7490, 74192, 74193)	L2, L3, L4
7. Adder/Subtractor – Full/half using Verilog data flow description	L2, L3, L4
8. Code converters using Verilog Behavioral description a) Gray to binary and vice versa b) Binary to excess3 and vice versa	L2, L3, L4
9. Multiplexers/decoders/encoder using Verilog Behavioral description - 8:1 mux, 3:8 decoder, 8:3 encoder, Priority encoder - 1:8 Demux and verify using test bench - 2-bit Comparator using behavioral description	L2, L3, L4
10. Flip-flops using Verilog Behavioral description a) JK type b) SR type c) T type and d) D type	L2, L3, L4
11. Counter up/down (BCD and binary) , sequential counters using Verilog Behavioral description	L2,L3, L4
12. Interface experiments: (a) Stepper motor (b) Relay (c) Waveform generation using DAC	L2,L3, L4

Course Outcomes: After studying this course, students will able to:

- Realize Boolean expression using Universal gates / basic gates using ICs and Verilog
- Demonstrate the function of adder/subtractor circuits using gates/ICs & Verilog.
- Design and analyze the Comparator, Multiplexers Decoders, Encoders circuits using ICs and Verilog.
- Design and analysis of different Flip-flops and counters using gates and FFs
- Able to use FPGA/CPLD kits for down loading Verilog codes for shift registers and counters and check output.

Graduate Attributes (as per NBA)

- Engineering Knowledge.

- Problem Analysis.
- Design/Development of solutions

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero

Reference Books:

1. Digital Principles and Design – Donald D Givone,12th reprint, TMH,2008
2. HDL Programming VHDL and Verilog By Nazeih M. Botros, 2009 reprint, Dreamtech press.
3. Digital Logic Applications and Design by John M Yarbrough, Thomson Learning,2001
4. Fundamentals of HDL- Cyril P R Pearson/Sanguin 2010

B. E. Common to all Programmes Outcome Based Education (OBE) and Choice Based Credit System (CBCS) SEMESTER –II / III / IV			
Aadalitha Kannada			
Course Code	**18KAK28/39/49**	CIE Marks	100
Teaching Hours/Week (L:T:P)	(0:2:0)		
Credits	01		

DqÀ½vÀ PÀ£ÀßqÀ PÀ°PÉAiÀÄ GzÉÝÃ±ÀUÀ¼ÀÄ:

- ¥ÀzÀ« «zÁåyð¼ÁVgÀÄªÀÅzÀjAzÀ DqÀ½vÀ PÀ£ÀßqÀzÀ ¥ÀjZÀAiÀÄ ªÀiÁrPÉÆqÀÄªÀÅzÀÄ.
- «zÁåyðUÀ¼À°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ ªÁåPÀgÀtzÀ §UÉÎ CjªÀÅ ªÀÄÆr¸ÀÄªÀÅzÀÄ.
- PÀ£ÀßqÀ ¨sÁµÁ gÀZÀ£ÉAiÀÄ°è£À ¤AiÀÄªÀÄUÀ¼À£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀÅzÀÄ.
- PÀ£ÀßqÀ ¨sÁµÁ §gÀºÀzÀ°è PÀAqÀÄ§gÀÄªÀ zÉÆÃµÀUÀ¼ÀÄ ºÁUÀÆ CªÀÅUÀ¼À ¤ªÁgÀuÉ. ªÀÄvÀÄÛ ¯ÉÃR£À aºÉßUÀ¼À£ÀÄß ¥ÀjZÀ¬Ä¸ÀÄªÀÅzÀÄ.
- ¸ÁªÀiÁ£Àå CfðUÀ¼ÀÄ, ¸ÀPÁðj ªÀÄvÀÄÛ CgÉ ¸ÀPÁðj ¥ÀvÀæªÀåªÀºÁgÀzÀ §UÉÎ CjªÀÅ ªÀÄÆr¸ÀÄªÀÅzÀÄ.
- ¨sÁµÁAvÀgÀ ªÀÄvÀÄÛ ¥Àæ§AzsÀ gÀZÀ£É §UÉÎ C¸ÀQÛ ªÀÄÆr¸ÀÄªÀÅzÀÄ.
- PÀ£ÀßqÀ ¨sÁµÁ¨sÁå¸À ªÀÄvÀÄÛ ¸ÁªÀiÁ£Åå PÀ£ÀßqÀ ºÁUÀÆ DqÀ½vÀ PÀ£ÀßqÀzÀ ¥ÀzÀUÀ¼À ¥ÀjZÀAiÀÄ ªÀiÁrPÉÆqÀÄªÀÅzÀÄ.

¥Àj«r (¥ÀoÀå¥ÀÄ¸ÀÛPÀzÀ°ègÀÄªÀ «µÀAiÀÄUÀ¼À ¥ÀnÖ)

CzsÁåAiÀÄ – 1 PÀ£ÀßqÀ¨sÁµÉ – ¸ÀAQë¥ÀÛ «ªÀgÀuÉ.
CzsÁåAiÀÄ – 2 ¨sÁµÁ ¥ÀæAiÉÆÃUÀzÀ¯ÁèUÀÄªÀ ¯ÉÆÃ¥ÀzÉÆÃµÀUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À ¤ªÁgÀuÉ.
CzsÁåAiÀÄ – 3 ¯ÉÃR£À aºÉßUÀ¼ÀÄ ªÀÄvÀÄÛ CªÀÅUÀ¼À G¥ÀAiÉÆÃUÀ.
CzsÁåAiÀÄ – 4 ¥ÀvÀæ ªÀåªÀºÁgÀ.
CzsÁåAiÀÄ – 5 DqÀ½vÀ ¥ÀvÀæUÀ¼ÀÄ.
CzsÁåAiÀÄ – 6 ¸ÀPÁðgÀzÀ DzÉÃ±À ¥ÀvÀæUÀ¼ÀÄ.
CzsÁåAiÀÄ – 7 ¸ÀAQë¥ÀÛ ¥Àæ§AzsÀ gÀZÀ£É (¦æ¸ÉÊ¸ï gÉÊnAUï), ¥Àæ§AzsÀ ªÀÄvÀÄÛ ¨sÁµÁAvÀgÀ.
CzsÁåAiÀÄ – 8 PÀ£ÀßqÀ ±À§Ý¸ÀAUÀæºÀ.
CzsÁåAiÀÄ – 9 PÀA¥ÀÆålgï ºÁUÀÆ ªÀiÁ»w vÀAvÀæeÁÕ£À.
CzsÁåAiÀÄ – 10 ¥Áj¨sÁ¶PÀ DqÀ½vÀ PÀ£ÀßqÀ ¥ÀzÀUÀ¼ÀÄ ªÀÄvÀÄÛ vÁAwæPÀ/ PÀA¥ÀÆålgï ¥Áj¨sÁ¶PÀ ¥ÀzÀUÀ¼ÀÄ.

DqÀ½vÀ PÀ£ÀßqÀ PÀ°PÉAiÀÄ ¥sÀ°vÁA±ÀÀUÀ¼ÀÄ:

- DqÀ½vÀ ¨sÁµÉ PÀ£ÀßqÀzÀ ¥ÀjZÀAiÀÄªÁUÀÄvÀÛzÉ.
- «zÁåyðUÀ¼À°è PÀ£ÀßqÀ ¨sÁµÉAiÀÄ ªÁåPÀgÀtzÀ §UÉÎ CjªÀÅ ªÀÄÆqÀÄvÀÛzÉ.
- PÀ£ÀßqÀ ¨sÁµÁ gÀZÀ£ÉAiÀÄ°è£À ¤AiÀÄªÀÄUÀ¼ÀÄ ªÀÄvÀÄÛ ¯ÉÃR£À aºÉßUÀ¼ÀÄ ¥ÀjZÀ¬Ä¸À®àqÀÄvÀÛªÉ.
- ¸ÁªÀiÁ£Åå CfðUÀ¼ÀÄ, ¸ÀPÁðj ªÀÄvÀÄÛ CgÉ ¸ÀPÁðj ¥ÀvÀæªÀåªÀºÁgÀzÀ §UÉÎ CjªÀÅ ªÀÄÆqÀÄvÀÛzÉ.
- ¨sÁµÁAvÀgÀ ªÀÄvÀÄÛ ¥Àæ§AzsÀ gÀZÀ£É §UÉÎ C¸ÀQÛ ªÀÄÆqÀÄvÀÛzÉ.
- PÀ£ÀßqÀ ¨sÁµÁ¨sÁå¸À ªÀÄvÀÄÛ ¸ÁªÀiÁ£Åå PÀ£ÀßqÀ ºÁUÀÆ DqÀ½vÀ PÀ£ÀßqÀzÀ ¥ÀzÀUÀ¼ÀÄ ¥ÀjZÀ¬Ä¸À®àqÀÄvÀÛªÉ.

¥ÀjÃPÉëAiÀÄ «zsÁ£À : ¤gÀAvÀgÀ DAvÀjPÀ ªÀiË®åªÀiÁ¥À£À - CIE **(Continuous Internal Evaluation):**

PÁ¯ÉÃdÄ ªÀÄlÖzÀ°èAiÉÄ DAvÀjPÀ ¥ÀjÃPÉëAiÀÄ£ÀÄß 100 CAPÀUÀ½UÉ «±Àé«zÁå®AiÀÄzÀ

¤AiÀÄªÀÄUÀ¼ÀÄ ªÀÄvÀÄÛ ¤zÉðÃ±À£ÀzÀAvÉ £ÀqÉ¸ÀvÀPÀÌzÀÄÝ.

¥ÀoÀå¥ÀÄ¸ÀÛPÀ : DqÀ½vÀ PÀ£ÀßqÀ ¥ÀoÀå ¥ÀÄ¸ÀÛPÀ (Kannada for Administration)

¸ÀÀA¥ÁzÀPÀgÀÄ

qÁ. J¯ï. wªÉÄäÃ±À

¥ÉÆæ. «. PÉÃ±ÀªÀªÀÄÆwð

¥ÀæPÀluÉ : ¥Àæ¸ÁgÁAUÀ, «±ÉéÃ±ÀégÀAiÀÄå vÁAwæPÀ «±Àé«zÁå®AiÀÄ, ¨É¼ÀUÁ«.

B. E. Common to all Programmes **Outcome Based Education (OBE) and Choice Based Credit System (CBCS)** **SEMESTER –II & III/IV**			
Vyavaharika Kannada			
Course Code	**18KVK28/39/49**	CIE Marks	100
Teaching Hours/Week (L:T:P)	(0:2:0)		
Credits	01		

Course Learning Objectives:
The course will enable the students to understand Kannada and communicate in Kannada language.

Table of Contents:
Chapter - 1: Vyavaharika kannada – Parichaya (Introduction to Vyavaharika Kannada).
Chapter - 2: Kannada Aksharamale haagu uchcharane (Kannada Alpabets and Pronunciation).
Chapter - 3: Sambhashanegaagi Kannada Padagalu (Kannada Vocabulary for Communication).
Chapter - 4: Kannada Grammar in Conversations (Sambhashaneyalli Kannada Vyakarana).
Chapter - 5: Activities in Kannada.

Course Outcomes:
At the end of the course, the student will be able to understand Kannada and communicate in Kannada language.

¥ÀjÃPÉëAiÀÄ «zsÁ£À : ¤gÀAvÀgÀ DAvÀjPÀ ªÀiË®åªÀiÁ¥À£À - CIE **(Continuous Internal Evaluation):**

PÁ¯ÉÃdÄ ªÀÄlÖzÀ°èAiÉÄ DAvÀjPÀ ¥ÀjÃPÉëAiÀÄ£ÀÄß 100 CAPÀUÀ½UÉ «±Àé«zÁå®AiÀÄzÀ

¤AiÀÄªÀÄUÀ¼ÀÄ ªÀÄvÀÄÛ ¤zÉðÃ±À£ÀzÀAvÉ £ÀqÉ¸ÀvÀPÀÌzÀÄÝ.

Textbook (¥ÀoÀå¥ÀÄ¸ÀÛPÀ): ªÁåªÀºÁjPÀ PÀ£ÀßqÀ ¥ÀoÀå ¥ÀÄ¸ÀÛPÀ (Vyavaharika Kannada Text Book)

¸ÀÀA¥ÁzÀPÀgÀÄ
qÁ. J¯ï. wªÉÄäÃ±À
¥ÉÆæ. «. PÉÃ±ÀªÀªÀÄÆwð

¥ÀæPÀluÉ : ¥Àæ¸ÁgÁAUÀ, «±ÉéÃ±ÀégÀAiÀÄå vÁAwæPÀ «±Àé«zÁå®AiÀÄ, ¨É¼ÀUÁ«.

B. E. Common to all Programmes
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - III

CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW (CPC)

Course Code	**18CPC39/49**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(1:0:0)	SEE Marks	60
Credits	01	Exam Hours	02

Course Learning Objectives: To

- know the fundamental political codes, structure, procedures, powers, and duties of Indian government institutions, fundamental rights, directive principles, and the duties of citizens
- Understand engineering ethics and their responsibilities; identify their individual roles and ethical responsibilities towards society.
- Know about the cybercrimes and cyber laws for cyber safety measures.

Module-1

Introduction to Indian Constitution:
The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian constitution, The Making of the Constitution, The Role of the Constituent Assembly - Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and significance in Nation building.

Module-2

Union Executive and State Executive:
Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives – Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Articles 370.371,371J) for some States.

Module-3

Elections, Amendments and Emergency Provisions:
Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73,74, ,75, 86, and 91,94,95,100,101,118 and some important Case Studies. Emergency Provisions, types of Emergencies and its consequences.

Constitutional special provisions:
Special Provisions for SC and ST, OBC, Women, Children and Backward Classes.

Module-4

Professional / Engineering Ethics:
Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, and Professional Responsibility.

Clash of Ethics, Conflicts of Interest. Responsibilities in Engineering Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering

Module-5

Internet Laws, Cyber Crimes and Cyber Laws:
Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship. Cybercrimes and enforcement agencies.

Course Outcomes: On completion of this course, students will be able to,

CO 1: Have constitutional knowledge and legal literacy.
CO 2: Understand Engineering and Professional ethics and responsibilities of Engineers.
CO 3: Understand the the cybercrimes and cyber laws for cyber safety measures.

Question paper pattern for SEE and CIE:

- The SEE question paper will be set for 100 marks and the marks scored by the students will proportionately be reduced to 60. The pattern of the question paper will be objective type (MCQ).
- For the award of 40 CIE marks, refer the University regulations 2018.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Constitution of India, Professional Ethics and Human Rights	Shubham Singles, Charles E. Haries, and et al	Cengage Learning India	2018
2	Cyber Security and Cyber Laws	Alfred Basta and et al	Cengage Learning India	2018
Reference Books				
3	Introduction to the Constitution of India	Durga Das Basu	Prentice –Hall,	2008.
4	Engineering Ethics	M. Govindarajan, S. Natarajan, V. S. Senthilkumar	Prentice –Hall,	2004

B. E. Common to all Programmes
Choice Based Credit System (CBCS) and Outcome Based Education (OBE)
SEMESTER - III

ADDITIONAL MATHEMATICS – I

(Mandatory Learning Course: Common to All Programmes)

(A Bridge course for Lateral Entry students under Diploma quota to BE/B. Tech programmes)

Course Code	**18MATDIP31**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	0	Exam Hours	03

Course Learning Objectives:

- To provide basic concepts of complex trigonometry, vector algebra, differential and integral calculus.
- To provide an insight into vector differentiation and first order ODE's.

Module-1

Complex Trigonometry: Complex Numbers: Definitions and properties. Modulus and amplitude of a complex number, Argand's diagram, De-Moivre's theorem (without proof).

Vector Algebra: Scalar and vectors. Addition and subtraction and multiplication of vectors- Dot and Cross products, problems.

Module-2

Differential Calculus: Review of successive differentiation-illustrative examples. Maclaurin's series expansions-Illustrative examples. Partial Differentiation: Euler's theorem-problems on first order derivatives only. Total derivatives-differentiation of composite functions. Jacobians of order two-Problems.

Module-3

Vector Differentiation: Differentiation of vector functions. Velocity and acceleration of a particle moving on a space curve. Scalar and vector point functions. Gradient, Divergence, Curl-simple problems. Solenoidal and irrotational vector fields-Problems.

Module-4

Integral Calculus: Review of elementary integral calculus. Reduction formulae for $\sin^n x$, $\cos^n x$ (with proof) and $\sin^m x \cos^n x$ (without proof) and evaluation of these with standard limits-Examples. Double and triple integrals-Simple examples.

Module-5

Ordinary differential equations (ODE's. Introduction-solutions of first order and first degree differential equations: exact, linear differential equations. Equations reducible to exact and Bernoulli's equation.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Apply concepts of complex numbers and vector algebra to analyze the problems arising in related area.
- CO2: Use derivatives and partial derivatives to calculate rate of change of multivariate functions.
- CO3: Analyze position, velocity and acceleration in two and three dimensions of vector valued functions.

- CO4: Learn techniques of integration including the evaluation of double and triple integrals.
- CO5: Identify and solve first order ordinary differential equations.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015
Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics	N.P.Bali and Manish Goyal	Laxmi Publishers	7th Edition, 2007
3	Engineering Mathematics Vol.I	Rohit Khurana	Cengage Learning	1st Edition, 2015

IV SEMESTER

B. E. Common to all Programmes
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - IV

COMPLEX ANALYSIS, PROBABILITY AND STATISTICAL METHODS

Course Code	**18MAT41**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Course Learning Objectives:

- To provide an insight into applications of complex variables, conformal mapping and special functions arising in potential theory, quantum mechanics, heat conduction and field theory.
- To develop probability distribution of discrete, continuous random variables and joint probability distribution occurring in digital signal processing, design engineering and microwave engineering.

Module-1

Calculus of complex functions: Review of function of a complex variable, limits, continuity, and differentiability. Analytic functions: Cauchy-Riemann equations in cartesian and polar forms and consequences. Construction of analytic functions: Milne-Thomson method-Problems.

Module-2

Conformal transformations: Introduction. Discussion of transformations: $w=z^2$, $w=e^z$, $w=z+\frac{1}{z},(z\neq 0)$. Bilinear transformations- Problems.

Complex integration: Line integral of a complex function-Cauchy's theorem and Cauchy's integral formula and problems.

Module-3

Probability Distributions: Review of basic probability theory. Random variables (discrete and continuous), probability mass/density functions. Binomial, Poisson, exponential and normal distributions- problems (No derivation for mean and standard deviation)-Illustrative examples.

Module-4

Curve Fitting: Curve fitting by the method of least squares- fitting the curves of the form-

$y=ax+b, y=ax^b$ & $y=ax^2+bx+c.$

Statistical Methods: Correlation and regression-Karl Pearson's coefficient of correlation and rank correlation-problems. Regression analysis- lines of regression –problems.

Module-5

Joint probability distribution: Joint Probability distribution for two discrete random variables, expectation and covariance.

Sampling Theory: Introduction to sampling distributions, standard error, Type-I and Type-II errors. Test of hypothesis for means, student's t-distribution, Chi-square distribution as a test of goodness of fit.

Course Outcomes: At the end of the course the student will be able to:

- CO1: Use the concepts of analytic function and complex potentials to solve the problems arising in electromagnetic field theory.
- CO2: Utilize conformal transformation and complex integral arising in aerofoil theory, fluid flow visualization and image processing.
- CO3: Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- CO4: Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data.
- CO5: Construct joint probability distributions and demonstrate the validity of testing the hypothesis.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.

- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbooks				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition,2016
2	Higher Engineering Mathematics	B. S. Grewal	Khanna Publishers	44th Edition, 2017
3	Engineering Mathematics	Srimanta Pal et al	Oxford University Press	3rd Edition,2016
Reference Books				
1	Advanced Engineering Mathematics	C. Ray Wylie, Louis C. Barrett	McGraw-Hill	6th Edition 1995
2	Introductory Methods of Numerical Analysis	S. S. Sastry	Prentice Hall of India	4th Edition 2010
3	Higher Engineering Mathematics	B.V. Ramana	McGraw-Hill	11th Edition,2010
4	A Textbook of Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publications	6th Edition, 2014
5	Advanced Engineering Mathematics	Chandrika Prasad and Reena Garg	Khanna Publishing,	2018

Web links and Video Lectures:

1. http://nptel.ac.in/courses.php?disciplineID=111
2. http://www.class-central.com/subject/math(MOOCs)
3. http://academicearth.org/
4. VTU EDUSAT PROGRAMME - 20

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – IV

Signal Conditioning and Data Acquisition Circuits

(Common to EI, BM & ML)

Subject Code	: **18 EI/BM/ML42**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3

Course Learning Objectives: This course will enable the students to

- Define and describe Op Amp, basic concepts, characteristics and specifications
- Gain knowledge about Linear and nonlinear applications op-amp.
- Design and develop circuits like, amplifiers, filters, Timers to meet industrial requirements.
- Get a firm grasp of basic principles of op-amp.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 – Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Introduction to Operational Amplifiers:** Introduction, Block schematic of an Op-amp, Power supply connections, Characteristics of an Ideal OP-AMP, Inverting Amplifier, Non-inverting Amplifier, Voltage follower, Differential Amplifier, CMRR. (Relevant problems). **Operational Amplifier Characteristics**: DC characteristics – Input bias current, Input offset current, Input offset voltage, Total output offset voltage, Thermal drift. AC characteristics – Frequency response, Slew rate, PSRR. **Basic op-amp applications** – Scale changer/Inverter. Summing amplifier: Inverting summing amplifier, Non-inverting Summing amplifier, Subtractor, Instrumentation Amplifier. (Relevant problems).	8 Hours	L1,L2, L3,L4
Module -2 **Operational Amplifier Applications:** V – I and I – V converter, Op-amp circuit using diodes, sample and hold circuit, Differentiator and Integrator. **Comparator and waveforms generator:** Comparator, Regenerative comparator (Schmitt Trigger), Astable mutivibrator, Monostable multivibrator and Triangular waveform generator. Phase shift oscillator, Wien bridge oscillator. (Relevant problems).	8 Hours	L1,L2, L3,L4
Module -3 **Voltage Regulators:** Introduction, Series Op-amp regulator, IC voltage regulators, 723 general purpose regulators, switching regulator. **Active filters:** First and Second order LPF, First and Second orders HPF, Band Pass Filters, Band Reject filters. (Design examples).	8 Hours	L1,L2, L3,L4
Module -4	8 Hours	L2,L3,L4, L5,

555 Timer: Description of Functional Diagram, Monostable operation, Applications of Monostable Multivibrator: Frequency Divider & Pulse Width Modulation. Astable operation, Applications of Astable Multivibrator: FSK Generator and Pulse Position Modulation. **Phase Locked Loops:** Basic Principles, Analog phase Detector/comparator, Voltage controlled oscillator.PLL applications: Frequency Multiplication/Division, Frequency translation, FM demodulation.		L6
Module -5 **Data Acquisition Systems:** Types of instrumentation systems, Components of analog data acquisition system, Digital data acquisition system. **Data Converters:** **Digital to Analog Converters:** Basic DAC techniques, Weighted Resistor DAC, R – 2R Ladder DAC, DAC 0800 (Data sheet: Features and description only). **Analogto Digital Converters:** Functional diagram of ADC, Flash ADC, Counter type ADC, Successive approximation ADC, Dual slope ADC. ADC 0809 (Data sheet: Features, specifications and description only), DAC/ADC specifications.	8 Hours	L2, L3,L4, L5, L6

Course Outcomes: After studying this course, students will able to:

1. Understand the basic principles and operation of op-amp.
2. Design and develop circuits to meet the practical applications
3. Implement and integrate the op-amp circuits in electronic gadgets.

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & development of solutions
- Investigation of Complex Problem

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International. (Module -1,2,3,4 & 5)
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI (Module-3)
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, Dhanpat Rai Publications, 19th edition, 2011.(Module-5)

Reference Books:

1. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin & Fred. F. Driscoll, PHI/Pearson, 2006
2. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
3. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

Choice Based Credit System (CBCS)
Semester - IV

Embedded Controllers

(Common to EI, BM & ML)

Subject Code	**18 EI/BM/ML 43**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total number of lecture hours	: 40		Exam hours	: 03

Credits - 3

Course Learning Objectives: This course enables students to understand:

- Basics of Microprocessor and Microcontroller
- 8051 Microcontroller architecture and Pin description
- 8051 Addressing modes and instruction set
- Programming of on-chip peripherals in 8051
- Design and develop applications using 8051 Assembly language and C program.
- MSP 430 Microcontroller architecture
- On-chip peripherals and program using Assembly language and C.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Microprocessor and Microcontrollers:** **Introduction: Microprocessor and Microcontroller**, Microprocessor survey, RISC and CISC, CPU Architecture, Harvard and Von-Neumann, CPU Architecture. 8051 Microcontroller Architecture. Pin functions organizations Input/ Output pins, ports and circuits. Internal and External memory Architecture. 8051 Reg. banks and stack, 8051 flag bits and PSW Register. Special function Registers. Timer /Counter, Serial data input/ output, Interrupts, program counter and ROM space in the 8051.	8 Hours	**L1,L2**
Module -2 **Addressing modes directives instruction set of 8051 Microcontroller**. Immediate and Register addressing modes. Accessing memory using various addressing modes. Bit addressing for I/o and RAM 8051 data types and directives. Jump Loop and CALL Instructions Arithmetic and Logic Instructions and programming I/o port programming. Assembly Language programs using various Instructions.	8 Hours	**L1,L2**
Module -3 **8051 programming in C and interfacing.** Data types and time delay in 8051 C, I/o programming, Logic operation, data conversion programs, accessing Code ROM Space, data serialization. **8051 interfacing** to LCD and key board, DAC, stepper motor, DC Motor, Parallel and serial ADC. Elevator.	8 Hours	**L2,L3,L4**
Module -4 **Timer/ Counter, Serial communication and Interrupts in 8051**.	8 Hours	**L2,L3,L4,L5**

Programming 8051 timer/ counter, programming timer 0 and 1 in 8051 C, Basics of serial communication, 8051 connections to **RS-232.** 8051 serial port programming in C. 8051 Interrupts, Programming Timer Interrupts, External hardware Interrupts and serial communication Interrupts. Interrupts priority & Interrupt programming in C.		
Module -5 **Introduction to Advanced Microcontrollers**. Salient Features of Advanced Microcontrollers. **MSP430F2013** Architecture and pin functions, Memory, Clock Generator, CPU Registers, Addressing modes, Instruction set and emulated Instruction set. Development Environment. Aspects of C for embedded system, Introduction to MSP 430 starter kit, parallel ports.	8 Hours	**L1,L2,L3**

Course Outcomes: After studying this course , Student will be able to:

- Learn architecture of 8051 and MSP 430.
- Learn programming skills using Assembly language and C
- Design and interfacing of microcontroller based embedded systems.
- Build projects

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. "The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. "MSP430 Microcontroller Basics" John H. Davis, Elsevier 2010.
3. "Embedded Systems Design using the TI MSP430 series", Cris Nagy, Newnes, Elsevier.

Reference Books:

1. "The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005.
2. "The 8051 Microcontroller: Hardware, Software and Applications" V. Udhayashankara and MallikarjunaSwamy ,TMH., 2009.

Control Systems
(Common to EI& BM)

Subject Code	: **18 EI/BM 44**	CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 03+02	SEE Marks	: 60
Total Number of Lecture Hours	: 50	Exam Hours	: 03

Credits - 4

Course Learning Objectives: This course will enable the students to

- Understand the basic concepts & mathematical modeling of systems
- Draw block diagram & reduction for a given system
- Obtain Transfer functions by reduction and Signal Flow graph techniques.
- Analyze the system response in time and frequency domain
- Understand and Design of control systems using state space analysis

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1 **Modeling of Systems and Block diagram**: Introduction to Control Systems, Types of Control Systems, with examples. Concept of mathematical modeling of physical systems- Mechanical, Translational (Mechanical accelerometer, systems excluded), and Rotational systems, Analogous systems based on force voltage analogy and force current analogy. Introduction to Block diagram algebra. Numerical problems on all topics.	10 Hours	L_1, L_2, L_3, L_4
Module -2 **Signal Flow graph**: Introduction to Signal Flow graph, Mason's gain formula. Obtaining Transfer functions for the given SFG using Mason's gain formula. **Time response analysis**: Introduction. Standard test signals, response of first order & second order systems for unit step input. Steady state errors & Error constants. Numerical problems on all topics.	10 Hours	L_1, L_2, L_3, L_4
Module -3 **Concepts of stability**: The Concept of stability. Necessary conditions for stability. Hurwitz stability criterion. Routh stability criterion. Relative stability analysis using RH Criterion. **The Root Locus Technique**: Introduction. Root locus concepts. Construction of root loci. Stability analysis using Root locus Technique Numerical problems on all topics.	10 Hours	L2, L3, L4, L5
Module -4 **Frequency domain Analysis**: Introduction to frequency domain analysis, Correlation between time & frequency response, Bode plots. Numerical problems on all topics. **Polar Plot**: Introduction to Polar plot andNyquist plots, Nyquist stability criterion. Stability analysis using Polar plot. Numerical problems on all topics.	10 Hours	L2, L3, L4, L5
Module -5	10 Hours	L2, L3, L4, L5

State space Analysis: Concept of state, state variables and state model. State diagrams and State models for Linear continuous-time systems (Electrical systems): State space representation using Physical and Phase variables. Derivation of transfer functions from the state model. Numerical problems on all topics.		

Course Outcomes: After studying this course, students will able to:

- Apply modeling knowledge in implementation physical systems.
- Understand the reduction of block diagram & analyze using Signal flow graph.
- Comment on performance of a system by evaluating various parameters.
- Model a system by applying the concept of State Space analysis

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Investigation of Complex Problem

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

Text Books:

1. "Control Systems Engineering", I.J. Nagarath and M. Gopal ,New Age International (P) Limited, Publishers, Fifth edition – 2012.
2. "Modern Control Engineering ", K. Ogata, Pearson Education Asia/ PHI, 4thEdition, 2002.

Reference Books:

1. "Automatic Control Systems", Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8thEdition, 2008.
2. "Feedback and Control System", Joseph J Distefano III et al., Schaum's Outlines, TMH, 2nd Edition 2007.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - IV

Process Instrumentation

Subject Code	: **18EI45**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits - 3

Course Learning Objectives:

- To discuss the principle, design and working of transducers/sensors for the measurement of temperature, flow, vibration, density, viscosity, humidity and moisture.
- To provide the basic knowledge in selection of appropriate transducers/sensors for the measurement of above parameters based on their specifications, advantages and limitations.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **Measurement of Temperature**: Introduction, temperature scales, mechanical temperature sensors, resistance type temperature sensors, platinum resistance thermometer, thermistors (principle, types & characteristics), thermocouples, solid state sensors – principle and working, brief discussion on AD590 (characteristics and features), LM35 (characteristics and features), Quartz thermometer, Temperature measurement by radiation methods, Optical pyrometer, Calibration of thermometers.	8 Hours	L1, L2, L3, L4
Module -2 **Flow Measurement**: Introduction, Classification of Flow Meters, Head type flow meters, Rotameter, Electromagnetic Flow Meter, Mechanical Flow Meters, Anemometers, Ultrasonic flow meters – Doppler shift type (principle, working & derivation of Δf), Transit time (principle, working & derivation of ΔT), Vortex flow meters, Thermal flow meter, Laser anemometer, Rotor torque mass flow meter.	8 Hours	L1, L2, L3, L4
Module -3 **Vibration Measurement:** Introduction, Characteristics of vibration**,** Vibration sensing devices,Shock measurements, Vibration exciters& Calibration. **Measurement of Density:** Definition & units of density and specific gravity, Liquid density measurement – Ball type, capacitance type, displacement type, hydrometers, oscillating Coriolis, radiation type, sound velocity type. Gas density measurement – displacement type, electromagnetic suspension type.	8 Hours	L1, L2, L3, L4
Module -4 **Viscosity Measurement:** Definition and units, selection of viscometer, viscometer applications. Laboratory Viscometers – Capillary, capillary extrusion, Efflux cup (Saybolt viscometer), Falling ball, Rotational	8 Hours	L1, L2, L3, L4

viscometer, Cone & plate viscometer. Industrial Viscometers - differential pressure continuous capillary viscometer, single and two float viscometer, cone and plate plastometer, vibrating reed viscometer. **Turbidity**: Definition, transmission type turbidity meter, light scattering turbidity meter.		
Module -5 **Humidity Measurement:** Definition and terminologies, dry and wet bulb psychrometers (Sling psychrometer), hair hygrometers, thin film capacitance humidity sensor, dew-point hygrometers, electrolytic hygrometers. **Moisture Measurement:**Definition and terminologies. Measurement of moisture in gases and liquids – Electrolytic hygrometer, capacitance hygrometer, impendence hygrometer, piezoelectric hygrometer, infrared absorption hygrometer. Measurement of moisture in solids – Nuclear moisture gauge, infrared reflection moisture gauge, capacitance moisture gauge..	8 Hours	L1, L2, L3, L4

Course Outcomes: After studying this course, students will able to:

- Explain the principle, construction/design and analyze the transducers/sensors for the measurement of temperature, flow, vibration, density, viscosity, humidity and moisture.
- Select the appropriate transducers/sensors based on the needs of the process.
- Install and analyze the transducers/sensors for the measurement of above parameters.

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Engineer and society
- Environment & sustainability
- Lifelong learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question fromeachmodule.

Text Books:

1. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. [Module1, Module 2, Module3- Measurement of vibration].
2. Process Measurement Instrument Engineers Handbook- BelaG.Liptak, Revised Edition, Chilton Book Company, 1982. [Module 3 – Measurement of Density, Module 4]
3. Industrial Instrumentation – K. Krishnaswamy and S. Vijayachitra, New Age International Pub., 2005. [Module 5]

Reference Books:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation-A. K. Ghosh, 2nd Edition, PHI, 2007
3. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.
4. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik,

5th Edition, McGraw Hill, 2007.

Subject Code	**18 EI/BM/ML 46**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits - 3

Course Learning Objectives:

- To introduce the basic concept of qualitative and quantitative analysis of a givensample.
- To impart various spectroscopic techniques and itsinstrumentation.
- To impart the concept of separation science and itsapplication.
- To impart methods of Industrial analyzers and itsapplication.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT)Level
Module -1 **An Introduction to Instrumental Methods:** Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation, Fundamental Laws of photometry (Text book 1). **IR Spectroscopy:** Basic Components of IR Spectrophotometers, monochromators- littrow mounting, Fourier Transform IR Spectroscopy (Text book 2).	08 Hours	L1, L2
Module -2 **UV and Visible Spectrometers** –**Instrumentation**: Radiation Sources, Wavelength selection: absorption filters, interference filters, Detector, Readout modules(Text book 1), Instruments for absorption photometry: single beam and double beam spectrophotometer. (Text book 2)	08 Hours	L1, L2
Module -3 **Flame Emission and Atomic Absorption Spectroscopy**: Introduction, Instrumentation for flame spectrometric methods,Flame emission spectrometry, atomic absorption spectrometry, Atomic fluorescence spectrometry, Interferences associated with Flames & furnaces, applications, comparison of FES and AAS. (Text book 1).	08 Hours	L1, L2
Module -4 **Gas Chromatography:** Chromatograph, Basics parts of a chromatograph: carrier gas supply, sample injection system, chromatographic columns: packed column & capillary column, Detectors: katharometer cell, differential flame ionization detector, electron capture detector.(Text book 2). **HPLC Instrumentation**: Mobile –phase delivery system sample introduction, separation of columns, Detectors– UltravioletPhotometers&Spectrophotometers,electrochemical detector (amperometric detector), Differential refractometer. (Text book 1).	08 Hours	L1, L2, L3

Module -5 **Blood analyzer:** Introduction, Blood pH measurements: electrodes for blood pH measurement, measurement of blood pCO_2, pO_2 , A Complete blood gas analyzer. **Air pollution monitoring instruments:** Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide (SO_2)-Conductivitimetry, UV fluorescence method, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis, **Water pollution monitoring instruments**. (Text book 2)	08 Hours	L1, L2, L3, L4

Course Outcomes:

1. The students get well versed with the principle, construction and working of various analytical instrumentation.
2. Students get detailed information about the application of analytical techniques in medicine, Industry, etc.

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Life-long Learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Instrumental Methods of Analysis, 7th edition. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS Publishing & Distribution (Module 1, Module 2, Module 3, Module 4HPLC)
2. Handbook of Instruments – R.S. Khandpur, Tata McGraw Hill (Module 1-IR Spectroscopy, Module 4, Module 5)

Reference Books:

1. Braun R.D., Introduction to Instrumental Analysis, McGraw –Hill Singapore,2006.
2. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and francis group, 2007.
3. Principles of Instrumental Analysis 5th Edition – Douglas A. Skoog, F. James Holler, Timothy A. Niemen, Thomason Brooks/ Cole

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - IV

Embedded Controllers Lab

(Common to EI, BM & ML)

Subject Code	**18 EI/BM/ML L47**		CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	02+02		SEE Marks	: 60
Total Number of Practical Hours	42		Exam Hours	: 03

Credits - 2

Course Learning Objectives:

This laboratory course enables students to :

- Write 8051 Assembly language and C programs for 8051 and MSP430.
- Interface hardware modules to Microcontroller board.
- Develop applications based on Microcontroller 8051 and MSP430.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

Laboratory Experiments Note: Software and Hardware program using KEIL software and MSP 430 IDE.	**Revised Bloom's Taxonomy (RBT)Level**
Software program using 8051 µc Simple Assembly Language; 1. Program using 8051 in Block, Move, Exchange. 2. Program in sorting, finding largest and smallest element in an array. 3. Counters ---> For Hex and BCD up/ down count. 4. Boolean and Logical Instructions. (Bit Manipulation). 5. Subroutines using CALL and RETURN instructions. 6. Code Conversions ---> ASCII to Decimal, Decimal to ASCII, BCD to ASCII 7. Programs to generate delay, programs using serial port and on chip timer/ counter.	**L2, L3, L4**
Software program using MSP 430 IDE 8. Assembly program using MSP 430 for data transfer, Block Move in an array.	**L2, L3, L4**
Hardware programming (using 8051) 9. Stepper motor Interface to 8051 Microcontroller with C Program. 10. DC Motor Interface to 8051 Microcontroller with C Program 11. DAC Interface for to generate sine wave, square wave, triangular wave, Ramp wave through 8051Microcontroller with C Program. 12. Keyboard Interfacing. 13. ADC Interfacing and Elevator System	**L3, L4, L5**

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

- Get hands-on exposure in 8051 and MSP430 platform.
- Enhance programming skills using Assembly language and C.
- Design and interfacing of microcontroller based embedded systems.
- Build projects

Graduate Attributes (as per NBA)

- Engineering Knowledge
- Problem Analysis
- Design and Development of solutions
- Modern Tool usage
- Individual and Team work

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

1. "The 8051 Microcontroller and Embedded systems-using assembly and C", Muhammad AliMazidi and Janice Gillespie Mazidi and Rollin D. McKinaly,PHI,2006/pearson,2006
2. "MSP430 Microcontroller Basics" John H. Davis, Elsevier 2010.
3. "Embedded Systems Design using the TI MSP430 series", Cris Nagy, Newnes, Elsevier.
4. "The 8051 Microcontroller architecture. Programming and applications", Kenneth J Alyala Thomson learning 2005.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - IV

Instrumentation and Measurement Lab

Subject Code	**18EIL48**	CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	02+02	SEE Marks	: 60
Total Number of practical Hours	42	Exam Hours	: 03

Credits - 2

Course Learning Objectives: This Lab course will enable the students to

- Impart the working principle of sensors and transducer
- Testing the response and plot the characteristics of different transducers
- Interpret and analyze experimental results with theoretical concepts.
- Calibrate the sensors/transducers
- Design the signal conditioning circuits and to make the transducer output compatible to interface with other devices
- Study and interpret data sheets of different transducers to select the suitable transducer for particular application and safe operation.

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 – Analyzing, L5 – Evaluating, and L6 - Creating

LIST OF EXPERIMENTS	**Revised Bloom's Taxonomy (RBT) Level**
1. Displacement measurement using LVDT	L1, L2, L3, L4
2. Temperature measurement using RTD, Thermistor and Thermocouple: Plotting the characteristics and finding their sensitivity.	L1, L2, L3, L4
3. Temperature measurement using AD590 / LM35: Plotting the characteristics and finding their sensitivity	L1, L2, L3, L4
4. Characteristics of LDR, Photodiode & Phototransistor by variable illumination & variable distance, and Plotting their characteristics	L1, L2, L3, L4
5. Measurement of unknown resistance by Wheatstone bridge & finding the sensitivity of the bridge.	L1, L2, L3, L4
6. Measurement of low resistance using Kelvin double bridge.	L1, L2, L3, L4
7. Measurement of self-inductance using Maxwell's bridge.	L1, L2, L3, L4
8. Calibration of voltmeter and ammeter using DC potentiometer.	L1, L2, L3, L4
8. Measurement of unknown capacitance using Schering's bridge.	L1, L2, L3, L4
9. Characteristics of pressure transducer.	L1, L2, L3, L4
10. Characteristics of Load cell and Cantilever beam using Strain gauge: Plotting the characteristics and finding their sensitivity for Quarter, Half and Full bridge configurations.	L1, L2, L3, L4
11. Characteristics of potentiometric transducer	L1, L2, L3, L4

Course Outcomes: After studying this course, students will able to:

- Analyze the response and plot the characteristics of temperature measurement transducers such as RTD, Thermistor, Thermocouple, AD590 and LM35.
- Analyze the response and plot the characteristics of displacement measuring transducers such as LVDT and Potentiometric transducer.
- Analyze the response and plot the characteristics of strain gauge type load cell.
- Analyze the response and plot the characteristics of pressure transducer.
- Measure unknown values of resistance, capacitance and Inductance using different bridges.
- Design , build and test the circuits for practical applications

Graduate Attributes (as per NBA)

- Engineering Knowledge.
- Problem Analysis.

- Design / development of solutions (partly)
- Interpretation of data

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

1. Measurement systems application and design by E.O. Doebline 4th Edition, TMH.
2. Instrumentation for Process Measurement by Norman. A. Anderson, 3rd Edition, CRC
3. Principle of Measurement System by John. P. Bentley, 3rd Edition, Pearson, 2007
4. Process Measurement by Bela G. Liptak

B. E. Common to all Programmes
Outcome Based Education (OBE) and Choice Based Credit System (CBCS)
SEMESTER - IV

ADDITIONAL MATHEMATICS – II
(Mandatory Learning Course: Common to All Programmes)
(A Bridge course for Lateral Entry students under Diploma quota to BE/B.Tech. programmes)

Course Code	**18MATDIP41**	CIE Marks	40

Teaching Hours/Week (L:T:P)	(2:1:0)	SEE Marks	60
Credits	**0**	Exam Hours	03

Course Learning Objectives:

- To provide essential concepts of linear algebra, second & higher order differential equations along with methods to solve them.
- To provide an insight into elementary probability theory and numerical methods.

Module-1

Linear Algebra: Introduction - rank of matrix by elementary row operations - Echelon form. Consistency of system of linear equations - Gauss elimination method. Eigen values and eigen vectors of a square matrix. Problems.

Module-2

Numerical Methods: Finite differences. Interpolation/extrapolation using Newton's forward and backward difference formulae (Statements only)-problems. Solution of polynomial and transcendental equations – Newton-Raphson and Regula-Falsi methods (only formulae)- Illustrative examples. Numerical integration: Simpson's one third rule and Weddle's rule (without proof) Problems.

Module-3

Higher order ODE's: Linear differential equations of second and higher order equations with constant coefficients. Homogeneous /non-homogeneous equations. Inverse differential operators.*[Particular Integral restricted to* $R(x)= e^{ax}, \sin ax/\cos ax$ *for* $f(D)y = R(x)$.]

Module-4

Partial Differential Equations(PDE's):- Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.

Module-5

Probability: Introduction. Sample space and events. Axioms of probability. Addition & multiplication theorems. Conditional probability, Bayes's theorem, problems.

Course Outcomes: At the end of the course the student will be able to:

CO1: Solve systems of linear equations using matrix algebra.
CO2: Apply the knowledge of numerical methods in modelling and solving engineering problems.
CO3: Make use of analytical methods to solve higher order differential equations.
CO4: Classify partial differential equations and solve them by exact methods.
CO5: Apply elementary probability theory and solve related problems.

Question paper pattern:

- The question paper will have ten full questions carrying equal marks.
- Each full question will be for 20 marks.
- There will be two full questions (with a maximum of four sub- questions) from each module.
- Each full question will have sub- question covering all the topics under a module.
- The students will have to answer five full questions, selecting one full question from each module.

Sl No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook				
1	Higher Engineering Mathematics	B.S. Grewal	Khanna Publishers	43rd Edition, 2015

Reference Books				
1	Advanced Engineering Mathematics	E. Kreyszig	John Wiley & Sons	10th Edition, 2015
2	Engineering Mathematics	N. P. Bali and Manish Goyal	Laxmi Publishers	7th Edition, 2007
3	Engineering Mathematics Vol. I	Rohit Khurana	Cengage Learning	1st Edition, 2015

5th Semester

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

Technological Innovation Management and Entrepreneurship

(Common to EC/TC/EI/BM/ML)

Subject Code	**18ES51**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	02+02		SEE Marks	: 60
Total Number of Lecture Hours	40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Course Learning Objectives: This course will enable students to:

- Understand basic skills of Management
- Understand the need for Entrepreneurs and their skills
- Identify the Management functions and Social responsibilities
- Understand the Ideation Process, creation of Business Model, Feasibility Study and sources of funding

Module-1

Management: Nature and Functions of Management – Importance, Definition, Management Functions, Levels of Management, Roles of Manager, Managerial Skills, Management & Administration, Management as a Science, Art & Profession (Selected topics of Chapter 1, Text 1).

Planning: Planning-Nature, Importance, Types, Steps and Limitations of Planning; Decision Making – Meaning, Types and Steps in Decision Making(Selected topics from Chapters 4 & 5, Text 1). **L1, L2**

Module-2

Organizing and Staffing: Organization-Meaning, Characteristics, Process of Organizing, Principles of Organizing, Span of Management (meaning and importance only), Departmentalisation, Committees– Meaning, Types of Committees; Centralization Vs Decentralization of Authority and Responsibility; **Staffing**-Need and Importance**,** Recruitment and Selection Process (Selected topics from Chapters 7, 8 & 11,Text 1).

Directing and Controlling: Meaning and Requirements of Effective Direction, Giving Orders; Motivation-Nature of Motivation, Motivation Theories (Maslow's Need-Hierarchy Theory and Herzberg's Two Factor Theory); Communication – Meaning, Importance and Purposes of Communication; Leadership-Meaning, Characteristics, Behavioural Approach of Leadership; Coordination-Meaning, Types, Techniques of Coordination; Controlling – Meaning, Need for Control System, Benefits of Control, Essentials of Effective Control System, Steps in Control Process (Selected topics from Chapters 15 to 18 and 9, Text 1). **L1, L2**

Module-3

Social Responsibilities of Business: Meaning of Social Responsibility, Social Responsibilities of Business towards Different Groups, Social Audit, Business Ethics and Corporate Governance (Selected topics from Chapter 3, Text 1).

Entrepreneurship: Definition of Entrepreneur, Importance of Entrepreneurship, concepts of Entrepreneurship, Characteristics of successful Entrepreneur, Classification of Entrepreneurs, Myths of Entrepreneurship, Entrepreneurial Development models, Entrepreneurial development cycle, Problems faced by Entrepreneurs and capacity building for Entrepreneurship (Selected topics from Chapter 2, Text 2). **L1, L2**

Module-4

Family Business: Role and Importance of Family Business, Contributions of Family Business in India, Stages of Development of a Family Business, Characteristics of a Family-owned Business in India, Various types of family businesses(Selected topics from Chapter 4,(Page 71-75) Text 2). **L1, L2**

Idea Generation and Feasibility Analysis-Idea Generation; Creativity and Innovation; Identification of Business Opportunities; Market Entry Strategies; Marketing Feasibility; Financial Feasibilities; Political Feasibilities; Economic Feasibility; Social and Legal Feasibilities; Technical Feasibilities; Managerial Feasibility, Location and Other Utilities Feasibilities. (Selected topics from Chapter 6(Page No. 111-117)&Chapter 7(Page No. 140-142), Text 2)

Module-5

Business model – Meaning, designing, analyzing and improvising; Business Plan – Meaning, Scope and Need; Financial, Marketing, Human Resource and Production/Service Plan; Business plan Formats; Project report preparation and presentation; Why some Business Plan fails? (Selected topics from Chapter 8 (Page No 159-164, Text 2)

Financing and How to start a Business? Financial opportunity identification; Banking sources; Nonbanking Institutions and Agencies; Venture Capital – Meaning and Role in Entrepreneurship; Government Schemes for funding business; Pre launch, Launch and Post launch requirements; Procedure for getting License and Registration; Challenges and Difficulties in Starting an Enterprise(Selected topics from Chapter 7(Page No 147-149),Chapter 5(Page No 93-99) &Chapter 8(Page No. 166-172) Text 2)

Project Design and Network Analysis: Introduction, Importance of Network Analysis, Origin of PERT and CPM, Network, Network Techniques, Need for Network Techniques, Steps in PERT, CPM, Advantages, Limitations and Differences.
(Selected topics from Chapters 20, Text 3). **L1, L2, L3**

Course Outcomes: After studying this course, students will be able to:

- Understand the fundamental concepts of Management and Entrepreneurship and opportunities in order to setup a business
- Describe the functions of Managers, Entrepreneurs and their social responsibilities
- Understand the components in developing a business plan
- Awareness about various sources of funding and institutions supporting entrepreneurs

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Principles of Management – P.C Tripathi, P.N Reddy, McGraw Hill Education, 6th Edition, 2017. ISBN-13:978-93-5260-535-4.
2. Entrepreneurship Development Small Business Enterprises- Poornima M Charantimath, Pearson Education 2008, ISBN 978-81-7758-260-4.
3. Dynamics of Entrepreneurial Development and Management by Vasant Desai. HPH 2007, ISBN: 978-81-8488-801-2.
4. Robert D. Hisrich, Mathew J. Manimala, Michael P Peters and Dean A. Shepherd,

"Entrepreneurship", 8th Edition, Tata Mc-Graw Hill Publishing Co.ltd.-new Delhi, 2012
Reference Book: Essentials of Management: An International, Innovation and Leadership perspective by Harold Koontz, Heinz Weihrich McGraw Hill Education, 10th Edition 2016. ISBN- 978-93-392-2286-4.

Choice Based Credit System (CBCS)
Semester - V

Fundamentals of Signals and DSP

(Common to EI & BM)

Subject Code	: **18EI/BM52**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 03+02		SEE Marks	: 60
Total Number of Lecture Hours	: 50		Exam Hours	: 03

Credits – 4 (Each module – 10 Hours)

Module -1

Introduction to Signals and Systems:

Basic elements of a DSP System, Classification of Signals, Sampling Theorem (statement and problems on Nyquist rate), Discrete Time Signals (Representation, Standard Signals, Classification, and Operations), Discrete Time Systems, Convolution Sum, Cross correlation and Auto correlation of sequences.

Text 1: 1.1.1, 1.2, 1.4.2, 2.1, 2.2, 2.3.3, 2.3.7, 2.6.1.

Module -2

Z- Transform and its Application to analysis of LTI Systems:

Direct Z-Transform, Properties of the Z-Transform, Examples, Inverse Z- Transform by Partial- Fraction Expansion method only, System Function of a LTI System, Causality and Stability (from H (z)).

Realization of Digital System: Direct Form I, Direct form II, cascade form and parallel form

Text 1: 3.1.1, 3.2, 3.4.3, 3.3.3, 3.5.3.

Text 2: 9.2,9.3

Module -3

DFT: Properties and Applications:

Definition and Problems on DFT&IDFT, DFT Properties – Periodicity, Linearity, Time Reversal, Circular Time Shift, Circular Frequency Shift, Circular Convolution, Multiplication of two DFTs& Circular Convolution, Parseval's Theorem, DFT in linear filtering. Introduction to FFT, 8-point DFT Computation using Radix-2 DIT-FFT&DIF-FFT methods only, relevant examples.

Text 1: 7.1.3, 7.2, 7.3.1, 8.1.3.

Module -4

IIR& FIR Filters:

IIR Filters: Low-pass filter specifications, IIR filter Design by Impulse Invariance & Bilinear Techniques, Design of Digital IIR filter by Butterworth approach, Examples. Magnitude response of lowpassChebyshev Type I, II filter (Theoretical concept only)

FIR Filters: Design of FIR filters – Symmetric and Antisymmetric FIR filters, Design of Linear phase FIR filters by Rectangular Hamming &Hanning windows. Summary of window function characteristics (window shape, transition bandwidth, stop band attenuation, etc.). Implementation of FIR filters by direct form and Single-stage lattice structure only.

Text 1: 10.3.2, 10.3.3, 10.3.4, 9.3.1, 9.3.3, 9.3.4, 10.2.1,10.2.2, 10.2.7, 9.2.1, 9.2.4

Module -5

Multirate Digital Signal Processing & Adaptive Filters:

Introduction, Decimation Process, Interpolation Process, Digital Filter Bank, Adaptive Filters, LMSadaptive algorithm, Applications, Features & Architectural of TMS320C54XX processor.

Text 2: 17.1, 17.2, 17.3, 17.4, 16.2, 16.3, 16.5, 19.2, 19.3.

Course Outcomes: After studying this course, students will able to:

1. Visualize, Classify and perform computation on discrete time signals, systems and properties
2. Perform the transformation techniques from time domain to other and vice versa, and analyze the system and properties (Z-Transform, DFT etc.)
3. Realize / implement the Direct/ cascade/ parallel/ lattice forms of the given digital system (IIR/ FIR)
4. ComputeDFT by FFT algorithms
5. Develop transformation from analog system to digital systemanddesign and implementIIR and FIR filters
6. Demonstrate the advanced concepts of signal processing (Multirate and Adaptive filtering) and architecture of DSP processor

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Dimitris G Manolakis, John G. Proakis, "Digital Signal Processing: Principles, Algorithms, and Applications", 4th Edition, Pearson India, 2007.
2. V.Udayashankara, "Modern Digital Signal Processing", Third Edition, PHI 2016

Reference Books:

1. Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2nd edition
2. S K Mitra, "Digital Signal Processing", 4th Edition, McGraw-Hill, Year
3. Avtar Singh, "Digital Signal Processing Implementation", Brooks Cole

Semester - V				
Process Control Systems				
Subject Code	: **18EI53**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 03+02		SEE Marks	: 60
Total Number of Lecture Hours	: 50		Exam Hours	: 03

Credits – 4 (Each module – 10 Hours)

Module -1

Introduction to Process Control and Final Control Operations:

Introduction, Process control principles, Process control block diagram, Control system evaluation, Analog and Digital Processing, Analog data representation.

Final Control: Introduction, Final control operation, Signal conversions, Actuators, Control elements. (Numerical problems on all topics)

Module -2

Controller Principles: Introduction, Process characteristics, Control system parameters, Discontinuous controller modes: Two position, multiposition, floating control modes. Continuous controller modes: Proportional (P), Integral (I), Derivative (D) control modes, Composite controller modes: PI, PD, PID modes. (Problems on all types of controller modes**).**

Module -3

Analog Controllers: Introduction, General features, Electronic controllers**,** Error detector, Single mode, Composite controller modes, Pneumatic controllers, Design considerations. (Numerical problems on all topics).

Digital Controllers: Digital electronic methods, Simple alarms, Two position control, Multivariable alarms, Data logging, Supervisory computer control (SDC) and Direct digital control. Sampled data systems, Input data operations. Controller Modes Software-Error, P, I, D, &PID control mode software.

Module -4

Control-Loop Characteristics: Introduction, Control system configurations: single variable and cascade control, Multivariable control system. Control system quality: Definition and measure of quality. Stability: Transfer function and frequency dependence, stability criteria. Process loop tuning: Open-loop transient response method, Ziegler-Nichols method, Frequency response methods. (Numerical problems on all topics).

Basic Instrumentation symbols, Process instrumentation & drawing (P&ID) symbols.

Module - 5

Modeling and Simulation for Plant Automation: Introduction, definition of terms, Need of system modeling, Uses of system simulation, how to build the mathematical model of a plant, Model evaluation and improvement, modern tools for modeling and simulation of systems, application examples, future perspectives.

Multivariable & Intelligent Controllers:

Ratio control, Feed-forward control. Adaptive controller, Optimal control, Predictive control, Artificial intelligent based systems, Expert controller.

Course Outcomes: After studying this course, students will able to:

1. Discuss the principles of process control, evaluation, data representation andtheelements of final control operation.
2. Analyze the principle and working of continuous and discontinuous controller modes.

3. Design analog controllers based on op-amps and pneumatic systems.
4. Discuss the principle and working digital controllers and implementation of controller mode software, concepts and applications of modelling and simulation of process plant
5. Analyze control loop characteristics, control system quality and process loop tuning, and sketch the basic process instrumentation symbols.
6. Describe the fundamental concepts of multivariable and intelligent controllers.

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Process Control Instrumentation Technology by C. D. Johnson, 7th Edition, Pearson Education Private Limited, New Delhi 2002. (Modules 1, 2 3 & 4).
2. Computer Based Industrial Control by Krishna Kant, PHI, New Delhi 1997. (Module 5)

Reference Books:

1. Chemical Process Control – George Stephanopoulos, 4th Indian reprint, PHI Ltd., 1997.
2. Process/ Industrial Instruments and Control Handbook by D.M. Considine, 4th Edition, McGraw Hill International Edition, 1993.
3. Process dynamics and control by S. S. Bhagade and G. D. Nageshwar PHI publications New Delhi, 2011.
4. Lessons in Industrial Instrumentation by Tony R. Kuphaldt, Creative Commons Attribution License (open source textbook), Sept. 2008. (for basic instrumentation symbols, 6.5.1, 6.5.2, 6.5.3, 6.5.4, 6.5.9).
5. Instrument Engineers Handbook-Process Control Volume2 by Bela G. Liptak, Chilton Book Company/ Radnor, 3rd Edition, Pennsylyania, 1969.

Biomedical Instrumentation				
Subject Code	: **18EI54**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Fundamentals of Biomedical Instrumentation: Sources of biomedical signals, Basic Medical Instrumentation system, Performance requirements of medical instrumentation systems. PC based medical instruments, General constraints in design of biomedical instrumentation systems.

Bioelectric Signals and Electrodes : Origin of Bioelectric signals, Types of bioelectric signals-ECG, EEG, EMG, Recording electrodes: Electrode – Tissue interface, polarization, skin contact- impedance, Silver-silver chloride
electrodes, Electrodes for ECG, EEG, EMG, Microelectrodes.

Module -2

Electrocardiograph: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram-description of an Electrocardiograph, ECG leads, Effects of artifacts on ECG Recordings, Multi- channel ECG machine.

Electroencephalograph: Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG. Electromyograph, Biofeedback instrumentation.

Module -3

Patient Monitoring System: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate, Definition of oximeter & Pulse oximeter.

Blood Pressure Measurement: Introduction, Indirect methods of blood pressure measurement: Korotkoff's method, Rheographic method, differential auscultatory technique, Oscillometric technique.

Measurement of Respiration Rate: Impedance pneumography, CO_2 method of respiration rate measurement, Apnoea detectors.

Module -4

Blood Flow Measurement: Electromagnetic blood flow meter- Principle and Square wave electromagnetic flowmeter. Doppler shift blood flow velocity meter, Blood flow measurement by Doppler imaging.

Cardiac Output Measurement: Measurement of continuous cardiac output derived from the aortic pressure waveform, ultrasound method.

Cardiac Pacemakers and Defibrillators: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers, Power sources for Implantable pacemaker.

Cardiac Defibrillator: Need for a Defibrillator, DC defibrillator, Pacer-Cardioverter-Defibrillator.

Module -5

Therapeutic Instruments:

Cardiac-assist devices, Pump oxygenators, Total artificial heart, Hemodialysis, Lithotripsy, Ventilators, Infant incubators, Drug infusion pumps, Ambulatory and Implantable Infusion systems, Anesthesia Machines, Electrosurgical unit.

Patient Safety: Electric shock hazards, Leakage currents, Electrical safety analyzer, Testing of Biomedical equipment

Course Outcome: After studying this course, students will able to:

1. Acquire knowledge about origin of bio-potential, bio-signals and their measurement
2. Describe the problem, identify and formulate solution in the field of Bio-Medical Engineering for current and future issues
3. Describe the cardiac, brain and muscular physiological systems with the related diagnostic measurement methods.
4. Recognize the therapeutic methods of treatment and the associated instrumentation.
5. Identify and judge patient safety issues related to biomedical instrumentation.
6. Describe the principle and working of cardiac pacemakers, defibrillators, BP measurement, blood flow meters, CO measurement, respiration measurements and their implementation.

Question Paper Pattern:

- The question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Handbook of Biomedical Instrumentation - R.S.Khandpur, 2nd Edition, Tata McGraw- Hill, 2003 (Module 1, 2, 3, 4 & Module 5- Patient Safety)
2. Medical Instrumentation: Application and Design – John G Webster, 3rd Edition, John Wiley & Sons, 2006. (Module 5- Therapeutic Instruments)

Reference Book:

1. Biomedical Instrumentation & Measurement - Leslie Cromwell, Fred J Weibell& Erich A Pfeiffer, 2nd Edition, Prentice Hall of India, 2001.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

Lasers and Optical Instrumentation

Subject Code	: **18EI55**	CIE Marks	: 40

Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Lasers -I: Introduction, Emission and absorption of radiation, Einstein relation, population inversion, threshold conditions, Line shape function, population inversion and pumping threshold conditions**.**

Lasers -II: Classes of LASER: Doped insulator LASERs, semiconductor LASERs, Gas LASERs, Liquid dye LASERs.

Module -2

Generation of Lasers: Single mode operation, frequency stabilization. Q-switching, mode locking, lasing threshold.

Applications of Laser: Measurement of distance: Interferometric methods, Beam modulation telemetry, Pulse echo techniques; Holography & its Applications.

Module -3

Overview of Optical Fiber Communications: Motivations for light wave communications, optical spectral bands, Decibel units, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical fiber communications.

Structures, Wave guiding, and Fabrication I: The nature of light, basic optical laws and definitions, optical fiber modes and configurations, Mode theory for circular waveguides, Single mode fibers.

Module -4

Structures, Wave guiding, and Fabrication II: Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication, Mechanical properties of fibers, Fiber optic cables.

Optical Amplifiers: Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, Optical SNR, System Applications, Raman amplifiers, wideband optical amplifiers.

Module -5

Applications of Fiber Optic Laser Systems in Medicine: Introduction, Fiberoptic laser systems in cardiovascular disease-Endoscopic laser systems in cardiology, Fiber-optic laser therapy-angioplasty, Endoscopic Nd:YAG Laser therapy in gastroenterology, Laproscopic laser surgery, photodynamic therapy inoncology, ophthalmological applications of laser-fiber systems, arthroscopic surgery in orthopedics, laser lithotripsy, flowchart diagrams for clinical applications of laser-fiber systems-advances.

Textbook 3: Unit 9.1, 9.2, 9.2.1, 9.2.2, 9.2.5, 9.3.4, 9.5.2.3, 9.7.3, 9.8.2, 9.9.2, 9.11.4.3

Course Outcomes: After studying this course, students will be able to:

1. Explain theprinciple and working of Laser system.
2. Discuss the engineering applications of laser systems.
3. Discuss the fundamentals of optical fiber communications.
4. Evaluate the design of optical fibers.
5. Apply fiber optic laser systems in medical field.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Optoelectronics- An Introduction-Wilson & Hawkes, Prentice Hall of India.
2. Optical fiber communications-GeirdKeser, McGraw Hill education (India) private limited, Fifth edition.
3. Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

Reference Books:

1. LASER Fundamentals- William T. Silfvast, Cambridge University Press.
2. Essentials of Opto Electronics with Applications - A.J. Rogers, CRC press 1997.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

VLSI Design

(Common to EI, BM & ML)

Subject Code	: **18 EI/BM/ML 56**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Moore's law, speed power performance, nMOS fabrication, CMOS fabrication: n-well, p-well processes, BiCMOS, Comparison of bipolar and CMOS.

Basic Electrical Properties of MOS And BiCMOS Circuits: Drain to source current versus voltage characteristics, threshold voltage, transconductance.

Module -2

Basic Electrical Properties of MOS And BiCMOS Circuits: nMOS inverter, Determination of pull up to pull down ratio, nMOS inverter driven through one or more pass transistors, alternative forms of pull up, CMOS inverter, BiCMOS inverters, latch up.

Basic Circuit Concepts: Sheet resistance, area capacitance calculation, Delay unit, inverter delay, estimation of CMOS inverter delay, driving of large capacitance loads, super buffers, BiCMOS drivers.

Module -3

MOS and BiCMOS Circuit Design Processes: MOS layers, stick diagrams, nMOS design style, CMOS design style, design rules and layout, λ - based design.

Scaling of MOS Circuits: scaling factors for device parameters, limitations of scaling.

Module -4

Subsystem Design and Layout-1 : Switch logic pass transistor, Gate logic inverter, NAND gates, NOR gates, pseudo nMOS, Dynamic CMOS, example of structured design, Parity generator, Bus arbitration, multiplexers, logic function block, code converter.

Subsystem Design and Layout-2 : Clocked sequential circuits, dynamic shift registers, bus lines, subsystem design processes, General considerations, 4-bit arithmetic processes, 4-bit shifter.

Module -5

Design Process-Computational Elements: Regularity, design of ALU subsystem, ALU using adders, carry look ahead adders, Multipliers, serial parallel multipliers, Braun array, Bough – Wooley multiplier.

Memory, Register and Aspects of Timing: Three Transistor Dynamic RAM cell, Dynamic memory cell, Pseudo- Static RAM, JK Flip-flop, D Flip-flop circuits, RAM arrays, practical aspects and testability: Some thoughts of performance, optimization and CAD tools for design and simulation.

Course Outcomes: After studying this course, students will able to;

1. Identify the CMOS layout levels, and the design layers used in the process sequence.
2. Describe the general steps required for processing of CMOS integrated circuits.
3. Design static CMOS combinational and sequential logic at the transistor level.
4. Demonstrate different logic styles such as complementary CMOS logic, pass-transistorLogic, dynamic logic, etc.
5. Interpret the need for testability and testing methods in VLSI.

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Basic VLSI Design -3rd Edition, Douglas A Pucknell, Kamaran Eshraghian, Prentice Hall of India publication, 2005.

Reference Books:

1. CMOS Digital Integrated Circuits, Analysis And Design, 3rd Edition, Sung – Mo (Steve) Kang, Yusuf Leblbici, Tata McGraw Hill, 2002.
2. VLSI Technology - S.M. Sze, 2nd edition Tata McGraw Hill, 2003.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

Signal Conditioning Circuits and Data Acquisition Lab

(Common to EI, BM & ML)

Subject Code	: **18 EI/BM/ML L57**		CIE Marks	: 40
Number of Tutorial+	: 02+02		SEE Marks	: 60

Practical Hours/Week				
Total Number of Practical Hours	: 42		Exam Hours	: 03

Credits - 2

Revised Bloom's Taxonomy Levels: L1 – Remembering, L2 – Understanding, L3 – Applying, L4 –Analyzing, L5 – Evaluating, and L6 - Creating

Laboratory Experiments: **Note:** Standard design procedure to be adopted Students should build the circuit using discrete components and ICs (models are not to be used)	**Revised Bloom's Taxonomy (RBT)Level**
1. To design and implement • Inverting Amplifier and Inverting Attenuator • Non-Inverting Amplifier and Voltage Follower	L3, L4
2. To realize • Full wave Precision rectifier • Voltage regulator using IC 723	L3, L4
3. To design and implement • Butterworth I order Low-pass filter • Butterworth II order High-pass filter	L3, L4
4. To design and implement • RC Phase shift oscillator • Wein Bridge oscillator	L3, L4
5. To realize • ZCD • Positive and Negative Voltage level detectors	L3, L4
6. To design and implement • Astable Multivibrator using 555 timer • Mono-stable Multivibrator using 555 timer	L3, L4
7. To realize • Sample and Hold circuit using discrete components	L3, L4
8. To realize • Programmable Gain Amplifier using Analog Mux	L3, L4
9. To design and implement • 4 bit R-2R DAC using discrete components	L3, L4
10. To design and implement • 8-bit DAC using IC (DAC 0800)	L3, L4
11. To design and implement • 8-bit ADC using IC (ADC 0809)	L3, L4
12. To design and implement • 3 bit Flash ADC using ICs	L3, L4

Course Outcomes: After studying this course, students will able to;

1. Sketch/draw circuit schematics, construct circuits on breadboards, analyze and troubleshoot circuits containing Op-amps, resistors, diodes, capacitors and independent sources.
2. Memorize and reproduce the manufacturer's data sheets of IC 555 timer, IC µa741 op-amp and data converters like IC ADC 0800 and IC DAC 0809.
3. Design and evaluate analog integrated circuits like Amplifiers, Oscillators, Active filters, Precision Rectifiers and Voltage level detectors, and compare the experimental results with theoretical values.

4. Demonstrate and analyze the working of Sample-Hold, Programmable gain amplifier and Analog Multiplexer circuits in data acquisition system.
5. Design and evaluate different resolution data converters using discrete components and ICs.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

1. "Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2010, New Age International.
2. "Op - Amps and Linear Integrated Circuits", Ramakant A. Gayakwad, 4th edition, PHI.
3. "A course in Electrical & Electronic Measurements & Instrumentation", A K Sawhney, DhanpatRai Publications, 19th edition, 2011.
4. "Operational Amplifiers and Linear Integrated Circuits", Robert. F. Coughlin &Fred. F. Driscoll, PHI/Pearson, 2006
5. "Op - Amps and Linear Integrated Circuits", James M. Fiore, Thomson Learning, 2001
6. "Design with Operational Amplifiers and Analog Integrated Circuits", Sergio Franco, TMH, 3e, 2005

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - V

Digital Signal Processing Lab

Subject Code	: **18EIL58**		CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 42		Exam Hours	: 03

Credits -2	
USING ONLY MATLAB / SCILAB/OCTAVE	
1	Verify the Sampling theorem.
2	Determine linear convolution, Circular convolution and Correlation of two given sequences. Verify the result using theoretical computations.
3	Determine the linear convolution of two given point sequences using FFT algorithm.
4	Determine the correlation using FFT algorithm.
5	Determine the spectrum of the given sequence using FFT.
6	Design and test FIR filter using Windowing method (Hamming Hanning and Rectangular window) for the given order and cut-off frequency.
7	Design and test Butterworth 1st and 2nd order low & high pass filter.
8	Design and test Chebyshev 1st and 2nd order low & high pass filter.
USING DSP KIT / EMULATORS FROM TI/ ADSPSHARC/ MOTOROLA	
9	Linear convolution of two given sequences.
10	Circular convolution of two given sequences
11	Computation of N-point FFT of a given sequence.
12	Implementation of an FIR filters to meet given specifications.
13	Implementation of an IIR filters to meet given specifications.

Course Outcomes: After studying this course, students will able to;

1. Write programs using Matlab / Scilab/Octave to demonstrate the DSP concepts on sampling, convolution and correlation, and implementation of the same using DSP kit.
2. Write programs using Matlab / Scilab/Octavefor generation and computation of discrete signals.
3. Write program using Matlab / Scilab/Octave to apply FFT/DFT algorithm to determine spectrum of a given signal, and implementation of the same using DSP kit.
4. Write programs using Matlab / Scilab/Octave to design and evaluate different types of low and high pass filters.
5. Designand demonstrate IIR and FIR filters using Matlab / Scilab/Octaveprograms and DSP Kit.
6. Design and demonstrate DSP system applications in noise cancellation, communication, biomedical signal processing.

Conduct of Practical Examination:

1. All laboratory experiments are to be included for practical examination.
2. Students are allowed to pick one experiment from the lot.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

Reference Books:

1. Roberto Cristi, “Modern Digital Signal Processing”, 2003, Nelson Engineering
2. Vinay K. Ingle (Author), John G. Proakis, “Digital Signal Processing Using MATLAB”, 3rd Edition, CL Engineering.
3. V.Udayashankara, “Modern Digital Signal Processing”, Third Edition, PHI 2016
4. John Proakis, Dimitris G Manolakis, “Digital Signal Processing Principles”, Algorithms and Application”, PHI, 3rd Edition (2000).
5. S K MITRA, “Digital Signal Processing”, 4th Edition, McGraw-Hill.
6. Avtar Singh, S. Srinivasan, “Digital Signal Processing Implementation”, Brooks Cole.
7. S. Salivahana, A.Vallavaraj, Gnanapriya, “Digital Signal Processing”, McGraw-Hill, 2nd Edition (2000).

B. E. COMMON TO ALL PROGRAMMES Choice Based Credit System (CBCS) and Outcome Based Education (OBE) SEMESTER – V			
ENVIRONMENTAL STUDIES			
Course Code	**18CIV59**	CIE Marks	40
Teaching Hours / Week (L:T:P)	(1:0:0)	SEE Marks	60
Credits	01	Exam Hours	02
Module - 1			

Ecosystems (Structure and Function): Forest, Desert, Wetlands, Riverine, Oceanic and Lake.
Biodiversity: Types, Value; Hot-spots; Threats and Conservation of biodiversity, Forest Wealth, and Deforestation.

Module - 2

Advances in Energy Systems (Merits, Demerits, Global Status and Applications)**:** Hydrogen, Solar, OTEC, Tidal and Wind.
Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Module - 3

Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies)**:** Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution.
Waste Management & Public Health Aspects: Bio-medical Wastes; Solid waste; Hazardous wastes; E-wastes; Industrial and Municipal Sludge.

Module - 4

Global Environmental Concerns (Concept, policies and case-studies):Ground water depletion/recharging, Climate Change; Acid Rain; Ozone Depletion; Radon and Fluoride problem in drinking water; Resettlement and rehabilitation of people, Environmental Toxicology.

Module - 5

Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO14001; Environmental Stewardship- NGOs.
Field work: Visit to an Environmental Engineering Laboratory or Green Building or Water Treatment Plant or Waste water treatment Plant; ought to be Followed by understanding of process and its brief documentation.

Course Outcomes: At the end of the course, students will be able to:

- CO1: Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale,
- CO2: Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
- CO3: Demonstrate ecology knowledge of a complex relationship between biotic and abiotic components.
- CO4: Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Question paper pattern:

- The Question paper will have 100 objective questions.
- Each question will be for 01 marks
- Student will have to answer all the questions in an OMR Sheet.
- The Duration of Exam will be 2 hours.

Sl. No.	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
Textbook/s				
1	Environmental Studies	Benny Joseph	Tata Mc Graw – Hill.	2nd Edition, 2012
2.	Environmental Studies	S M Prakash	Pristine Publishing House, Mangalore	3rd Edition, 2018
3	Environmental Studies – From Crisis to Cure	R Rajagopalan	Oxford Publisher	2005
Reference Books				
1	Principals of Environmental Science and Engineering	Raman Sivakumar	Cengage learning, Singapur.	2nd Edition, 2005

2	Environmental Science – working with the Earth	G.Tyler Miller Jr.	Thomson Brooks /Cole,	11th Edition, 2006
3	Text Book of Environmental and Ecology	Pratiba Sing, Anoop Singh& Piyush Malaviya	Acme Learning Pvt. Ltd. New Delhi.	1st Edition

6th SEMESTER

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

Analog and Digital Communication Systems
(Common to EI, BM &ML)

Subject Code	**: 18EI/BM/ML61**		CIE Marks	: 40
Number of Lecture Hours / Week	: 04		SEE Marks	: 60
Total Number of Lecture Hours	: 50		Exam Hours	: 03

Credits – 4 (Each module – 10 Hours)

Module -1
Introduction to analog and Digital Communication, Historical Background and Applications.
Amplitude Modulation: Amplitude Modulation, Virtues, Limitations, and Modifications of AM,DSBSC Modulation, Costas Receiver, Single Side band Modulation, Vestigial Sideband Modulation, Theme Examples.(Text 1:1.1,1.2,3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 3.9)

Module -2
Angle Modulation: Basic Definitions, Properties of Angle-Modulated Waves, Relationship between PM and FM Waves, NBFM, WBFM, Transmission Bandwidth of FM Waves, Generation of FM waves, Demodulation of FM Signals, Theme Example.(Text 1:Chapter 4)

Module -3
Pulse Modulation: Transition from Analog to Digital Communications: Sampling Process, PAM, Completing the Transition from Analog to Digital, Quantization Process, PCM, Delta Modulation, Theme Examples.(Text 1: 5.1, 5.2, 5.4, 5.5, 5.6, 5.7, 5.10)

Module -4
Digital Band-Pass Modulation Techniques: Binary Amplitude Shift Keying (BASK): Generation and Detection, Binary Phase Shift-Keying (BPSK): Generation and Detection, Quadriphase Shift Keying (QPSK): Generation and Detection, Binary Frequency Shift Keying (BFSK), Minimum-Shift Keying (MSK), Differential Phase Shift Keying (DPSK): Generation and Detection, Theme Examples.
(Text 1: 7.2, 7.3, 7.4, 7.6, 7.9)
[Note: Excluding Computer Experiments in all the above Modules]

Module -5
Wireless Personal Area Networks (WPAN): Network Architecture, WPAN Components, WPAN Technologies and protocols (Bluetooth &Zigbee), WPAN Applications.(Text2: 4.1, 4.2, 4.3, 4.4, 4.5)

Course Outcomes: After studying this course, students will be able to:

1. Explain the basics concepts of analogmodulation techniques.
2. Discuss the basic concepts of digital modulation techniques.
3. Describe the basic concepts of digital data and pulse communication.
4. Explain and analyze different digital modulation techniques.
5. Describe different wireless area networks and their applications.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Book:

1. Simon Haykin, John Wiley & sons, "Introduction to Analog and Digital Communications"-Second Edition, 2012, ISBN 978-81-265-3653-5.
2. Dr. SunilKumarS.Manvi, Mahabaleshwar S. Kakkasageri, "Wireless and Mobile Networks Concepts and Protocols", John Wiley & sons, 2014 Edition, ISBN 978-81-265-2069-5.

Reference Books:

1. John G Proakis and MasoudSalehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.
2. Ian A Glover and Peter M Grant, "Digital Communications", Pearson Education, Third Edition, 2010, ISBN 978-0-273-71830-7.
3. B. P. Lathi and Zhi Ding, "Modern Digital and Analog communication Systems", Oxford University Press, 4th Edition, 2010, ISBN: 978-0-198-07380-2.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

Power and Industrial Electronics

Subject Code	**: 18EI62**		CIE Marks	: 40
Number of Lecture Hours / Week	: 04		SEE Marks	: 60
Total Number of Lecture Hours	:50		Exam Hours	: 03

Credits – 4 (Each module – 10 Hours)

Module -1

Introduction: Applications of power electronics, power semiconductor devices, control characteristics, types of power electronic circuits, peripheral effects.

Power BJTs, switching characteristics, switching limits, base-drive control, introduction to IGBT, and MOSFET, isolation of gate and base drives.

Module -2

Thyristors: Introduction, static characteristics of SCR, two transistor model, turn-on and turn off methods, di/dt and dv/dt protection of SCR, series and parallel operation of thyristors, thyristor firing circuitusingUJT.

Commutation Techniques: Introduction, natural commutation, forced commutation: self-commutation, impulse commutation.

Module -3

Controlled Rectifiers: Introduction, principle of phase controlled converter operation, single-phase semi converters, full converters and dual converters.

AC Voltage Controllers: Introduction, principle of ON-OFF and phase control, single-phase bidirectional controllers with resistive and inductive loads.

Module -4

DC Choppers: Introduction, principle of step-down operation, step-down chopper with R- L loads, Principle of step-up operation, Classification of DC Choppers.

DC Drives: Introduction, basic characteristics of DC Motors, operating modes single phase Full-converter drives, Introduction to stepper motor

Module -5

Inverters: Introduction, principle of operation, single phase bridge inverters, three phase inverters, voltage control of single phase inverters, current source inverter

Applications of Power electronics: Power supplies, switched- mode DC power supplies and configurations, AC power supplies (UPS only), Industrial applications.

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

1. Explain static and dynamic characteristics of power semiconductor devices.
2. Analyze operation, model, characteristics, and turn-on and turn-off methods of devices.
3. Describe the converter circuits and their operation using Thyristors, BJT, MOSFET etc.
4. Analyze, evaluate and apply the power converter circuits in Industry
5. Apply the knowledge in the Domestic/Industrial control system applications.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Book:

1. Power Electronics - M. H. Rashid, Prentice Hall of India Pvt. Ltd., 2nd edition New Delhi, 2002.
2. Power Electronics: Converters, Applications and Design - Ned Mohan, Tore M. Undeland and William P. Robbins, 3rd Edition, John Wiley and Sons, 2003.

Reference Books:

1. Power Electronics- M. D. Sing and Khanchandani K. B., Tata McGraw Hill Publishing Company Limited, Reprint 2001.
2. Power Electronics - Cyril W. Lander, 3rd Edition, McGraw Hill, 1993.

Choice Based Credit System (CBCS)
Semester – VI

JAVA Programming
(Common to EI, BM & ML)

Subject Code	**: 18EI/BM/ML63**		CIE Marks	: 40
Number of Lecture Hours /Week	: 04		SEE Marks	: 60
Total Number of Lecture Hours	: 50		Exam Hours	: 03

Credits – 4 (Each module – 10 Hours)

Course Learning Objectives: This course will enable students to

- Understand object oriented programming concepts, and apply them in solving problems.
- Set up Java JDK environment to create, debug and run simple Java programs.
- Introduce the concepts of exception handling and multithreading.
- Introduce the design of Graphical User Interface using applets and swing controls.

Module -1

Object Oriented Programming and JAVA: Object Oriented Paradigm, basic concepts, benefits and applications of OOPs. JAVA history and features, How java differs from C and C++, JAVA and Internet, JAVA and World Wide Web, Web browsers, JAVA support systems, JAVA environment. JAVA program structure, Tokens, Statements, JAVA Virtual Machine.

Overview of JAVA Language: Simple Java Program, Math functions, An application with two classes, Java program structure, Java Tokens, Java Statement, Implementing a Java Program, Java Virtual Machines, Command and Line Arguments, Programming Style.

Module -2

Constants, Variables, Data Types: Declaration and scope of Variables, Symbolic constants, Type Casting, Standard Default values.

Operators and Expression: Arithmetic, Relational, Logical, Assignment, Increment, Decrement, Conditional, Bitwise, Special Operators, Arithmetic Expressions, Evaluation, Procedure of Operators, Type Conversion in Expressions, Mathematical functions.

Decision Making, Branching and Looping: If Statement, If….Else statement, Nesting of statements, Switch Statement, Operator, While Statement, Do statement, For statement, Jump in Loops.

Module-3

Classes, Objects and Methods: Class definition and declaration, Creating Object, Accessing Class Members, Constructors, Methods Overloading, Static Members, Nesting Methods, Inheritance, Overriding Methods, Final Variables and Methods, Final Classes, Finalizer Methods, Abstract Methods and Classes, Visibility Control.

Arrays, Strings and Vectors: One and two dimensional arrays, Strings, Vectors, Wrapper Classes

Module -4

Interfaces: Definition, Extending and Implementing Interfaces, Accessing Interface variables.

Packages: JAVA API Packages, Using System packages, Naming conventions, Creating, Accessing and Using a package, Adding a class to a Package, Hiding Classes.

Multithreaded Programming : Creating and Extending Thread Class, Stopping, Blocking and Life Cycle of Thread, Using Thread Methods, Thread Exceptions and Priority, Synchronization, Implementing runnable Interface.

Module -5

Applet Programming: Introduction, How Applets Differ from Applications, Preparing to write Applets, Building Applet Code, Applet Life Cycle, Creating an Executable Applet , Designing a Web Page, Applet Tag, Adding Applet to HTML File, Running the Applet, Passing Parameters to Applets, Aligning the Display, More about HTML Tags, Displaying Numerical Values, Getting Input from the User, Event Handling.

Course Outcomes: After studying this course, students will be able to

- Explain the object-oriented concepts and JAVA.
- Develop computer programs to solve real world problems in Java.
- Develop multithreaded applications with synchronization.
- Develop applets for web applications.
- Design GUI based applications.

Question Paper Pattern

- The question paper will have TEN questions
- Each full question carries 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Graduate Attributes

- Programming Knowledge
- Design/Development of Solutions
- Conduct Investigations of Complex Problems
- Life-Long Learning

Text Books:

1. E.Balaguruswamy – Programming with JAVA – A Primer – 5th Edition, McGraw Hill
2. Herbert Schildt, Java the Complete Reference, 7th Edition, Tata McGraw Hill, 2007.

Reference Books:

1. Object oriented programming in TURBO C++ - Robert Lafore, Galgotia Publications, 2002.
2. Mahesh Bhave and Sunil Patekar, "Programming with Java", First Edition, PearsonEducation, 2008.

Choice Based Credit System (CBCS)
Semester - VI

Aeronautical Instrumentation

Subject Code	**: 18EI641**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Aircraft Instruments: Introduction-Qualitative and quantitative displays, basic T grouping of instruments, basics of Altitude Director Indicator (ADI) &Horizontal Situation Indicator.

Air Data Instruments: Pneumatic type and air data computers, International Standard Atmosphere (ISA), combined pitot-static probe, separate static probe, air speed indicator, instantaneous vertical speed indicator.

Module -2

Altimeters, **Air Data Warning System:** Mach warning system, altitude alerts system, airspeed warning system.

Module -3

Directional Systems: Earth's total magnetic field, horizontal and vertical components of total field direct reading compass and its limitations, fluxgate detector units.gyro stabilized direction indicating systems.

Module -4

Gyroscopic Flight Instruments: types of gyros-mechanical, ring laser gyros, fiber optic gyros and their limitations, basic mechanical gyro and its properties namely rigidity and precision, gyro horizon, direction indicator, turn and bank indicator.

Module -5

Engine Instruments: pressure measurement (EPR), Temperature measurement (EGT), capacitance type volumetric fuel quantity indicator, densitometer, fuel quantity indicator by weight. Engine speed measurement, torque measurement, integrated impellor type flow meter.

Course Outcomes: After studying this course, students will able to

1. Outline the scope and extent of avionics and identify the types of flight instruments anddisplay panels.
2. Describe the fundaments of flight, basics of aircraft structures, propulsion and materialsused in the development of an aircraft.
3. Comprehend the complexities involved during development of flight vehicles.
4. Recognize the fundamental applications of gyroscopic flight instruments in aircraft and analyses the performance of aircraft control system and interpret the results.
5. Evaluate the performance characteristics of engine instruments of aircraft and give better view and ways to improve efficiency.

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Aircraft Instruments and Integrated Systems- EHJ Pallet, Longman Scientific & Technical, 1992.

Reference Books:

1. Aircraft Instrumentation and Systems -S. Nagabhushana&L.K. Sudha, IK International
2. Aircraft Systems: Mechanical, electrical, and avionics subsystems integration - Ian Moir and Allan Seabridge, Third Edition, John Wiley & Sons, Ltd., 2008.

Semester - VI				
Digital Image Processing				
Subject Code	: **18EI642**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Introduction: Background, Examples of fields that use DIP, Fundamental steps in Digital Image Processing (DIP), Components of DIP system, Image sensing and acquisition, A simple image formation model, Image sampling and quantization. Basic relationship between pixels, Color image processing fundamentals and models.

Text: Chapter 1, 2.3, 2.4, .2.5

Module -2

Image Enhancement in Spatial Domain: Background, Point processing – Image negatives, Log transformations, Power law transformations, Contrast stretching, Intensity level slicing, Bit plane slicing, Histogram processing – Histogram equalization, Histogram matching (specification), Arithmetic/Logicoperations. Fundamentals of spatial filtering, Smoothing spatial filters, Sharpening spatial filters

Text: 3.1, 3.2, 3.3, 2.6.1, 2.6.2, 2.6.3, 2.6.4, 3.4, 3.5, 3.6

Module -3

Image Enhancement In Frequency Domain: Background, 2D-Discrete Fourier Transform and its inverse, Basic properties of the 2D-Discrete Fourier Transform, Basicsof filtering in the frequency domain.

Image smoothing using frequency domain filters:Ideal low pass filters, Butterworth low-pass filters, Gaussian low-pass filters;Image sharpening using frequencydomain filters, Ideal high-pass filters, Butterworth high-pass filters, Gaussian high-pass filters, Homomorphicfiltering.

Text: 4.1, 4.2, 4.5.5, 4.6, 4.7,4.8, 4.9

Module -4

Image Restoration: Model of the Image degradation/restoration process, Noise models, Restoration using spatial filtering: Mean filters, Order statistic filters - Median filter, Min and Max filters, Midpoint filter.

Image Compression: Fundamentals, Image compression models, Basic compression methods – Huffman coding, Arithmetic coding, LZW coding, Run-length coding.

Text: 5.1, 5.2, 5.3.1, 5.3.2, 8.1, 8.2.1, 8.2.3, 8.2.4, 8.2.5

Module -5

Image Segmentation: Fundamentals, Point detection, Line detection, Edge models, Edge detection, Cannyedge detector.

Thresholding, Region based segmentation.

Text: 10.1, 10.2.1 – 10.2.6, 10.3, 10.4

Course Outcomes: After studying this course, students will be able to:

1. Describe the fundamentals of Image Processing and Image transform techniques.
2. Apply image enhancement technique in frequency and spatial domain
3. Analyze and implement restoration and color models.

4. Develop and analyze image compression techniques.
5. Apply segmentation algorithms for general image.
6. Develop image processing algorithms for real-world problems.

Question Paper Pattern

- The question paper will have TEN questions
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Digital Image Processing - Rafael. C. Gonzalez and Richard. E. Woods, Third Edition, Pearson Education, 2008.

Reference Books:

1. Fundamentals of Digital Image Processing - Anil K. Jain, 5th Indian Print, PHI, 2002.
2. Digital Image Processing and Computer Vision - Milan Sonka, India Edition, Cengage Learning.

Semester - VI

Operating Systems

(Common to EI & BM)

Subject Code	**: 18EI/BM643**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Introduction to Operating Systems: What operating systems do, Computer System Organization, Architecture and Operations, Process Management, memory management, Storage Management, Protection and Security, Computing Environments.

Operating system structures: OS Services, User-OS Interface, System calls, System programs, OS structure, System Boot.

Text: 1.1, 1.2, 1.3, 1.5, 1.6, 1.7, 1.8, 1.9, 1.11, 2.1, 2.2, 2.3, 2.5, 2.7, 2.10.

Module -2

Process Management

Processes: Process concept, Process scheduling, Operation on processes, Inter process communication.

Threads – Overview, Multithreading models, Threading issues.

CPU scheduling – Basic concepts, Scheduling criteria, Scheduling algorithms, real time scheduling.

Text: 3.1, 3.2, 3.3, 3.4, 4.1, 4.3, 4.6, 6.1, 6.2, 6.3, 6.6

Module -3

Process Synchronization: Background, The critical section problem, Peterson's Solution, Synchronization hardware, Mutex Locks, Semaphores, Classical problems of synchronization, Monitors.

Deadlock – System model, Deadlock characterization, Methods for handling deadlocks, deadlock prevention, deadlock avoidance, deadlock detection and recovery from deadlock.

Text: 5.1, 5.2, 5.3, 5.4, 5.5, 5.6, 5.7, 5.8, 7.1, 7.2, 7.3, 7.4, 7.5, 7.6, 7.7.

Module -4

Memory management:

Main Memory: Background, Swapping, Contiguous, allocation, Paging.

Virtual memory: Background, Demand paging, Copy-on-write, Page replacement.

Text: 8.1, 8.2, 8.3, 8.5, 9.1, 9.2, 9.3, 9.4.

Module -5

Storage Management:

Mass storage structure: Overview of mass storage structure, Disk structure, Disk scheduling, Disk management, Swap space management.

File System Interface: File concept, Access methods, Directory and Disk structure, File system mounting, Protection.

File System Structure: File system structure, File system implementation, Directory implementation, Allocation methods, and free space management.

Text: 10.1, 10.2, 10.4, 10.5, 10.6, 11.1, 11.2, 11.3, 11.4, 11.6, 12.1, 12.2, 12.3, 12.4, 12.5

Course Outcomes: After studying this course, students will able to;

1. Define OS and explain organization of computer system, and components, computing environments, & typical structure of OS.

2. Analyze the process management, process scheduling and threads.
3. Describe the concepts of process synchronization and analyze the problems of synchronization
1. Evaluate, prevent and avoid the deadlocks
2. Develop the techniques of memory allocation and paging
3. Apply appropriate disk scheduling algorithms.
4. Describe the interfaces to file systems, file structure and implement file systems and directory structure.

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Operating System Concepts-by Abraham Silberschatz, Peter Baer Galvin, Greg Gagne, **9th Edition**, John Wiley &Sons 2016 (India Edition).

Reference Books:

1. Operating system concepts and design- Milan Milankovic, 2nd Edition, McGraw Hill 1992.
2. Operating systems- Harvey M Deital Addison Wesley 1990.
3. Operating Systems concepts based approach, D.M. Dhamdhere, Tata McGraw Hill 2002.

Robotics and Automation

Subject Code	: 18EI644		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Fundamentals of Robotics &Automation: Automation and robotics, history of robotics, robotics market and future prospects, robot anatomy, work volume, robot drive systems, control systems, precision of movement, end effectors, robotic sensors, robot programming and work cell control, robot applications[Textbook-1]

Automation Concepts: SCADA, introduction and brief history of SCADA, SCADA systems software, distributed control system (DCS), introduction to the PLC, considerations and benefits of SCADA system. [Textbook-2]

Module -2

Robot Motion Analysis, Sensors and Control: Introduction to manipulator kinematics, homogeneous transformations and robot kinematics, manipulator path control, robot dynamics, configuration of a robot controller, types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems.

Sensors inRobotics: Transducers and sensors, sensors in robotics, tactile sensors, proximity and rangesensors, uses of sensors in robotics. [Textbook-1]

Module -3

Machine Vision, Robot Programming & Artificial Intelligence: Introduction to machine vision, sensing and digitizing function in machine vision, image processing and analysis, training the vision system, robotic applications, problems. RobotProgramming: Methods of robot programming, lead - through programming methods, a robotprogram as a path in space, motion interpolation, wait, signal and delay commands, branching, capabilities and limitations of lead-through methods, problems.

Artificial Intelligence (AI): Introduction & goals of AI in research, AI techniques, LISP programming,AI & robotics, LISP in factory, robotic paradigms. [Textbook-1]

Module -4

Robotics in Manufacturing/Automation , Material Transfer, Machine Loading/Unloading:

Robot cell layouts, multiple robots and machine interference, considerations in work -cell design, work-cell control, interlocks, error detection and recovery, work -cell controller, robot cycle time analysis, graphic simulation of robotic work-cells, problems.

Material Transfer, Machine Loading/Unloading: General considerations in robot material handling, material transfer applications, machine loading and unloading. [Textbook-1]

Module -5

Robots in Automatic Processing Operations, Assembly &Inspection: Introduction, spot welding, continuous arc welding, spray coating, other processing operations. Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote center compliance (RCC) device, assembly system configurations, adaptable programmable assembly system, designing for robotic assembly, inspection automation. [Textbook-1]

Autonomous Mobile Robots: Introduction, Planning &Navigation: Introduction, basic control scheme for mobile robots (only basic understanding of perception, localization, path planning & motion control). [Textbook-3]

Course Outcomes: After studying this course, students will able to:

1. Identify basic components of robot system and its functionality
2. Analyze the functions of sensors in the robot.
3. Solve forward and inverse kinematic problems.
4. Evaluate and compare the use Robots in different applications.
5. Recognize material-handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. SrinivasMedida, Pocket Guide on Industrial Automation: For Engineers and Technicians, 1st Edition, IDC Technologies, 2007. (http://www.pacontrol.com/download/Industri al-Automation-Pocket-Guide.pdf)
3. Roland Siegwart, Illah R. Nourbakhsh, and DavideScaramuzza, "Introduction to Autonomous Mobile Robots", 2ndEdition, PHI, 2011.

Reference Books:

1. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.

B.E. Electronics and Instrumentation Engineering (EI)

Choice Based Credit System (CBCS)

Semester - VI

Power Electronics, Controls and Communication Lab

Subject Code	: **18EIL66**		CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	: 02+02		SEE Marks	: 60
Total No. of Practical Hours	: 42		Exam Hours	: 03

Credits:2

1. Static VI characteristics of SCR.
2. Static VI characteristics of Triac. (First and Third mode only).
3. Controlled half wave rectifier using R & RC triggering.
4. AC voltage controller using Triac&Diac.
5. Full wave controlled rectifier using one SCR and four diodes.
6. To determine the step response of 1^{st}order system using RC circuit and to measure time constant.
7. To determine the step response of 2^{nd}order system using RLC circuit and to determine Time domain specifications for under damped and critically damped conditions. Verification using theoretically calculated values.
8. To study the frequency response of Lag, Lead and Lag-lead Network.
9. Characteristics of IGBT and MOSFET.
10. Stability analysis of a given Transfer Function based on Bode plot / Root locus / Nyquist plots using Matlab / Lab VIEW codes.
11. To design and test tuned amplifier using BJT/FET/ MOSFET.
12. Amplitude modulation using transistor/FET/ MOSFET(Generation and detection).
13. Frequency modulation using IC 8038/2206 and demodulation.
14. ASK &FSK: Generation and Detection.

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

1. Recognize and demonstrate functioning of semiconductor power devices.
2. Evaluate the characteristics,switching, power conversion and control by semiconductor power devices.
3. Design and analyze 1^{st} and 2^{nd} order control system, compensators and controllers, and evaluate stability of a system.
4. Design and verify the frequency tuning, AM and FM circuits used in communication systems.
5. Apply the concepts to build power electronic circuits, control and communication systems

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

B.E. Electronics and Instrumentation Engineering (EI)

Choice Based Credit System (CBCS)

Semester - VI

JAVA Programming Lab

(Common to EI, BM & ML)				
Subject Code	: **18EI/BM/MLL67**		CIE Marks	: 40
Number of Tutorial+ Practical Hours/Week	: 02+02		SEE Marks	: 60
Total No. of Practical hours	:42		Exam Hours	: 03

Credit-2

1) a. Write a java Program to illustrate the creation of variables of basic types and effect of type conversions.
   b. Write a java Program that display the roots of a quadratic equation ax2+bx=0. Calculate the discriminate D and based on value of D, describe the nature of root.
2) a. Write a java program to demonstrate creation and accessing of objects and methods.
   b. Write a java program to illustrate use of constructor overloading and method overloading.
3) a. Write a java Program to demonstrate the concept of single Inheritance.
   b. Write a java program to implement multi level Inheritance.
4) Write a simple Program on Java to illustrate the implementation of the concept of multiple inheritance using interfaces.
5) a. Write a java program to demonstrate StringMethods used for manipulating strings like accessing, inserting, modifying and appending.
   b. Write a java program to illustrate use of most commonly used wrapper class methods.
6) Write a Java program to implement the concept of importing classes from user defined package and creating packages.
7) Write a Java program using Synchronized Threads, which demonstrates Producer Consumer concept.
8) a. Write a Java program for creation of Java Built-in Exceptions.
   b. Write a Java program for creation of User Defined Exceptions.
9) Complete the following:
   i. Create a package named shape.
   ii. Create some classes in the package representing some common shapes like Square, Triangle, and Circle.
   iii. Import and compile these classes in other program
10) a. Write a Java program to copy bytes from one file to another using FileInputStream and File Output Stream.
    b. Write a Java program to illustrate the process of file concatenation and buffering.
11) Write a Java applet program, which handles keyboard event.
12) Write an Applet that displays ―Hello World‖ (Background color-black, text color-blue and your name in the status window.).
13) Write a Java Program to demonstrate Mouse events.
14) Write programs for using Graphics class
    i. To display basic shapes and fill them
    ii. Draw different items using basic shapes
    iii. set background and foreground colors.

Assignment: Create simple JAVA or Android Calculator console application which performs both basic and scientific operation.

Course Outcome: After the completion of this Laboratory course, students will be able to:

1. To Understand OOPs concepts and basics of Java programming.
2. To Create Java programs using inheritance and polymorphism.
3. To Implement error-handling techniques using exception handling and multithreading.
4. To Develop GUI using Applets and Swing components.

5. Analyze, design and develop solutions to real-world problems applying OOPs concepts through JAVA.
Conduct of Practical Examination: • All laboratory experiments are to be included for practical examination. • Students are allowed to pick one experiment from the lot. • Strictly follow the instructions as printed on the cover page of answer script for breakup of marks. • Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero.

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VI			
Mini Project			
Subject Code	: **18EIMP68**	CIE Marks	: 40

Number of Practical Hours /Week	: 02		SEE Marks	: 60
Total Number of Lecture Hours	: --		Exam Hours	: 03

Credits – 2

Mini-project work:
Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary Mini-project can be assigned to an individual student or to a group having not more than 4 students.

CIE procedure for Mini-project:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.
The CIE marks awarded for the Mini-project work, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all the guides of the college.
The CIE marks awarded for the Mini-project, shall be based on the evaluation of project report, project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

SEE for Mini-project:

(i) Single discipline: Contribution to the Mini-project and the performance of each group member shall be assessed individually in the semester end examination (SEE) conducted at the department.

(ii) Interdisciplinary: Contribution to the Mini-project and the performance of each group member shall be assessed individually in semester end examination (SEE) conducted separately at the departments to which the student/s belong to.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VI

Internship

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be

included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

7th SEMESTER

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VII				
Automation in Process Control				
Subject Code	**: 18EI71**		CIE Marks	: 40
Number of Lecture +	: 2+2		SEE Marks	: 60

Tutorial Hours /Week				
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Introduction to Programmable Logic Controllers (PLC): The digital concept, Analog signals, The input status file, the output status file, input and output status file, sixteen point I/O modules, PLC addressing, PLC memory.

Input modules: Discrete input modules, Discrete AC and DC input modules

Output modules : Discrete output modules, solid-state output module switching, relay output modules

Module-2

PLC Instructions: What is logic?, PLC programming languages, ladder programming- Conventional ladder Vs PLC ladder, the basic relay instructions: Normally open and normally closed, output and latching instructions, series and parallel function of AND, OR, NOT, XOR logic, Analysis of rung. Understanding relay instructions and the PLC input modules, interfacing start stop pushbutton and motor to PLC, developing ladder diagrams with analytical problems.

Module -3

Timers and Counter Instructions: Timer addressing, On delay, off delay and retentive timer instructions and associated status bits. Counter addressing, PLC counter up and down instructions and associated status bits.

Data Handling Instructions: Data handling instructions-MOVE, Masked Move, COPY. Sequencer instructions: Programming sequence output instructions, developing ladder diagram with analytical.

Module -4

Distributed Digital Control: Introduction, History, Functional requirements of Distributed Process Control System, System Architecture, Distributed Control Systems, Configuration, Some popular Distributed Control Systems, Field bus System

Text 2: **Ch.7; 7.1 To 7.8**

Module -5

Supervisory Control and data Acquisition System: Basic Functions: Channel Scanning, conversion to Engineering units, Data Processing, Distributed SCADA System, Remote Terminal Unit, Reliable System Development Strategy.

Modeling and Simulation for Plant Automation: Introduction, Overview of Process Models, Model Based Automatic Control, System Modeling, uses of systems simulation, How to build the mathematical model of a plant, Model evaluation & improvement, Modern tools for modeling and simulation of systems.

Text 2: **Ch.3**; 3.6,3.7, 3.8 (3.8.1- 3.8.7), and **Ch.11;** 11.1,11.2,11.3,11.5,11.6,11.7,11.8,11.9

Note: Minimum ONE industrial visit need to be organized to see automation of process industries based on PLC, SCADA and DCS.

Course Outcomes: After studying this course, students will be able to:

1. Describe architecture, functioning and applications of PLC in automation.
2. Recognize various I/O modules of PLC and apply programming concepts to interface peripherals.
3. Write ladder diagram program using different PLC instruction sets
4. Develop an automation system based on PLC ladder diagram program.
5. Analyze the basics of distributed control system and communication protocols used in automation industries.
6. Develop process automation system using SCADA and DSC.

7. Develop models of process automation using modern tools.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Introduction to Programmable Logic Controllers, Garry Dunning, 3nd edition, Centage Learning. (Modules: 1, 2 & 3).
2. Computer based Industrial Control, Krishna Kant, 2nd edition, PHI, 2017 (Modules: 4&5)

Reference Books:

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
3. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3, 60870.5 and Related Systems", Newnes, 1st Edition, 2004

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

ARM Processor

(Common to EI, BM & ML)

Subject Code	: **18 EI/BM/ML72**	CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2	SEE Marks	: 60

Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

ARM Embedded Systems

Introduction, RISC design philosophy, ARM design philosophy, Embedded system hardware - AMBA bus protocol, ARM bus technology, Memory, Peripherals, Embedded system software – Initialization (BOOT) code, Operating System, Applications.

ARM Processor Fundamentals

ARM core dataflow model, registers, current program status register, Pipeline, Exceptions, Interrupts and Vector Table, Core extensions.

Module -2

Introduction to the ARM Instruction set:

Introduction, Data processing instructions, Load - Store instruction, Software interrupt instructions, Program status register instructions, Loading constants, ARMv5E extensions, Conditional Execution.

Module -3

Introduction to the THUMB instruction set:

Introduction, THUMB register usage, ARM – THUMB interworking, Other branch instructions, Data processing instructions, Stack instructions, Software interrupt instructions.

Efficient C Programming:

Overview of C Compilers and optimization, Basic C Data types, C looping structures.

Module -4

Exception and Interrupt Handling:

Exception Handling-ARM Processor Exceptions and Modes, Vector Table, Exception Priorities, Link Register Offset, Interrupts- Interrupt Latency, Basic Interrupt Stack design and implementation, Interrupt Handling Scheme- Non nested Interrupt Handler, Nested Interrupt Handler, Reentrant Interrupt Handler, Prioritized Simple Interrupt Handler, Prioritized Standard Interrupt Handler, Prioritized Direct Interrupt Handler, Prioritized Grouped Interrupt Handler.

Embedded Operating Systems:

Fundamental Components, SLOS Directory Layout, Memory Interrupts and Exceptions handling, scheduler, Context Switch, Device Driver Framework.

Module -5

CACHES:

The memory Hierarchy and caches memory-caches and memory management units, Cache Architecture-basic architecture of caches memory, basic operation of cache controller, the relationship between cache and main memory.

Memory Management Units:

Moving from an MPU to an MMU**,** Virtual memory Working-Defining regions using pagers, multitasking and the MMU, Memory organization in a virtual memory system, page tables Translational look aside buffer.

Note: Two or four tutorial classes need to be conducted (in a semester) to discuss the Embedded ARM Applications, such as GSM Chip and Bluetooth controller & assignment should be based on applications only.

Course Outcomes: After studying this course, students will be able to:

1. Depict the organization, architecture, bus technology, memory and operation of the ARM microprocessors
2. Employ the knowledge of Instruction set of ARM processors to develop basic Assembly

Language Programs

3. Recognize the importance of the Thumb mode of operation of ARM processors and develop C programs for ARM processors
4. Describe the techniques involved in Exception and Interrupt handling in ARM Processors and understand the fundamental concepts of Embedded Operating Systems
5. Develop embedded C programs to interact with Built in Peripherals
6. Design, analyze and write programs using RTOS (MicroC/OS) on ARM based development boards.

Question Paper Pattern

- The Question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Andrew N Sloss, Dominic System and Chris Wright," ARM System Developers Guide", Elsevier, Morgan Kaufman publisher, 1st Edition, 2008/,ISBN:1758608745.

Reference Books:

1. David Seal, "ARM Architecture Reference Manual", Addison- Wesley, 2nd Edition, 2009, ISBN:978-0201737196.
2. Furber S, "ARM System on chip Architecture", Addison Wiley, 2nd Edition 2008, ISBN:978-0201675191
3. Rajkam, "Embedded System", Tata McGraw-Hill Publishers, 2nd Edition, 2008, ISBN: 0070494703.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Mechatronics

Subject Code	**: 18EI731**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	:40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)
Module 1 **Introduction:** Introduction to Mechatronics, Design process, Systems, Measurement systems, Control systems, Examples of mechatronic systems: Digital camera with autofocus, Engine management system. **Sensors and Transducers** (only selected topics): Smart sensors, Pneumatic sensors, Proximity switches, Pyroelectric sensors, Piezoelectric sensors, Tactile sensor. [Textbook-1]
Module -2 **Pneumatic And Hydraulic Actuation Systems:** Actuation systems, Pneumatic and hydraulic systems, Directional control valves, Pressure control valves, Servo and proportional control valves, Process control valves, Rotary actuators. **Mechanical Actuation Systems:** Mechanical systems, Types of motion, Kinematic chains, Cams, Gears, Belt and chain drives, Bearings.[Textbook-1]
Module -3 **Electrical Actuation Systems:** Electrical systems, Mechanical switches, Solenoids, D.C. motors, A.C. motors, Stepper motors. **Fault Finding:** Fault-detection techniques, Watchdog timer, Parity and error coding checks, Common hardware faults, Microprocessor systems, Emulation and simulation. [Textbook-1]
Module -4 **Interfacing Microcontrollers with Actuators:** Introduction, Interfacing with general purpose three state transistors, Interfacing relays, Interfacing solenoids, Interfacing stepper motors, interfacing permanent magnet motors, Interfacing sensors, Interfacing with DAC, interfacing power supplies, Compatibility at an interface. **Reliability:** Meaning of reliability**,** The life curve, Repairable and non-repairable systems, Failure or hazard rate models, Reliability systems, Response surface modeling. [Textbook-2]
Module -5 **Components Based Modular Design and System Validation:** Introduction, Components based modular design view, System validation, Validation methodology, Validation scheme, Fusion technique-An example with vision system. **Integration:** Introduction, Background, Advanced actuators, Industrial robot, Autonomous guided vehicle (AGV), Drilling machine for PCB board. [Textbook-3]
Course Outcomes: After studying this course, students will be able to: 1. Describe and analyze the mechatronic systems and their associated systems 2. Discuss and illustrate different types of actuation systems that can be employed in a mechatronic system. 3. Demonstrate the integration of mechatronic systems. 4. Identify and solve the faults in mechatronic systems and assess the reliability. 5. Designand develop microcontroller and actuator based mechatronic system. 6. Design modular system and perform validation.
Question Paper Pattern • The question paper will have TEN questions. • Each full question carry 20 marks • There will be TWO full questions (with maximum of THREE sub questions) from each module. • Each full question will have sub questions covering all the topics under a module. • The students will have to answer FIVE full questions, selecting ONE full question from each

module.

Text Books:

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering– W. Bolton, Pearson Education Asia, 4th Edition, 2013.
2. Mechatronics: Principles and Applications – Godfrey C. Onwubolu, Elsevier (BH) Publications, India Reprint 2013.
3. Mechatronics: Principles, Concepts and applications – NitaigourPremchandMahailik, TMH, 2003.

Reference Books:

1. Introduction to mechatronics and measurement systems –David G. Alciatore& Michel BiHistand, Tata McGraw Hill –2000.
2. Mechatronics H.D. Ramachandra, Sudha Publication 2003 Mechatronics by HMT Ltd. Tata McGraw-Hill, 2000.
3. Mechatronics System design by DevadasShetty and Richard A. Kark, Thomas Learning, 1997.
4. Mechatronics an Introduction by Robert H Bishop, CR, 2005.
5. Mechatronics Systems Fundamentals by Rolf Isermann, Springer, 2005

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Power Plant Instrumentation

Subject Code	**: 18EI732**	CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2	SEE Marks	: 60
Total Number of Lecture Hours	: 40	Exam Hours	: 03

Credits – 3 (Each module – 08Hours)

Module -1

Coal Based Thermal Power Plants: Rankine cycle - improvisations, Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants – Fuel and ash handling, Draught system, Feed water treatment. Binary Cycles and Cogeneration systems.

Module -2

Diesel, Gas Turbine And Combined Cycle Power Plants: Otto, Diesel, Dual &Brayton Cycle - Analysis & Optimization. Components of Diesel and Gas Turbine power plants. Combined Cycle Power Plants. Integrated Gasifier based Combined Cycle systems.

Module -3

Nuclear Power Plants: Basics of Nuclear Engineering, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors : Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANada Deuterium- Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants.

Module -4

Power From Renewable Energy: Hydro Electric Power Plants – Classification, Typical Layout and associated components including Turbines. Principle, Construction and working of Wind, Tidal, Solar Photo Voltaic (SPV), Solar Thermal, Geo Thermal, Biogas and Fuel Cell power systems.

Module -5

Energy, Economic And Environmental Issues Of Power Plants: Power tariff types, Load distribution parameters, load curve, Comparison of site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Pollution control technologies including Waste Disposal Options for Coal and Nuclear Power Plants.

Course Outcomes: After studying this course, students will be able to:

1. Identify the resources of power generation and implementation
2. Describe the installation, operation, maintenance and control of coal based power plant
3. Recognize various analyzer for monitoring impurity, feed water and flue gas etc.
4. Evaluate the safety and boiler control system in power plants
5. Apply the knowledge to design, install, control and monitor the power plants as per the natural resources.

Note: Faculty members are advised to take the students to power generation stations/plants and assignments can be based on these visits.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Power Plant Engineering, P.K. Nag, McGraw-Hill Education.3rd edition 2008.

Reference Books:

1. Power Plant Technology, M.M. El-Wakil, McGraw-Hill Education .2010
2. Thermal Engineering, R. K. Rajput, Laxmi Publication

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Advanced Control Systems

Subject Code	: **18EI733**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	:40		Exam Hours	: 03

Credits – 3 (Each module – 8 Hours)

Module -1

Design of Lag/Lead/Lag-lead compensators using Frequency domain (Bode plot) technique: Lead, lag, lead lag network and compensator design using Bode techniques. Numerical problems

Text 1:9.1, 9.2, 9.3, 9.4.

Module-2

Design of Lag/Lead/Lag-lead compensators using Root Locus technique: Lead, lag, lead lag network and compensator design using Root locus techniques. Numerical problems

Text 1: 7.1, 7.2, 7.3, 7.4, 7.5.

Module -3

Nonlinear Systems: Introduction, Common physical nonlinearities, phase-plane Method: Basic concepts, singular points, Stability of non –linear system, Construction of phase trajectories (by analytical method only).

Describing function Method: Basic Concepts, Derivation of describing functions, Stability Analysis by Describing function Method,

Text 3:17.1, 17.2, 17.7, 17.8, 17.9

Module -4

Introduction to Discrete Time Control Systems: Introduction, Digital Control Systems, Impulse sampling and Data Hold, Reconstructing original signals from Sampled signals, The Pulse Transfer Function, Stability analysis of closed loop systems in the Z-plane.

Text 2: 1.1, 1.2, 3.2, 3.4, 3.5, 4.3.

Module -5

State space Analysis: State-Space representations of continuous and discrete-Time systems, Solving Discrete-time state space equations, Controllability, Observability. Numerical problems

Text 2: 5.1, 5.2, 5.3, 6.2, 6.3.

Course Outcomes: After studying this course, students will be able to:

1. Explain concepts of Lag, Lead and lag-Lead networks and their design and implementation in controls systems
2. Design of control system for given time domain and frequency domain specifications
3. Describe the concept of nonlinearity and linearity of systems and stability analysis
4. Describe the concept of discrete control system, transform function and solutions and stability analysis
5. Develop model of physical process in state space form and solve state space equations.
6. Test the controllability and observability of a system.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Modern Control Engineering – K. Ogata, 3rd Edition, Prentice Hall of India, 1997.
2. Discrete Time Control Systems – K. Ogata, 2nd Edition, Prentice Hall of India, 1995.

3. Control Systems Engineering – J. Nagarath& M. Gopal, New Age Int. Pvt. Ltd. Publishers, 5th Edn. 2008.

Reference Books:

1. Digital control and state variable methods, Madan Gopal, PHI, 2nd Edition, 2005.
2. Advanced control theory- A NagoorKani, 2nd edition, RBA Publications.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VII

Electrical Machines and Drives

Subject Code	: **18EI734**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/ Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 08Hours)

Module -1

Electrical Circuits and Transformers: Ohms law, series and parallel circuits Kirchhoff's law mesh analysis, A.C. voltage – sinusoidal waves, power factor complex power Basic operation of transformers, EMF equation, Turns ratio, Losses and efficiency– simple problems

Module -2

Electrical Motors: Constructional details, principle of operation and performance characteristics of D.C. motors, single phase induction motor, three phase induction motor, synchronous motors, universal motors, stepper motors and reluctance motor

Module -3

Speed Control and Starting: Speed control of D.C. motors – three phase induction motors – starting methods of D.C. motor and three phase induction motor – electrical braking – simple problems

Module -4

Electrical Drives: Type of Electrical Drives – Selection & factors influencing the selection – heating and cooling curves –loading condition and classes of duty – determination of power rating – simple problems

Module -5

Solid State Drives (Qualitative Treatment Only): Advantages of solid state drives – D.C. motor control using rectifiers and choppers – control of induction motor by V, V/f and slip power recovery scheme using inverters and A.C. power regulators

Course Outcomes: After studying this course, students will be able to:

1. Formulate and analyze the basic construction, working principle and characteristics of various electrical machines.
2. Evaluate the performance characteristics of motor drives for mechanical load requirements to design torque, speed and position controller in an energy efficient manner
3. Describe the various electrical drives with basic structure, operation and characteristics.
4. Analyze the structure of electric drive systems and their role in various applications and requirements placed by mechanical systems on electric drives.
5. Illustrate the basic concepts of solid-state drives in controlling of DC motor and induction motors.
6. Design and install electrical machines and drives in an industrial environment.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Vukosavic, "Digital Control of Electrical Drives", Springer, Indian Reprint, 2010.
2. Vedam Subrahmanyam. "Electric Drives: Concepts and Applications", Tata McGraw Hill, New Delhi, 2007.
3. N.K.De and P. K. Sen, "Electric Drives", Prentice Hall India Pvt. Limited 2002.

Reference Books:

1. Crowder, "Electric Drives and Electromechanical Systems", Elsevier, Indian Reprint, 2009
2. DubeyG.K. "Fundamental Electrical Drives" 2nd Edition, Narosa Publications, 2002
3. Bhattacharya S.K. &Brinjinder Singh , "Control of Electrical Machines", New Age International

Publishers, 2002

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) **Semester - VII**				
Smart Sensors and Intelligent Instrumentation				
Subject Code	: **18EI741**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 08 Hours)				

Module -1

Basics of smart sensors and micromachining: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining, other micromachining techniques.

Module -2

MCUs and DSPs for sensor: Introduction, MCU control, MCUs for sensor interface, DSP control, Software, tools and support, sensor integration.

Module -3

Sensor Communication and MEMS: Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Micro optics, micro-grippers, micro-probes, micro- mirrors, FEDs, communications for smart sensors - sources and standards, automotive protocols, industrial networks, office and building automation, home automation, protocols in silicon, other aspects of network communications.

Module -4

Packaging, Testing and Reliability of Smart Sensors: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors. Unit Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.

Module -5

Implications of Smart Sensor Standards and Recent Trends: Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.

Course Outcomes: After studying this course, students will be able to:

1. Describe the principle of smart sensors and process of micromachining in development of smart sensors.
2. Develop intelligent systems by interfacing the smart sensors to MCUs and DSPs.
3. Analyze the use of smart sensors in communication, MEMS and automation.
4. Evaluate the standards of smart sensors by the assessment of reliability testing and packaging.
5. Discuss the applications of smart sensors in different fields and recent development.
6. Develop/sketch the simple models of intelligent instrumentation.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Understanding Smart Sensors- Randy Frank, 2nd Edition. Artech House Publications, 2013.

Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems: Technology and modeling, Willey Publications,2012.

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) **Semester - VII**				
Biomedical Signal Processing				
Subject Code	: **18EI742**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 08 Hours)				

Module -1

Introduction: The nature of biomedical signals, objectives of biomedical signal analysis, difficulties encountered in biomedical signal analysis, Computer aided diagnosis. Text-1: 1.1, 1.3, 1.4, 1.5

Neurological Signal processing: Brain and its potentials, Electrophysiological origin of Brain waves, EEG signal and its characteristics, EEG analysis, Linear prediction theory, Autoregressive (AR) method, Recursive Estimation of AR parameters, Spectral error measure, Adaptive segmentation.

Text-2: 4.1 to 4.9

Module -2

Filtering for Artifacts Removal: Random noise, structured noise and physiological interference, stationary versus non-stationary processes, typical case study, time domain filters with application: Synchronized averaging, moving-average filters.

Frequency domain filters with examples, removal of high frequency noise by Butterworth low pass filters, removal of low frequency noise by Butterworth high pass filter, removal of periodic artifacts by notch and comb filters. Weiner filter

Text-1: 3.1, 3.1.1, 3.1.2, 3.3, 3.3.1, 3.3.2, 3.3.3, 3.4, 3.4.1, 3.4.2, 3.4.3, 3.5.

Module-3

Basics of signal averaging, Signal averaging as a digital filter, A typical average, Software for signal averaging, Limitations of signal averaging.

Text-3: 9.1 to 9.5

Data Acquisition and classification of sleep stages, The Markov model and Markov chains, Dynamics of Sleep-wave Transitions, Hypnogram Model Parameters.

Text-2: 5.1 to 5.4

Module -4

ECG Parameters and their estimation, A review of wiener filtering problem, Principle of an adaptive filter, the steepest descent algorithm, Adoptive noise canceller, Cancellation 60Hz Interference in ECG, Cancelling Donor heart Interference in Heart-transplant ECG, Cancellation of Electrocardiographic signals from the electrical activity of chest muscles, Cancelling of maternal ECG in Fetal ECG, Cancellation of higher frequency noise in electro-surgery.

Text-2: 7.4, 6.1, 6.2, 6.3, 6.5, 6.6.

Module -5

Direct data compression techniques, Direct ECG data compression techniques, Transformation compression techniques, Other data compression techniques, Data compression techniques comparison.

Text-2: 8.1 to 8.5

Course Outcomes: After studying this course, students will be able to:

1. Discuss the origin, nature and characteristics of biomedical signals.
2. Identify the noise and artifacts in biomedical signals and apply suitable filters remove.
3. Apply the signal averaging technique.
4. Evaluate various event detection techniques for the analysis of the EEG and ECG.
5. Apply different data compression techniques on biomedical Signals.
6. Develop algorithms to process and analyze biomedical signals for better diagnosis.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.

- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Biomedical signal analysis- A case study approach, Rangayyan Rangaraj, Wiley Inderscience (IEEE Press)-2005
2. Biomedical Signal Processing- principles and techniques, Tata McGraw-Hill, D.C.Reddy, 2005
3. Biomedical Digital Signal Processing-Willis J.Tompkins, PHI,

Reference Books:

1. Biomedical Signal Processing -Akay M, , Academic: Press 1994.
2. Biomedical Signal Processing -Cohen.A, -Vol. I Time & Frequency Analysis, CRC Press, 1986.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Computer Communication Networks

Subject Code	: **18EI743**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 08 Hours)

Module -1

Introduction: Uses of Computer Networks, Network Hardware, Network Software, Reference Models, Example Networks, Network Standardization

The Physical Layer: The Theoretical Basis for Data Communication, Guided Transmission Media, Wireless Transmission, Communication Satellites, The Public Switched Telephone Network,

Module -2

The Data Link Layer: Data Link Layer Design Issues, Error Detection and Correction,

Elementary Data Link Protocols, Sliding Window Protocols, Protocol Verification, Data Link Protocols

Module -3

The Medium Access Control Sub Layer: The Channel Allocation Problem,

Multiple Access Protocols, Ethernet, Wireless LANS Broadband Wireless, Bluetooth

Module -4

The Network Layer: Network Layer Design Issues,

Routing Algorithms, Congestion Control Algorithms and quality of service.

Module -5

The Transport Layer: The Transport Service. A Simple Transport Protocol, The Internet Transport Protocols (TCP and UDP), Performance Issues.

The Application Layer: Domain Name System (DNS), electronic mail, worldwide web.

Course Outcomes: After completion of this course the student is able to:

1. Describe the basic computer network technology.
2. Identify and analyze the different network topologies and protocols.
3. Analyze the different network devices and their functions within a network\
4. Apply the knowledge in the establishing computer based networks in real world problems.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Computer Networks: Andrews S. Tanenbaum, 4th Edition, Pearson Education, 2010.

Reference Books:

1. ATM Networks concepts and Protocols – SumitKasera, Tata McGraw Hill 2nd edition, 2008
2. Data and computer networks- W STALLINGS 5th Edition, Prentice Hall of India 1998.

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VII				
Internet of Things **(Common to EI, BM &ML)**				
Subject Code	: **18EI/BM/ML744**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				
Course Learning Objectives: This course will enable the students to				

- Assess the genesis and impact of IoT applications, architectures in real world
- Illustrate diverse methods of deploying smart objects and connect them to network
- Compare different application protocols for IoT
- Infer the role of Security in IoT
- Identify sensor technologies for sensing real world entities and understand the role of IoT in various domains of Industry

Module -1
Introduction and IoT: Introduction to IoT, IoT Ecosystem, IoT Reference model
Text 1-Chapter 1

Module -2
Transducers, Sensors and Actuators: Defining Transducers, Sensors and Actuators, Introduction to Transducers, Introduction to Sensors, Introduction to Actuators, Interfacing Concepts to Embedded Systems, Wireless Sensor Networks and its Technologies
Text 1-Chapter 2

Module -3
IoT Protocols: Protocol Classification, MQTT, XMPP, DDS, AMQP, COAP, Representational State Transfer(REST), Comparison of the Protocols
Text 1-Chapter 3

Module -4
Domain Specific IoT: Introduction, Home automation, Smart Cities, Environment, Retail, Logistics, Agriculture, Health and Life style
Text 1-Chapter 4
Public Safety : Overview of Public Safety, an IoT Blueprint for Public Safety, Emergency Response IoT Architecture, IoT Public Safety Information Processing, School Bus Safety.
Text 2-Chapter 15

Module -5
IoT Platform Design Methodology: Introduction to IoT Platform Design Methodology, Purpose and Requirements Specification, Process Specification, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specification, Functional View Specification, Operational View Specification, Device and Component Integration, Application Developments
Text 1-Chapter 5

Note: As a part of assignments, the students (in a group of 3 or 4) advised to carry out mini / hobby project using IoT technology.

Course Outcomes: After studying this course, students will be able to:

- Interpret the impact and challenges posed by IoT networks leading to new architectural models.
- Compare and contrast the deployment of smart objects and the technologies to connect them to network
- Appraise the role of IoT protocols for efficient network communication
- Elaborate the need for security in IoT
- Illustrate different sensor technologies for sensing real world entities and identify the applications of IoT in industry

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books

1. Srinivasa K G , Siddesh G M, Hanumantha Raju R, "Internet of Things" Cengage Learning India Pvt Ltd (ISBN : 978-93-86858-95-5).
2. David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, "IoT Fundamentals : Networking Technologies, Protocols and Use Cases for the Internet of Things", 1st Edition, Pearson Education (Cisco Press Indian Reprint)(ISBN: 978-9386873743).

Reference Books

1. Vijay Madisetti and Arshdeep Bahga, "Internet of Things (A Hands-on-approach)", 1st Edition, VPT, 2014(ISBN: 978-8173719547)
2. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, McGraw Hill Education, 2017(ISBN: 978-9352605224)

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Process Control and Virtual Instrumentation Lab

Subject Code	**: 18EIL76**		CIE Marks	: 40
Tutorial + Practical Hours/Week	: 2+2		SEE Marks	: 60
Total No. of Practical hours	: 42		Exam Hours	: 03

Credits – 2

1. Rig up and test the circuit to display the temperature using RTD/Thermistor with suitable signal

conditioning circuit.

2. Rig up and test the circuit to display the temperature using IC AD590 / LM35 with suitable signal conditioning circuit.
3. Rig up and test the circuit to display the load/ strain using load cell/ strain gauge with suitable signal conditioning circuits.
4. Realize Op-amp based Proportional (P), Derivative (D) and Integral (I) analog controller modes.
5. Realize Op-amp based PI and PD composite analog controller modes.
6. Conduct an experiment to perform and analyze PC based temperature/pressure controller. Plot the optimum response of different controller modes for different set-points.
7. Conduct an experiment to perform and analyze PC based level/flow controller. Plot the optimum response of different controller modes for different set-points.
8. Realization of basic gate functions using PLC. The logic should be solved using ladder diagram.

   (i) AND (ii)OR (iii)NAND(iv) XOR(v)NOR (vi)Latch and Unlatch of output
9. Study and demonstration of working of different types of Timers and Counters of PLC. The logic should be solved using ladder diagram.
10. Study and demonstration of Bottle Filling Process using PLC. The logic should be solved using ladder diagram.
11. Study and demonstration of Lift/Elevator System using PLC. The logic should be solved using ladder diagram.
12. Conduct an experiment to plot the characteristics of different type's process control valves.
13. Basic operations, simple programming structure using LabVIEW.
    (i) Basic arithmetic operations
    (ii) Boolean operations
    (iii) Sum of 'n' numbers using 'for' loop
    (iv) Sorting even numbers using 'while' loop in an array
14. Creation of a CRO using LabVIEW and measurement of frequency and amplitude.
15. Data acquisition using LabVIEW for temperature measurement with thermocouple and AD590.

Course Outcomes: After studying this course, students will able to:

1. Design and evaluate signal conditioning circuits for given transducer/sensor.
2. Design and evaluate the controllers to obtain the optimal response.
3. Write ladder logic programs for specific applications using PLC.
4. Develop LabVIEW programs for specific applications.
5. Design and develop complete process control system for specific application.

Conduct of Practical Examination:

- All laboratory experiments are to be included for practical examination.
- Students are allowed to pick one experiment from the lot.
- Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be

made zero.

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VII				
ARM Processor Lab **(Common to EI, BM & ML)**				
Subject Code	**: 18 EI/BM/MLL77**		CIE Marks	: 40
Tutorial + Practical Hours/Week	: 2+2		SEE Marks	: 60
Total No. of Practical hours	: 42		Exam Hours	: 03
Credits – 2				
PART-A: Conduct the following experiments by writing Assembly Language Program (ALP) using				

ARM Cortex M3 Registers using an evaluation board/simulator and the required software tool.

1. Write an ALP to multiply two 16 bit binary numbers.
2. Write an ALP to find the sum of first 10 integer numbers.
3. Write an ALP to find factorial of a number.
4. Write an ALP to add an array of 16 bit numbers and store the 32 bit result in internal RAM
5. Write an ALP to add two 64 bit numbers.
6. Write an ALP to find the square of a number (1 to 10) using look-up table.
7. Write an ALP to find the largest/smallest number in an array of 32 numbers.
8. Write an ALP to arrange a series of 32 bit numbers in ascending/descending order.
9. Write an ALP to count the number of ones and zeros in two consecutive memory locations.
10. Write an ALP to scan a series of 32 bit numbers to find how many are negative.

PART-B: Conduct the following experiments on an ARM CORTEX M3 evaluation board using evaluation version of Embedded 'C' &Keil Uvision-4 tool/compiler.

1. Display “Hello World” message using Internal UART.
2. Interface and Control a DC Motor.
3. Interface a Stepper motor and rotate it in clockwise and anti-clockwise direction.
4. Determine Digital output for a given Analog input using Internal ADC of ARM controller.
5. Interface a DAC and generate Triangular and Square waveforms.
6. Interface a 4x4 keyboard and display the key code on an LCD.
7. Using the Internal PWM module of ARM controller generate PWM and vary its duty cycle.
8. Demonstrate the use of an external interrupt to toggle an LED On/Off.
9. Display the Hex digits 0 to F on a 7-segment LED interface, with an appropriate delay in between.
10. Interface a simple Switch and display its status through Relay, Buzzer and LED.

Note:

1. More weightage should be given for PART-B experiments in the evaluation of Internal Assessment and Laboratory Examinations.
2. Introduction class on instruction set of Cortex M3 LPC1768 need to be conducted before start of hardware experiments.

Conduction of Practical Examination:

1. All laboratory experiments (Part-A + Part-B) are to be included for practical examination.
2. Students are allowed to pick & execute one experiment from each part.
3. Strictly follow the instructions as printed on the cover page of answer script for breakup of marks.
4. Change of experiment is allowed only once and 15% of Marks allotted to the procedure part to be made zero.

Course Outcomes: After studying this course, students will able to;

1. Write ALP for implementation of specific arithmetic or logical operations.
2. Write programs to demonstrate functioning of various devices interfaced to ARM processor.
3. Develop programs for ARM processors to implement real world problems.
4. Design and develop mini projects.

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VII				
Project Work Phase-1				
Subject Code	: **18EIP78**		CIE Marks	: 100
Number of Practical Hours /Week	: 02		SEE Marks	: --
Total Number of Lecture Hours	: --		Exam Hours	: --
Credits – 1				
Project Work Phase-1: Based on the ability/abilities of the student/s and recommendations of the mentor, a single discipline or a multidisciplinary project can be assigned to an individual student or to a group having not more than 4				

students.In extraordinary cases, like the funded projects requiring students from different disciplines, the project student strength can be 5 or 6.

CIE procedure for Project Work Phase - 1:

(i) Single discipline: The CIE marks shall be awarded by a committee consisting of the Head of the concerned Department and two senior faculty members of the Department, one of whom shall be the Guide.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of the project work phase -1 Report (covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the Project report shall be the same for all the batch mates.

(ii) Interdisciplinary: Continuous Internal Evaluation shall be group wise at the college level with the participation of all guides of the college. Participation of external guide/s, if any, is desirable.

The CIE marks awarded for the project work phase -1, shall be based on the evaluation of project work phase -1 Report(covering Literature Survey, Problem identification, Objectives and Methodology), project presentation skill and question and answer session in the ratio 50:25:25.The marks awarded for the project report shall be the same for all the batch mates.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VII

Internship

Internship: All the students admitted to III year of BE/B.Tech shall have to undergo mandatory internship of 4 weeks during the vacation of VI and VII semesters and /or VII and VIII semesters. A University examination shall be conducted during VIII semester and the prescribed credit shall be included in VIII semester. Internship shall be considered as a head of passing and shall be considered for the award of degree. Those, who do not take-up/complete the internship shall be declared fail and shall have to complete during subsequent University examination after satisfying the internship requirements.

8th SEMESTER

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VIII				
Neural Network and Fuzzy Logic Systems				
Subject Code	: **18EI81**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03
Credits – 3 (Each module – 8 Hours)				

Module -1

Introduction. - Neural Networks, Application Scope of Neural Networks, Fuzzy Logic, Generic Algorithm, Hybrid Systems, Soft Computing.

Artificial Neural Network: An Introduction. - Fundamental Concept, Evolution of Neural Networks, Basic models of Artificial Neural Networks (ANN), Important Technologies of ANNs, McCulloch-Pitts Neuron, Linear Separability.

Module -2

Hebb Network and simple problems,

Supervised Learning Network – Introduction –Perceptron Networks, Adaptive Linear Neuron (Adaline), Multiple Adaptive Linear Neurons.

Module -3

Back –Propagation Network. - Theory, Architecture, Flowchart for training process, Training Algorithm, Learning Factors of Back-Propagation Network, Testing Algorithm of Back-Propagation Network. Radial Basis Function Network, Time Delay Neural Network, Functional Link Networks, Tree Neural Networks, wavelet neural network.

Module -4

Introduction to Fuzzy Logic, Classical sets and Fuzzy sets.

Introduction to Fuzzy Logic, Classical sets (crisp sets) - Operations on Classical sets, Properties of Classical sets, Function of Mapping of Classical sets. Fuzzy sets – Fuzzy set operations, Properties of fuzzy sets. Simple Problems

Classical Relations and Fuzzy Relations – Introduction, Cartesian Product of Relation, Classical Relation, Fuzzy Relation, Tolerance and Equivalence Relations, Non-interactive Fuzzy sets, Simple Problems.

Module -5

Membership Functions – Introduction, Features of the Membership functions, Fuzzication, Methods of Membership Value Assignments, Simple Problems

Defuzzification- Introduction, Lamba-cuts for Fuzzy sets (Alpha-Cuts), Lamba-Cuts for Fuzzy Relation, Defuzzification Methods.

Fuzzy Logic Control Systems – Introduction, Control System Design, Architecture and Operation of FLC system, FLC system Models, Application of FLC systems.

Course Outcomes: After studying this course, students will be able to:

1. Compare and contrast the biological neural network and ANN.
2. Discuss the ANN for pattern classification.
3. Develop and configure ANN'swith different types of functions and learning algorithms.
4. Apply ANN for real world problems.
5. Discuss the fundamentals of fuzzy logic, implementation and their functions
6. Apply fuzzy logic concepts in building automated control systems.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. S. N. Sivanandam and S.N. Deepa, "Principles of Soft Computing", 2nd Edition, Wiley India Pvt. Ltd.-2014.
2. Timothy J. Ross, "Fuzzy logic with engineering applications", McGraw Hill International Edition, 1997

Reference Books:

1. Simon Haykin, "Neural Networks: A comprehensive foundation", 2nd Edition, PHI, 1998.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Medical Imaging Techniques

Subject Code	**: 18EI821**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/ Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 08 Hours)

Module-1

X-Ray Imaging: Definition of x-ray, Interactions between X-rays and matter, Intensity of X-ray beam, Attenuation, Generation and Detection of X-rays – X-ray generation, X-ray generators, Filters, Beam restrictors and grids, Intensifying screens, fluorescent screens, and image intensifiers, X-ray detectors.

X-Ray Diagnostic Methods: Conventional X-ray radiography, Fluoroscopy, Angiography, Mammography.

Computed Tomography: Conventional tomography, Computed tomography – Projection function, CT number. Recent developments – Digital radiography, Digital subtraction angiography (DSA). Biological effects of ionizing radiation.

Module-2

Ultrasound Imaging: Definition of ultrasound**,** Fundamentals of acoustic propagation (only theoretical concepts, no derivations) - Reflection and refraction, Attenuation, absorption & scattering, Doppler effect, Generation and detection of Ultrasound-Piezoelectric effect, Ultrasonic transducers, Axial and Lateral resolution.

Ultrasonic Diagnostic Methods: Pulse echo systems- Amplitude mode (A-mode), Brightness mode (B-mode), Motion mode (M-mode). Doppler methods, Duplex imaging, Colour Doppler flow imaging, Biological effects of ultrasound.

Module-3

Radionuclide Imaging: Introduction**,** Fundamentals of Radioactivity: Nuclear particles, Nuclear activity and half-life, Units of measuring nuclear activity, Specific activity, Interaction of nuclear particles and matter, Attenuation of Gamma radiation, Radionuclides, Generation & Detection of Nuclear Emission – Nuclear sources, Radionuclide generators, nuclear radiation detectors, Collimators,

Diagnostic Methods using Radiation Detector Probes: Thyroid function test, Renal function test, Blood volume measurement, Radionuclide imaging systems- Rectilinear scanner, Scintillation camera, SPECT: Principle and working. PET: Principle and working.

Module-4

Basics of Magnetic Resonance Imaging: Fundamentals of nuclear magnetic resonance- Angular momentum, magnetic dipole moment, magnetization, Larmor frequency, Free induction decay (FID), Fourier spectrum of the NMR signal, Relaxation times, Pulse sequences.

Generation and Detection of NMR Signal: Introduction (block diagram and working), Magnet, Imaging Methods- Introduction, slice selection, frequency encoding, phase encoding, Spin-Echo imaging-Gradient echo imaging. Biological effects of magnetic fields-Brief summary of all types of effects.

Module -5

Thermal Imaging & Advances in Medical Imaging

Thermal Imaging: Medical thermography, Physics of thermography, Infrared detectors, Thermographic equipment, Quantitative medical thermography, Pyroelectricvidicon camera. Applications of thermal imaging medicine.

Image Guided Intervention: Introduction, Stereotactic neurosurgery, Stereotactic neurosurgery based on digital image volumes- image acquisition, planning and transfer, Intraoperative Imaging- Intraoperative diagnostic imaging.

Course Outcomes: After studying this course, students will be able to:

1. Describe the fundamentals of x-ray radiography and computed tomography, and analyze the system requirements.
2. Explain principles of ultrasound imaging and diagnostic methods and analyze the system requirements.
3. Discuss the fundamentals of radionuclide imaging, MRI, thermal imaging and analyze the system requirements.
4. Describe the concepts of image Guided Intervention and image guided surgery.
5. Design and develop prototype of simple medical imaging system.

Question Paper Pattern:

- The question paper will have TEN questions
- Each full question carry 20 marks
- TWO full questions will be set (with maximum of THREE sub questions) from each module
- Covering all the topics under that module.
- The students will have to answer FIVE full questions, selecting one full question from each module.

Text Books:

1. Principles of Medical Imaging - by Kirk Shung, Michael B. Smith and BanjaminTsui, Academic Press, 1992.
2. Handbook of Biomedical Instrumentation – by R.S.Khandpur, 2nd Edition, Tata McGraw Hill, 2003.
3. Fundamentals of Medical Imaging - by Paul Suetens, Cambridge University Press, 2002.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Industrial Process Instrumentation

Subject Code	:**18EI822**		CIE Marks	: 40
Number of Lecture Hours /Week	: 03		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 08 Hours)

Module -1

Food Industry Instrumentation: Instrumentation in canning, baking, dairy industries.

Module-2

Paper and Pulp Instrumentation: Different types of pulping, pulp bleaching, pulp blending, wet end and drier instrumentation.

Module -3

Cement Plants: Objectives of automation system, automation strategy, Distributed Control System for Cement Plant- A case study.

Module -4

Thermal power plant Instrumentation: Automation strategy, distributed system structure, Man-machine interface, software system, communication, advanced control systems.

Module -5

Steel Plant: Automation strategy, production planning and area supervision, iron zone, steel zone, mill zone, utility zone.

Course Outcomes: After studying this course, students will be able to:

1. Sketch the typical instrumentation and control strategy in the process industries like paper, pulp, cement, power and steel plants.
2. List the variable to be monitored and controlled in the above said process industries.
3. Describe the instrumentation, control requirements and complete functioning of the above said industries.
4. Analyze the hardware and software tools required for the above said process industries.
5. Design and develop instrumentation and control strategy for simple process industry.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Handbook of Applied Instrumentation by Considine and Ross,, McGraw Hill Pub. (Modules 1 &2)
2. Computer Based Industrial Control by Krishna Kant, 2nd Edition, PHI, 2017 (Modules: 3, 4 &5).

Reference Books:

1. Donald P Eckman, " Industrial Instrumentation", J.Wiley
2. S K Singh, "Industrial Instrumentation & Control", 3rd edition, TMH 2009
3. J S Smith, "Food Processing Principles & Applications", University press (US) 2004.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VIII

Instrumentation Buses and Industrial Data Networks

Subject Code	: **18EI823**	CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2	SEE Marks	: 60
Total Number of Lecture Hours	: 40	Exam Hours	: 03

Credits – 3 (Each module – 08 Hours)

Module -1

Data Network Fundamentals: Network hierarchy and switching – Open System Interconnection model of ISO– Data link control protocol: - HDLC – Media access protocol – Command/response – Token passing – CSMA/CD, TCP/IP.

Module-2

Inter Networking: Bridges – Routers – Gateways –Standard ETHERNET and ARCNET configuration-special requirement for networks used for control.

Module -3

HART and Fieldbus: Introduction- Evolution of signal standard – HART communication protocol – Communication modes– HART networks – HART commands – HART applications.

Fieldbus: – Introduction – General Fieldbus architecture – Basic requirements of Field bus standard – Fieldbus topology – Interoperability – Interchangeability – Introduction to OLE for process control (OPC).

Module -4

Modbus and Profibus PA/DP/FMS:MODBUS protocol structure, function codes troubleshooting Profibus; Introduction – Profibus protocol stack –Profibus communication model communication objects – system operation – troubleshooting – review of foundation field bus.

Module -5

Industrial Ethernet and Wireless Communication: Industrial Ethernet: Introduction – 10Mbps Ethernet, 100Mbps Ethernet. Radio and wireless communication: Introduction – components of radio link the radio spectrum and frequency allocation – radio modems.

Course Outcomes: After studying this course, students will be able to:

1. Explain basic concepts of network hierarchy and switching.
2. Apply network data communication protocols.
3. Describe routers and gateways Standards followed in inter-networking.
4. Evaluate appropriateness of different industrial data networks.
5. Develop the various communication networks for industries.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, 'Practical Industrial Data networks Design, Installation and Troubleshooting', Newnes publication, Elsevier First edition, 2004
2. Buchanan, W., "Computer Buses", CRC Press, 2000,

Reference Books:

1. Andrew S. Tanenbaum, Modern Operating Systems, Prentice Hall of India Pvt. LTD, 2003
2. Stallings,W., "wireless Communication and networks", 2nd Edition, Prentice Hall of India, 2005
3. Process Software and Digital Networks", B.G. Liptak, CRC Press ISA- The Instrumentation, Systems, and AutomationSociety.
4. TheodoreS.Rappaport,'Wirelesscommunication:Principles&Practice',2nd Edition,2001, PrenticeHallof India.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Artificial Intelligence and Machine Learning

(Common to EI/BM/ML)

Subject Code	**:18EI/BM/ML824**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (Each module – 08Hours)

Module -1

Artificial Intelligence: The AI Problems, the underlying Assumption, what is an AI technique? (Text 1- 1.1,1.2,1.3)

Natural Language Processing: Introduction, Steps in the Process. (Text 1- 15.1,15.1.1)

Module – 2

Parallel and Distributed AI: Psychological Modeling, Parallelism in Reasoning Systems, Distributed Reasoning Systems: Coordination and Cooperation.
(Text1-16.1,16.2,16.3,16.3.1)

Connectionist Models: Introduction: Hopfield Networks, Connectionist AI and Symbolic AI. (Text 1-

18.1,18.6)

Module – 3

Genetic Algorithms (Gas): Learning: Generalization of an Input-Output table, Significance of the Genetic operators, Ant Algorithms (Text 1- 23.2,23.2.2,23.3,23.8)

Multilayer Perceptrons: The Perceptron, multilayer Perceptrons, Learning time – Time delay networks, Recurrent networks, Deep Learning (Text 2-11.1.2,11.2,11.5,11.12,11.13)

Module -4

Machine Learning: Introduction, Examples of Machine learning Applications.

Supervised Learning: Learning a class from examples, Noise, Learning Multiple classes, Regression, Model selection and Generalization, Dimensions of a supervised Machine learning Algorithm. (Text 2-1.1,1.2,2.1,2.4,2.5,2.6,2.7,2.8)

Module -5

Dimensionality Reduction: Introduction, Subset selection, Principal Component analysis.

Kernel Machines: Introduction, Optimal separating hyperplane (SVM).

(Text 2- 6.1,6.2,6.3,13.1,13.2)

Course Outcomes: After studying this course, students will be able to

- Appraise the basics of Artificial intelligence and concepts of natural language processing.
- Illustrate the working of Parallel, Distributed and connectionist models of AI.
- Discuss the fundamentals of Genetic algorithms.
- Escalate the underlying mathematical relationships within and across Machine Learning algorithms and the paradigms of supervised learning.
- Explore the associated parameters of the Machine Learning algorithms viz., dimensionality reduction, classification, etc.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 16 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books

1. Artificial Intelligence – Elaine Rich,Kevin Knight,Shivashankar B Nair, McGraw Hill Education, 3rd Edition, 2016.ISBN 978-0-07-008770-5.
2. Introduction to Machine Learning – Ethem Alpaydin, PHI Learning,3rd Edition,2018. ISBN 978-81-203-5078-6.

Reference Books

1. Introduction to Artificial Intelligence – Eugene Charnik, Drew McDermott,Pearson Education India, 1st edition, ISBN - 978-8131703069

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Project Work Phase-2

Subject Code	: **18EIP83**		CIE Marks	: 40
Number of Lecture Hours /Week	: --		SEE Marks	: 60
Total Number of Lecture Hours	: --		Exam Hours	: 03

Credits – 8

Course Learning Objectives:

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgment, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

Course outcomes: At the end of the course the student will be able to:

- Describe the project and be able to defend it.
- Develop critical thinking and problem solving skills.
- Learn to use modern tools and techniques.
- Communicate effectively and to present ideas clearly and coherently both in written and oral forms.
- Develop skills to work in a team to achieve common goal.
- Develop skills of project management and finance.
- Develop skills of self learning, evaluate their learning and take appropriate actions to improve it.
- Prepare themselves for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Evaluation Procedure:

- **As per University guidelines**
- **Internal Marks:** The Internal marks (100 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.
- **Semester End Examination:** SEE marks for the project (100 marks) shall be based on Project report, Presentation and Demonstration of the actual/model/prototype of the project, as per the University norms by the examiners appointed VTU.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Technical Seminar

Subject Code	: **18EIS84**		CIE Marks	: 100
Number of Lecture Hours /Week	: --		SEE Marks	: --
Total Number of Lecture Hours	: --		Exam Hours	: 03

Credits – 1

Course Learning Objectives:

The objective of the seminar is to inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas. Each student, under the guidance of a Faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carryout literature survey; organize the Course topics in a systematic order.

- Conduct literature survey in the domain area to find appropriate topic.
- Prepare the synopsis report with own sentences in a standard format.
- Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation.
- Present the seminar topic orally and/or through power point slides.
- Communicate effectively to answer the queries and involve in debate/discussion.

The participants shall take part in discussion to foster friendly and stimulating environment in which the

students are motivated to reach high standards and become self-confident.
Course outcomes: At the end of the course the student will be able to: • Develop knowledge in the field of Electronics &Instrumentation Engineering and other disciplines through independent learning and collaborative study. • Identify and discuss the current, real-time issues and challenges in engineering & technology. • Develop written and oral communication skills. • Explore concepts in larger diverse social and academic contexts. • Apply principles of ethics and respect in interaction with others. • Develop the skills to enable life-long learning.
Evaluation Procedure: • As per University guidelines. • The Internal Assessment marks for the seminar shall be awarded based on the relevance of the seminar topic, quality of the report, presentation skills, participation in the question and answer, and attendance in the seminar classes/sessions.

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester - VIII

Internship

Subject Code	: **18EII85**		CIE Marks	: 40
Number of Lecture Hours /Week	: --		SEE Marks	: 60
Total Number of Lecture Hours	: --		Exam Hours	: 03

Credits – 3

Course Learning Objectives:

Internship/Professional practice provide students the opportunity of hands-on experience that include personal training, time and stress management, interactive skills, presentations, budgeting, marketing, liability and risk management, paperwork, equipment ordering, maintenance, responding to emergencies etc. The objective are further,

- To put theory into practice
- To relate to, interact with, and learn from current professionals in the field.
- To gain a greater understanding of the duties and responsibilities of a professional
- To understand and adhere to professional standards in the field.
- To gain insight to professional communication including meetings, memos, reading, writing, public speaking, research, client interaction, input of ideas, and confidentiality.
- To identify personal strengths and weaknesses.
- To develop the initiative and motivation to be a self-starter and work independently.

Internship/Professional practice: Students under the guidance of internal guide/s and external guide shall take part in all the activities regularly to acquire as much knowledge as possible without causing any inconvenience at the place of internship.

Seminar: Each student, is required to

- Present the seminar on the internship orally and/or through power point slides.
- Answer the queries and involve in debate/discussion.
- Submit the report duly certified by the external guide.

Course outcomes: At the end of the course the student will be able to:

- Acquire practical experience within industry in which the internship is done.
- Apply knowledge and skills learned to classroom work.
- Experience the activities and functions of professionals.
- Develop and refine oral and written communication skills.
- Recognize the areas for future knowledge and skill development.
- Acquire the basic knowledge of administration, marketing, finance and economics.
- Develop the skills to enable lifelong learning.

Evaluation Procedure:

- **As per University guidelines.**
- **Evaluation of CIE Marks:** The Internal Assessment marks shall be awarded based on the Internship/Professional Practice Report and Seminar Presentation.
- **Semester End Examination**: The marks shall be awarded based on the Internship/Professional Practice Report and Seminar Presentation as per the University norms by the examiners appointed VTU.

B.E. – ELECTRONICS AND INSTRUMENTATION ENGINEERING (EI)
OPEN ELECTIVES (REVISED)

Semester - VI			
OPEN ELECTIVE - A			
Course Code	**18EI65X**	CIE Marks	40
TeachingHours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Students can select any one of the open electivesoffered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited).

Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Sl.NO.	**Board and the Department offering the Electives**		**Course**		**Course Title**
			Sl. No.	**code under 18EI65X**	
01	**EI/ BM/ ML**	Electronics and Instrumentation Engineering	1	18EI651	Transducers and Process Instrumentation
			2	18EI652	Analytical Instrumentation
			3	18EI653	Optical Instrumentation

Semester –VI: Open Elective-A				
Transducers and Process Instrumentation				
Subject Code	: **18EI651**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (8 Hours per module)

Course Objectives:

- To provide the fundamental knowledge of transducers, instrumentation and measurement systems.
- To understand the functional elements of instrumentation/measurement systems.
- To impart the knowledge of static and dynamic characteristics of instruments, and understand the factors in selection of instruments for measurement.
- To discuss the principle, design and working of transducers for the measurement of displacement, level, strain, force, torque, pressure, sound and speed.

Modules

Module -1

Measurement, Instruments and Generalized Measurement/ Instrumentation system:

Measurement, significance of measurement, Methods of Measurements, instruments and measurement systems, Mechanical, electrical and electronic instruments, Deflection & Null type instruments and their comparison, Analog and digital modes of operation, functions of instruments and measurement systems, applications of measurement systems, Elements of generalized measurement system, Input-output configuration of measuring instruments and measurement systems, methods of correction for interfering and modifying inputs.

Module -2

Characteristics of Instruments & Measurement Systems: Measurement system performance,Static calibration and error calibration curve, accuracy and precision, indications of precision, static error, relative error, static correction, scale range and scale span, reproducibility and drift, repeatability, signal to noise ratio, static sensitivity, linearity, hysteresis, threshold, dead time and dead zone, resolution.

Transducers: Definition of Transducers, Classifications of transducers-based on principle, primary & secondary transducers, active & passive transducers, analog and digital transducers, transducers & inverse transducers, summary of factors influencing the choice of transducers/instruments.

Module -3

Transducers/Instruments for Measurement of Displacement: Introduction, Principles of Transduction, Variable resistance devices, Variable Inductance Transducer-LVDT, variable reluctance, Synchros and Resolvers, Variable Capacitance Transducer, Hall Effect Devices, Digital Transducer.

Transducers/Instruments for Measurement of Level: Capacitance probes – bare and coated capacitance probes, Conductivity probes, Float level devices – atmospheric tanks, mercury float switch, pneumatic float switch, Optical level switches-Noncontact level sensor, contacting level sensor, laser based level detector, Ultrasonic level detector-On-ff and continuous, Thermal level sensors

Module -4

Transducers/Instruments for Measurement of Strain: Introduction, Types of Strain Gauges, Theory of operation of resistance strain gauges, Types of Electrical Strain Gauges – Wire gauges, unbounded strain gauges, foil gauges, Semiconductor strain gauges (principle, types & list of main characteristics only), Strain gauge Circuits – Wheatstone bride circuit (quarter bridge, half bridge and full bridge), Applications.

Transducers/Instruments for Measurement of Force & Torque: Introduction, Force measuring sensor – Load cells – column types devices, proving rings, cantilever beam, pressductor. Hydraulic load cell, Electronic weighing system. Torque measurement: Absorption type, transmission type, stress type & deflection type.

Module -5

Transducers/Instruments for Measurement of Pressure: Introduction, Diaphragms, Other elastic elements, Transduction methods – potentiometric device, strain gauge transducer, variable reluctance, LVDT type, variable capacitance device (principle & working, no derivation), force balance transducer with analysis, Thin film pressure transducers, Digital pressure transducer, Piezoelectric pressure transducer, Pressure multiplexer, Pressure calibration.

Course Outcomes: After studying this course, students will able to:

- Define the transducer, instrument, measurement and classify different types of transducers
- Explain the functional elements of instrumentation / measurement systems
- Discuss the input-output configuration of measurement systems
- Define, interpret and analyze the static and dynamic characteristics of instruments

- Explain the principle, design and analyze the transducers for the measurement of displacement, level, strain, force, torque, and pressure.

Graduate Attributes (as per NBA)

- Engineering knowledge
- Problem analysis
- Design & Development of Solutions
- Engineer and society
- Environment & sustainability
- Lifelong learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question consists of 20 marks.
- There will be 2 full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question fromeachmodule.

Text Books:

1. Electrical and Electronic Measurements and Instrumentation – A. K. Sawhney, 17th Edition (Reprint 2004), DhanpatRai& Co. Pvt. Ltd., 2004. (Module 1 & 2)
2. Instrumentation: Devices and Systems- C. S. Rangan, G. R. Sarma, V. S. V. Mani, 2nd Edition (32nd Reprint), McGraw Hill Education (India), 2014. (Module 3-Displacement measurement, Module 4, and Module 5)
3. Process Measurement Instrument Engineers Handbook- BelaG.Liptak, Revised Edition, Chilton Book Company, 1982. (Module 3 – Level measurement**)**

Reference Books:

1. Transducers and Instrumentation – D.V.S.Murty, 2nd Edition, PHI, 2009.
2. Introduction to Measurements and Instrumentation - A. K. Ghosh, 2nd Edition, PHI, 2007.
3. Instrumentation Measurement and Analysis- B.C.Nakra and K.K.Choudhry, 3rd Edition, McGraw Hill Education (India) Pvt.Ltd. 2009.
4. Measurement Systems Application and Design- Ernest O.Doeblin and Dhanesh N Manik, 5th Edition, McGraw Hill, 2007

B.E. Electronics and Instrumentation Engineering (EI)
Choice Based Credit System (CBCS)
Semester – VI: Open Elective-A

Analytical Instrumentation

Subject Code	: **18EI652**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (8 Hours per module)

Course Objectives:

- To introduce the basic concept of qualitative and quantitative analysis of a given sample.
- To impart various spectroscopic techniques and its instrumentation.
- To impart the concept of separation science and its application.
- To impart methods of Industrial analyzers and its application.

Modules
Module -1 **An Introduction to Instrumental Methods:** Terms associated with Chemical analysis, Classification of instrumental techniques, A review of important consideration in analytical methods, Basic functions of instrumentation (Text book 1). **IR Spectroscopy:** Basic Components of IR Spectrophotometers, monochromators- Littrow mounting, Fourier Transform IR Spectroscopy (Text book 2).
Module -2 **Colorimeters and Spectrophotometers(Visible - Ultraviolet)**: Electromagnetic radiation, The Beer Lambert Law, Absorption instruments ,Colorimeters, Spectrophotometers-Single beam Null-Type Spectrophotometer , Microprocessor based Spectrophotometer, Sources of error in Spectrophotometric measurements.(Text book 2)
Module -3 **Flame Photometers**: Principle of Flame Photometry, Constructional details of Flame photometers, clinical flame photometers, Interferences in flame photometry, procedure for determinations. **Thermo-Analytical Methods**: Thermogravimetric analysis(TGA), Differential thermal analysis(DTA) (Text book 2).
Module -4 **Gas Chromatography:** Chromatograph, Basics parts of a chromatograph: carrier gas supply, sample injection system, chromatographic columns: packed column & capillary column, Detectors: katharometer cell, differential flame ionization detector, electron capture detector.(Text book 2). **HPLC Instrumentation**: Mobile –phase delivery system sample introduction, separation of columns, Detectors–Ultraviolet Photometers & Spectrophotometers, electrochemical detector (amperometric detector), Differential refractometer. (Text book 1).
Module -5 **Industrial gas analysers :** Typesof gas analysersMagnetic wind instruments. Infrared gas analyser, Thermal conductivity analysers, analysers based on gas density, method based on Ionization of gases. **Air pollution monitoring instruments:** Carbon monoxide (CO) -Non-dispersive infrared analyzer, Sulphur dioxide (SO_2)-Conductivitimetry, UV fluorescence method, Nitrogen oxides-Using CO laser, laser opto-acoustic spectroscopy, Hydrocarbons-Flame ionization detector, Ozone-Chemiluminescence, Automated wet chemical air analysis, **Water pollution monitoring instruments**. (Text book 2)
Course Outcomes: 1. The students get well versed with the principle, construction and working of various analytical instrumentation. 2. Students get detailed information about the application of analytical techniques in pollution monitor, Industry, etc.
Graduate Attributes (as per NBA) • Engineering Knowledge • Problem Analysis • Life-long Learning

Question Paper Pattern:

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Instrumental Methods of Analysis, 7th edition. H.H. Willard, L.L. Merritt, J.A. Dean, F.A. Settle, CBS Publishing & Distribution (Module 1 and Module 4-HPLC)
2. Handbook of Analytical Instruments – R.S. Khandpur, Tata McGraw Hill (Module 1-IR Spectroscopy, Module2,Module 3, Module 4-GasChromatography, Module 5)

Reference Books:

1. Braun R.D., Introduction to Instrumental Analysis, McGraw –Hill Singapore,2006.
2. Frank G. Kerry Industrial Gas Handbook: Gas Separation and Purification, Taylor and Francis group, 2007.
3. Principles of Instrumental Analysis 5th Edition – Douglas A. Skoog, F. James Holler, Timothy A. Niemen, Thomason Brooks/ Cole

Semester – VI: Open Elective-A

Optical Instrumentation

Subject Code	: **18EI653**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (8 Hours per module)

Module -1

Introduction to Laser (Lasers -I): Introduction, Emission and absorption of radiation, Einstein relation, population inversion, optical feedback, threshold conditions, Line shape function, population inversion and pumping threshold conditions**.**

Classes of Laser: Doped insulator Lasers, semiconductor Lasers, Gas Lasers, Liquid dye Lasers.

(Textbook-1)

Module -2

Lasers-II: Single mode operation, frequency stabilization, Mode locking and Q-switching.

Applications of Laser: Measurement of distance: Interferometric methods, Beam modulation telemetry; Holography &Holography interferometry.

(Textbook-1)

Module -3

Optical Fiber Communications: Motivations for light wave communications, optical spectral bands, Network information rates, WDM concepts, Key elements of optical fiber systems, standards for optical fiber communications, Modeling and simulation tools.

Optical Fibers: Structures, Wave guiding, and Fabrication: The nature of light, basic optical laws and definitions, optical fiber modes and configurations.

(Textbook-2)

Module -4

Types of Fibers, Material and Fabrication: Single mode fibers, Graded index fiber structure, Fiber materials, Photonic crystal fibers, Fiber fabrication,Fiber optic cables.
Optical Amplifiers: Types of optical amplifiers and its applications, Semiconductor optical amplifiers, Erbium-doped fiber amplifiers, Amplifier noise, Optical SNR, System, Raman amplifiers.
(Textbook-2)

Module -5
Applications of Lasers in Medicine: Fiberoptic laser systems in cardiovascular disease-Endoscopic laser systems in cardiology, Fiber-optic laser therapy-angioplasty, Endoscopic Nd:YAG Laser therapy in gastroenterology, Laproscopic laser surgery, ophthalmological applications of laser-fiber systems, arthroscopic surgery in orthopedics, laser lithotripsy.
(Textbook-3)

Course Outcomes: After studying this course, students will be able to:

1. Explain theprinciple and working of Laser system.
2. Discuss the engineering applications of laser systems.
3. Discuss the fundamentals of optical fiber communications.
4. Evaluate the design of optical fibers.
5. Apply fiber optic laser systems in medical field.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Optoelectronics- An Introduction-Wilson & Hawkes, Prentice Hall of India.
2. Optical fiber communications-GeirdKeser, McGraw Hill education (India) private limited, Fifth edition.
3. Lasers and Optical Fibers in Medicine - by Abraham Katzir, Academic Press, 1998.

Reference Books:

1. LASER Fundamentals- William T. Silfvast, Cambridge University Press.
2. Essentials of Opto Electronics with Applications - A.J. Rogers, CRC press 1997.

B.E. Electronics and Instrumentation Engineering (EI) Choice Based Credit System (CBCS) Semester - VII			
OPEN ELECTIVE - B			
Course Code	**18EI75X**	CIE Marks	40
Teaching Hours/Week (L:T:P)	(2:2:0)	SEE Marks	60
Credits	03	Exam Hours	03

Students can select any one of the open electives offered by other Departments expect those that are offered by the parent Department (For syllabus, please refer to the concerned Programme syllabus book or VTU website vtu.ac.in may be visited.).
Selection of an open elective shall not be allowed if,

- The candidate has studied the same course during the previous semesters of the programme.
- The syllabus content of open elective is similar to that of the Departmental core courses or professional electives.
- A similar course, under any category, is prescribed in the higher semesters of the programme.

Registration to electives shall be documented under the guidance of Programme Coordinator/ Advisor/Mentor.

Sl. NO.	**Board and the Department offering the Electives**		**Course**		**Course Title**
			Sl. No.	**code under 18EI75X**	
01	**EI/ BM/ ML**	Electronics and Instrumentation Engineering	1	18EI751	Medical Instrumentation
			2	18EI752	Robotics and Industrial Automation
			3	18EI753	Smart Sensors

Semester – VII: Open Elective-B				
Medical Instrumentation				
Subject Code	: **18EI751**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	:40		Exam Hours	: 03

Credits – 3 (8 Hours per module)

Module -1

Fundamentals of Biomedical Instrumentation: Sources of biomedical signals, Basic Medical Instrumentation system, Interfacing analog signals to microprocessors. PC based medical instruments, General constraints in design of biomedical instrumentation systems.

Bioelectric Signals and Electrodes: Origin of Bioelectric signals, Types of bioelectric signals-ECG, EEG, EMG, Recording electrodes: Electrode – Tissue interface, polarization, skin contact-impedance, Silver-silver chloride electrodes, Electrodes for ECG (limb electrodes, floating electrodes, pregelled disposable electrodes), EEG, EMG, Microelectrodes.

Module -2

Electrocardiograph: Physiology of the heart, Electrical activity of the heart and Electrocardiogram (ECG), Normal & Abnormal cardiac Rhythms, Block diagram-description of an Electrocardiograph, ECG leads, Effects of artifacts on ECG Recordings, Multichannel ECG Machine.

Electroencephalograph: Block diagram description of an Electroencephalograph, 10-20 electrode systems, computerized analysis of EEG.

Module -3

Patient Monitoring System: Bedside patient monitoring systems, Central monitors, Measurement of heart rate – Average heart rate meter, Instantaneous heart rate meter, Measurement of pulse rate.

Blood Pressure Measurement: Introduction, Indirect methods of blood pressure measurement: Korotkoff's method, Rheographic method, differential auscultatory technique.

Measurement of Respiration Rate: Impedance pneumography, CO_2 method of respiration rate measurement, Apnoea detectors.

Module -4

Blood Flow Measurement: Electromagnetic blood flow meter- Principle and Square wave electromagnetic flowmeter. Doppler shift blood flow velocity meter, Blood flow measurement by Doppler imaging, NMR blood flowmeter.

Cardiac Pacemakers: Need for cardiac pacemaker, External pacemaker, Implantable pacemaker, Types of Implantable pacemakers, Programmable pacemakers.

Cardiac Defibrillator: Need for a Defibrillator, DC defibrillator, Pacer-Cardioverter-Defibrillator.

Module -5

Therapeutic Instruments:

Cardiac-assist devices, Pump oxygenators, Total artificial heart, Haemodialysis, Ventilators, Infant incubators, Drug infusion pumps.

Patient Safety: Electric shock hazards, Leakage currents, Electrical safety analyzer, Testing of Biomedical equipment.

Course Outcome: After studying this course, students will able to:

1. Acquire knowledge about origin of bio-potential, bio-signals and their measurement
2. Describe the problem, identify and formulate solution in the field of Bio-Medical Engineering for current and future issues
3. Describe the cardiac, brain and muscular physiological systems with the related diagnostic measurement methods.
4. Recognize the therapeutic methods of treatment and the associated instrumentation.
5. Identify and judge patient safety issues related to biomedical instrumentation.
6. Describe the principle and working of cardiac pacemakers, defibrillators, BP measurement, blood flow meters, CO_2 measurement, respiration measurements and their implementation.

Question Paper Pattern:

- The question paper will have TEN questions
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Handbook of Biomedical Instrumentation - R.S.Khandpur, 2nd Edition, Tata McGraw- Hill, 2003 (Module 1, 2, 3, 4 & Module 5- Patient Safety)
2. Medical Instrumentation: Application and Design – John G Webster, 3rd Edition, John Wiley & Sons, 2006. (Module 5- Therapeutic Instruments)

Reference Book:

1. Biomedical Instrumentation & Measurement - Leslie Cromwell, Fred J Weibell& Erich A Pfeiffer, 2nd Edition, Prentice Hall of India, 2001.

Semester – VII: Open Elective-B

Robotics and Industrial Automation

Subject Code	: **18EI752**		CIE Marks	: 40
Number of Lecture + Tutorial Hours/Week	: 02+02		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (8 Hours per module)

Module -1

Fundamentals of Robotics & SCADA: Automation and robotics, robots in science fiction, history of robotics, robotics market and future prospects, robot anatomy, work volume, robot drive systems, control systems and dynamic performance, precision of movement and robot applications.[Textbook-1] SCADA: Introduction and brief history of SCADA, SCADA systems software, considerations and benefits of SCADA system. [Textbook-2]

Module -2

Control Systems and Components: Basic control systems concepts and models, controllers, robot actuation and feedback components.

Robot end effectors: Types of end effecters, mechanical grippers, other types of grippers, tools as end effectors, robot/end effector interface, consideration in gripper selection and design, problems.

Sensors in Robotics: Transducers and sensors, sensors in robotics, tactile sensors, proximity and range sensors [Textbook-1]

Module -3

Machine Vision & Artificial Intelligence: Introduction to machine vision, The sensing and digitizing function in machine vision, image processing and analysis: image data reduction, segmentation, feature extraction, object recognition, training the vision system, robotic applications.

Artificial Intelligence (AI): Goals of AI in research, AI techniques: knowledge representation, problem representation and problem solving and search techniques in problem solving. [Textbook-1]

Module -4

Robot cell design and control, Material Transfer, Machine Loading/Unloading:

Robot cell layouts, multiple robots and machine interference, other considerations in work -cell design, work-cell control, interlocks, error detection and recovery, work -cell controller, robot cycle time analysis.

Material Transfer, Machine Loading/Unloading: General considerations in robot material

handling, material transfer applications, machine loading and unloading. [Textbook-1]

Module -5

Processing Operations, Assembly & Inspection: Spot welding, continuous arc welding, spray coating, other processing operations using robots. Assembly and robotic assembly automation, parts presentation methods, assembly operations, compliance and remote center compliance (RCC) device, assembly system configurations, designing for robotic assembly, inspection automation. [Textbook-1]

Autonomous Mobile Robots: Introduction, Planning &Navigation: Introduction, basic control scheme for mobile robots (only basic understanding of perception, localization, path planning & motion control). [Textbook-3]

Course Outcomes: After studying this course, students will able to:

1. Identify basic components of robot system and its functionality
2. Identify DH representation of robot and homogenous transformation for various arm configurations.
3. Analyze the functions of sensors in the robot.
4. Solve forward and inverse kinematic problems.
5. Evaluate and compare the use Robots in different applications.
6. Recognize material-handling applications, processing operations, assembly and inspection operations to increase product quality and uniformity in minimize cycle times and effort.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks.
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Mikell P. Groover, Mitchel Weiss, Roger N. Nagel, Nicholas G. Odrey and AshishDutta, "Industrial Robotics: Technology, Programming and Applications", 2nd Edition, Tata McGraw Hill, 2012.
2. SrinivasMedida, Pocket Guide on Industrial Automation: For Engineers and Technicians, 1st Edition, IDC Technologies, 2007. (http://www.pacontrol.com/download/Industri al-Automation-Pocket-Guide.pdf)
3. Roland Siegwart, Illah R. Nourbakhsh, and DavideScaramuzza, "Introduction to Autonomous Mobile Robots", 2ndEdition, PHI, 2011.

Reference Books:

1. Ghosh, Control in Robotics and Automation: Sensor Based Integration, Allied Publishers, Chennai, 1998.
2. Asfahl C.R., Robots and manufacturing Automation, John Wiley, USA 1992.

Semester – VII: Open Elective-B				
Smart Sensors				
Subject Code	: **18EI753**		CIE Marks	: 40
Number of Lecture + Tutorial Hours /Week	: 2+2		SEE Marks	: 60
Total Number of Lecture Hours	: 40		Exam Hours	: 03

Credits – 3 (8 Hours per module)

Module -1

Basics of smart sensors and micromachining: Introduction, Mechanical-Electronic transitions in sensing, nature of sensors, overview of smart sensing and control systems, integration of micromachining and microelectronics, introduction to micromachining, bulk micromachining, wafer bonding, surface micromachining.

Module -2

MCUs and DSPs for sensor: Introduction, MCU control, MCUs for sensor interface, DSP control, Software, tools and support, sensor integration.

Module -3

Sensor Communication and MEMS: Wireless zone sensing, surface acoustical wave devices, intelligent transportation system, RF-ID, Micro optics, micro-grippers, micro-probes, micro-mirrors. **Communications for smart sensors** - sources and standards, automotive protocols, industrial networks, office and building automation, home automation, protocols in silicon, other aspects of network communications.

Module -4

Packaging, Testing and Reliability of Smart Sensors: Introduction, Semiconductor packaging applied to sensors, hybrid packaging, packaging for monolithic sensors, reliability implications, testing smart sensors.

Standards for Smart Sensors: Introduction, setting the standards for smart sensors and systems, IEEE 1451.1, IEEE 1451.2, IEEE P1451.3, IEEE 1451.4, extending the systems to network.

Module -5

Implications of Smart Sensor Standards and Recent Trends: Introduction, sensor plug-and-play, communicating sensor data via existing wiring, automated/remote sensing and web, process control over the internet, alternative standards, HVAC sensor chip, MCU with integrated pressure sensors, alternative views of smart sensing, smart loop.

Course Outcomes: After studying this course, students will be able to:

1. Describe the principle of smart sensors and process of micromachining in development of smart sensors.
2. Develop intelligent systems by interfacing the smart sensors to MCUs and DSPs.
3. Analyze the use of smart sensors in communication, MEMS and automation.
4. Evaluate the standards of smart sensors by the assessment of reliability testing and packaging.
5. Discuss the applications of smart sensors in different fields and recent development.
6. Develop/sketch the simple models of intelligent instrumentation.

Question Paper Pattern

- The question paper will have TEN questions.
- Each full question carry 20 marks
- There will be TWO full questions (with maximum of THREE sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer FIVE full questions, selecting ONE full question from each module.

Text Books:

1. Understanding Smart Sensors- Randy Frank, 2nd Edition. Artech House Publications, 2013.

Reference Books:

1. G. K. Ananthasuresh, K. J. Vinoy, S. Gopalakrishnan, K. N. Bhat, V. K. Aatre, Micro and Smart Systems: Technology and modeling, Willey Publications,2012.