GITAM

(DEEMED TO BE UNIVERSITY)

(Estd. u/s 3 of the UGC Act, 1956)

VISAKHAPATNAM ✹ HYDERABAD ✹ BENGALURU

Accredited by NAAC with 'A+' Grade

REGULATIONS AND SYLLABUS

of

Bachelor of Technology

in

Electronics and Communication Engineering

with specialized subjects in

Artificial Intelligence and Machine Learning

Internet of Things

Medical Electronics

VLSI Design

(w.e.f 2020-21 admitted batch)

A University Committed to Excellence

B.Tech ECE with specialized subjects in AI&ML, IoT, Medical Electronics and VLSI Design

REGULATIONS

(w.e.f. 2020-21 admitted batch)

1. ADMISSION

1.1 Admission into B.Tech. program of GITAM (Deemed to be University) is governed by GITAM admission regulations.

2. ELIGIBILITY CRITERIA

2.1 A first class in 10+2 or equivalent examination approved by GITAM (Deemed to be University) with subjects Physics, Chemistry and Mathematics.

2.2 Admission into B.Tech. will be based on an All India Entrance Test (GITAM Admission Test - GAT) conducted by GITAM/ Specified rank holders of JEE mains/EAMCET(AP & TS). For Bengaluru CET and COMEDK instead of EAMCET (AP & TS) are considered. The rules of reservation of statutory bodies, wherever applicable, will be followed.

3. CHOICE BASED CREDIT SYSTEM

3.1 Choice Based Credit System (CBCS) was introduced with effect from the academic year of 2015-16 admitted batch and revised in 2019-20 academic year, based on guidelines of the statutory bodies in order to promote:

- Activity based learning
- Student centered learning
- Cafeteria approach
- Learning at their own pace
- Interdisciplinary learning

3.2 Course Objectives, Learning Outcomes and Course Outcomes are specified, focusing on what a student should be able to do at the end of the course and program.

4. STRUCTURE OF THE PROGRAM

4.1 The program consists of courses based on humanities and social sciences, basic sciences, basic engineering, program core, program electives, open electives, interdisciplinary electives, industry internship, laboratory, mandatory courses and project work.

S. No.	Broad Course Classification	Course Group/ Category	Course Description
1	Foundation Courses	Basic Sciences	Mathematics, physics, chemistry and life sciences
		Engineering Sciences	Fundamental engineering Courses
		Humanities and Social Sciences	Related to English, humanities, social sciences and management
2	Core Courses	Program Core	Branch specific and mandatory core courses
3	Elective Courses	Program Electives	Supportive to the discipline with expanded scope in a chosen track of specialization or cross track courses
		Interdisciplinary Electives	Interdisciplinary exposure to nurture the interest of a student in other department courses
		Open Electives	Common to all disciplines that nurtures general interest of a student
4	Core Activities	Project Work	University or industry
		Internship	Training in industry or research organization

5	Mandatory Courses		Non-credit mandatory courses on environment, constitution and ethical values

4.2 Each course is assigned a certain number of credits depending upon the number of contact hours lectures/tutorials/practical) per week.

4.3 In general, credits are assigned to the courses based on the following contact hours per week.

- One credit for each Lecture/Tutorial hour per week.
- One credit for two hours of Practicals per week.

5. MEDIUM OF INSTRUCTION

The medium of instruction (including examinations and project reports) shall be English.

6. REGISTRATION

Every student has to register for the courses in each semester at the time specified in the academic calendar.

7. ATTENDANCE REQUIREMENTS

7.1 A student whose attendance is less than 85% in all the courses put together in any semester will not be permitted to attend the end semester examination and will not be allowed to register for subsequent semester of study. He/she has to repeat the same semester along with juniors.

7.2 However, the Vice-Chancellor on the recommendation of the Principal / Director of the Institute/School may condone the shortage of attendance of the students whose attendance is between 75% and 84% on medical grounds and on payment of prescribed fee.

8. EVALUATION

8.1 Assessment of the performance of a student in theory courses shall be based on two components: Continuous Evaluation (40 marks) and Semester-end Examination (60 marks).

8.2 A student has to secure a minimum of 40% in any theory course in the two components (ref 8.1) put together to be declared to have passed the course, subject to the condition that the student must have secured a minimum of 24 marks out of 60 marks (i.e. 40%) in the theory component at the semester-end examination.

8.3 Practical courses are assessed under Continuous Evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure pass grade.

8.4 For courses having both theory and practical components, 70% of the weightage will be given for theory component and 30% weightage for practical component. The student has to acquire 40% in the semester end theory examination. However, student must have secured overall 40% (Theory + Practical) to secure pass grade.

8.5 Project work/ Industrial internship courses are assessed under continuous evaluation for a maximum of 100 marks, and a student has to obtain a minimum of 40% to secure pass grade.

8.6 Mandatory courses are assessed for PASS or FAIL only. No credits will be assigned to these courses. If a student secures more than 40 out of 100 marks, he / she will be declared PASS, else FAIL. PASS grade is necessary to be eligible to get the degree.

8.7 Mandatory courses NCC/NSS/NSO/YOGA are assessed for satisfactory or not satisfactory only. No credits will be assigned. A student has to undergo two hours training per week in any one of the above courses in both I and II semesters and should obtain satisfactory grade to be eligible to get degree.

The details of Assessment Procedure are furnished in Table 1.

Table 1: Assessment Procedure

S. No	Component of Assessment	Types of Assessment	Marks Allotted	Scheme of Evaluation
1	Theory courses	Continuous Evaluation	40	(i) Thirty (30) marks for mid semester examinations. Three mid examinations shall be conducted for 15 marks each; performance in best two shall be taken into consideration ii) Ten (10) marks for Quizzes, Assignments and Presentations.
		Semester end Examinations Total	60 100	Sixty (60) marks for semester end Examinations.
2	Practical courses	Continuous Evaluation	100	(i) Fifty (50) marks for regularity and performance, records and oral presentations in the laboratory. Weightage for each component shall be announced at the beginning of the semester. ii) Ten (10) marks for case studies. iii) Forty (40) marks for two tests of 20 marks each (one at the mid-term and the other towards the end of the semester) conducted by the concerned lab teacher.
3	Theory and Practical combined courses	(a) Theory component: continuous evaluation and semester end examination. (b)Practical component: continuous evaluation Total	100 100 200	70% of the weightage will be given for theory component. Evaluation for theory component shall be same as S. No 1 as above. 30% weightage for practical components. Evaluation for practical component shall be same as S.No. 2 as above
4	Project work (VII & VIII Semesters)	Continuous Evaluation	100	i) Forty (40) marks for periodic evaluation on originality, innovation, sincerity and progress of the work assessed by the project supervisor. ii) Thirty (30) marks for mid-term evaluation by a panel of examiners. iii) Thirty (30) marks for final report, presentation and Viva- voce by a panel of examiners.

5	Industrial Internship (VII Semester)	Continuous Evaluation	100	i) Thirty (30) marks for performance assessed by the Supervisor of the host Industry/ Organization. Submission of Project Completion Certificate from host organization is mandatory. ii) Forty (40) marks for Report and Seminar presentation on the training, assessed by the Teacher Coordinator. iii) Thirty (30) marks for presentation on the training, before a panel of examiners.
6	Mandatory Courses	Continuous Evaluation	100	Sixty (60) marks for midterm semester examinations. Three midterm examinations shall be conducted for 30 marks each; performance in best two shall be taken into consideration Forty (40) marks for Quizzes, Assignments and Presentations

9. RETOTALING / REVALUATION

9.1 Retotaling / revaluation of any theory answer script of the semester- end examination is permitted on request by a student by paying the prescribed fee within one week after the announcement of the results.

9.2 Revaluation of the theory answer scripts of the semester-end examination is permitted on request by student by paying the prescribed fee within one week after the announcement of the results.

9.3 A student who has secured 'F' grade in a theory course shall have to reappear at the subsequent examination held in that course. A student who has secured 'F' grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

9.4 A student who has secured 'F' grade in a practical course shall have to attend special instruction classes held during summer.

9.5 A candidate who has secured 'F' grade in a combined (theory and practical) course shall have to reappear for theory component at the subsequent examinations held in that course. A student who has secured 'F' grade can improve continuous evaluation marks upto a maximum of 50% by attending special instruction classes held during summer.

9.6 A student who has secured 'F' Grade in project work / Industrial Training shall be permitted to submit the report only after satisfactory completion of the work and viva-voce examination.

10. PROVISION FOR VERIFICATION OF ANSWER BOOK AND CHALLENGE EVALUATION

10.1 If a student is not satisfied with his/her grade after revaluation, the student can apply for verification of answer book on payment of prescribed fee for each course within one week after announcement of revaluation results.

10.2 After verification, if a student is not satisfied with revaluation marks/grade, he/she can apply for challenge valuation within one week after announcement of answer book verification result or two weeks after the announcement of revaluation results, which will be valued by the two examiners i.e., one Internal and one External examiner on payment of prescribed fee. The challenge valuation fee will be refunded, if the student is successful in the appeal by securing a better grade.

11. SUPPLEMENTARY AND SPECIAL EXAMINATIONS

11.1 The odd (I, III, V, VII) semester supplementary examinations will be conducted after conducting regular even semester examinations during April/May.

11.2 The even (II, IV, VI, VIII) semester supplementary examinations will be conducted after conducting regular odd semester examinations during October / November.

11.3 A student who has completed period of study and has "F" grade in final semester courses is eligible to appear for special examination.

12. PROMOTION TO THE NEXT YEAR OF STUDY

12.1 A student shall be promoted to the next academic year only if he/ she passes 60% of the credits till that academic year.

12.2 Whenever there is a change in syllabus or curriculum he/she has to continue the course with new syllabus and regulations after detention as per the equivalency established by the BoS to continue his/her further studies.

13. MASSIVE OPEN ONLINE COURSES

Greater flexibility to choose variety of courses is provided through Massive Open Online Courses (**MOOCs**) during the period of study. Students without any backlog courses upto fourth semester are permitted to register for MOOCs from fifth semester onwards up to a maximum of 15 credits from program elective/interdisciplinary elective/ open elective courses. However the Departmental Committee (DC) of the respective campuses has to approve the courses under MOOCs. The grade equivalency for these courses will be decided by the respective Board of Studies (BoS).

14. ELIGIBILITY FOR AWARD OF THE B. Tech. DEGREE

14.1 The curriculum of the eight semesters B.Tech. program is designed to have a total of 160 credits for the award of B.Tech. degree.

14.2 Duration of the program: A student is ordinarily expected to complete the B. Tech program in eight semesters of four years. However, a student may complete the program in not more than eight years including study period.

14.3 However, the above regulation may be relaxed by the Vice- Chancellor in individual cases for cogent and sufficient reasons.

14.4 A student shall be eligible for award of the B.Tech. Degree if he / she fulfils the following conditions:

i) Registered and successfully completed all the courses and project as per the curriculum.
ii) Successfully acquired the minimum required credits as specified in the curriculum in the branch of his/her study within the stipulated time.
iii) Has no dues to the Institute, Hostels, Libraries, NCC/NSS etc, and no disciplinary action is pending.

15. B. Tech (HONORS)

A student who secured 8.0 CGPA or above up to IV semester is eligible to register for B. Tech (Honors) degree. The student has to complete additional 20 credits (six theory courses + seminar) as approved by the respective DC to secure B. Tech (Honors). The courses will be approved by DC of respective campuses.

16 GRADING SYSTEM

16.1 Based on the student performance during a given semester, a final letter grade will be awarded at the end of the semester in each course. The letter grades and the corresponding grade points are as given in Table 2.

Table 2: Grades and Grade Points

S. No.	Grade	Grade Points	Absolute Marks
1	O (Outstanding)	10	90 and above
2	A+ (Excellent)	9	80 to 89
3	A (Very Good)	8	70 to 79
4	B+ (Good)	7	60 to 69
5	B (Above Average)	6	50 to 59
6	C (Average)	5	45 to 49
7	P (Pass)	4	40 to 44
8	F (Fail)	0	Less than 40
9	Ab. (Absent)	0	-

16.2 A student who earns a minimum of 4 grade points (P grade) in a course is declared to have successfully completed the course, subject to securing CGPA of 5.0 at the end of the program to declare pass in the B. Tech program.

17. GRADE POINT AVERAGE

17.1 Grade Point Average (GPA) for a semester is calculated as follows:

$$GPA = \frac{\Sigma[\, C \times G \,]}{\Sigma\, C}$$

Where,

C = number of credits for the course.

G =grade points obtained by the student in the course.

17.2 The Cumulative Grade Point Average (CGPA), is calculated using the above formula considering the grades obtained in all the courses, in all the semesters up to that particular semester.

17.3 CGPA required for classification of class after the successful completion of the program is as shown in Table 3.

Table 3: CGPA required for award of Class

Class	CGPA Required
First Class with Distinction	≥8.0*
First Class	≥ 6.5
Second Class	≥ 5.5
Pass	≥ 5.0

* In addition to the required CGPA of 8.0 or more, a student must have necessarily passed all the courses in the first attempt.

18. BETTERMENT OF GRADES

18.1 A student who has secured only a pass or second class and desires to improve his/her class can appear for betterment examinations for only upto eight theory courses of his/her choice, conducted in summer vacation along with the special examinations.

18.2 Betterment of Grades is permitted 'only once', immediately after completion of the program of study.

19. DISCRETIONARY POWER

Notwithstanding anything contained in the above sections, the Vice-Chancellor may review all exceptional cases, and give his decision, which will be final and binding.

Department of Electrical, Electronics and Communication Engineering

B.Tech ECE with specialized subjects in AI&ML, IoT, Medical Electronics and VLSI Design

Semester I

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA101	Engineering Mathematics I (Calculus and Algebra)	BS	3	0	0		3	Common to all except BT
2.	GEL131	Communicative English	HS	2	0	2		3	Common to all
3.	19EPH131/ 19ECY131	Engineering Physics /Engineering Chemistry	BS	3	0	3		4.5	Common to all
4.	19EID131/ 19EEE131	Problem Solving and Programming / Basic Electrical and Electronics Engineering	ES	3	1	3		5.5	Common to all
5.	19EME121/ 19EME131	Workshop / Engineering Graphics	ES	0/1	0	3		1.5/ 2.5	Common to all
6.	19EMC181X	NSS/NCC/NSO/YOGA	MC	0	0	2		0	Common to all
						Total		**17.5/18.5**	

Semester II

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA102	Engineering Mathematics II (ODE, PDE and Multivariable Calculus)	BS	3	0	0		3	Common with EEE, ME,CE and AE
2.	19ECY131/ 19EPH131	Engineering Chemistry / Engineering Physics	BS	3	0	3		4.5	Common to all
3.	19EEE131/ 19EID131	Basic Electrical and Electronics Engineering / Problem Solving and Programming	ES	3	1	3		5.5	Common to all
4.	19EID132/ 19EID134	Design Thinking / AI Tools	ES	2	0	2		3	Common to all
5.	19EME131 / 19EME121	Engineering Graphics / Workshop	ES	1/0	0	3		2.5/1.5	Common to all
6.	19EEC122	Electronics Workshop	PC	0	0	3		1.5	Common with ECE
7.	19EMC181X	NSS/NCC/NSO/YOGA	MC	0	0	2		0	Common to all
8.	19EHS122	Comprehensive Skill Development I	HS	0	0	0	6	1	Common to all
9	VDC111	Venture Discovery	PW	0	0	4		2	Common to all
						Total		**23/22**	

Semester III

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA203	Engineering Mathematics III (Complex Variables and Transform Techniques)	BS	3	0	0		3	Common with ECE & EEE
2.	19EID134/ 19EID132	AI Tools/ Design Thinking	ES	2	0	2		3	Common to all
3.	19EEC231	Network Theory and Analysis	PC	3	0	2		4	Common with ECE
4.	19EEC233	Electronic Devices and Amplifier Circuits	PC	3	0	3		4.5	Common with ECE & EEE
5.	19EEC235	Signals and Systems	PC	2	0	2		3	Common with ECE & EEE
6.	19EEC237	Electromagnetic Waves	PC	2	0	2		3	Common with ECE
7.	19EMC281/ 19EMC282	Constitution of India / Environmental Sciences	MC	3	0	0		0	Common to all
8.	19EHS221	Comprehensive Skill Development II	HS	0	0	0	6	1	Common to all
Total								**21.5**	

Semester IV

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EMA104 / 19EMA204	Engineering Mathematics IV (Probability and Statistics) / (Probability Theory and Random Processes)	BS	3	0	0		3	AI&ML/ Common with ECE & EEE
2.	19EID232 /19EID234	Internet of Things / Life Sciences for Engineers	ES/BS	2	0	2		3	Common to all
3.	19EEC232	Digital Logic Design	PC	3	0	3		4.5	Common with ECE & EEE
4.	19EEC234	Analog Circuits	PC	3	0	3		4.5	Common with ECE & EEE
5.	19EEC236	Analog and Digital Communications	PC	3	0	3		4.5	Common with ECE
6.	19EEC238	Control System Engineering	PC	2	0	2		3	Common with ECE & EEE
7.	19EMC282/ 19EMC281	Environmental Science / Constitution of India	MC	3	0	0		0	Common to all
8.	19EEC292	Comprehensive Skill Development III	PW	0	0	0	6	1	Common to all
Total								**23.5**	

Semester V

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EEC331	Antenna Analysis and Synthesis	PC	3	0	2		4	Common with ECE
2.	19EEC333	Digital Signal Processing	PC	3	0	3		4.5	Common with ECE
3.	19EID234/ 19EID232	Life Sciences for Engineers/ Internet of Things	BS/ES	2	0	2		3	Common to all
4.	19EID331	**Artificial Neural Networks**	PC	2	0	2		3	AI & ML
	19EEC335I	**Sensors for IoT**	PC	2	0	2		3	Internet of Things
	19EEC335M	**Anatomy and Human Physiology**	PC	2	0	2		3	Medical Electronics
	19EEC335V	**Basic VLSI Design**	PC	2	0	2		3	VLSI Design
5.	19ZOE3XX	Open Elective I	OE	3	0	0		3	Common to all
6.	19EYY3/4XX	Interdisciplinary Elective I	ID	2/3	0	2/0		3	Common with ECE
7.	19EEC391	Comprehensive Skill Development IV	PW	0	0	0	6	1	Common to all
						Total		**21.5**	

Semester VI

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EEC332	Microprocessors and Microcontrollers	PC	3	0	3		4.5	Common with ECE & EEE
2.	19EEC334A	**AI in VLSI Design Automation**	PC	3	0	3		4.5	AI & ML
	19EEC334I	**Programming IoT**	PC	3	0	3		4.5	Internet of Things
	19EEC334M	**Bio-Medical Instrumentation**	PC	3	0	3		4.5	Medical Electronics
	19EEC334V	**Digital Design with FPGAs**	PC	3	0	3		4.5	VLSI Design
3.	19EEC3XX	Programme Elective I	PE	2/3	0	2/0		3	Program specific
4.	19EEC3XX	Programme Elective II	PE	2/3	0	2/0		3	Program specific
5.	19ZOE3XX	Open Elective II	OE	3	0	0		3	Common to all
6.	19EHS302	Engineering Economics and Management	HS	3	0	0		3	Common to all
7.	19EMC382	Engineering Ethics	MC	3	0	0		0	Common to all
8.	19EEC392	Comprehensive Skill Development V	PW	0	0	0	6	1	Common to all
						Total		**22**	

Semester VII

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EEC431	Communication Networks	PC	3	0	2		4	Common with ECE
2.	**19EEC433A**	**AI in Wireless Communications**	PC	3	0	2		4	AI & ML
	19EEC433I	**IoT Architecture and Protocols**	PC	3	0	2		4	Internet of Things
	19EEC433M	**Medical Image Processing**	PC	3	0	2		4	Medical Electronics
	19EEC433V	**VLSI Design Automation**	PC	3	0	2		4	VLSI Design
3.	19EEC4XX	Programme Elective III	PE	2/3	0	2/0		3	Program specific
4.	19EEC4XX	Programme Elective IV	PE	2/3	0	2/0		3	Program specific
5.	19EHS403	Organizational Behavior	HS	3	0	0		3	Common to all
6.	19EEC491	Project Phase I	PW	0	0	2		1	Common to all
7.	19EEC493	Internship*	PW					1	Common to all
8.	19EEC495	Comprehensive Skill Development VI	PW	0	0	0	6	1	Common to all
						Total		**20**	

*****Industrial Training / Research Projects in National Laboratories / Academic Institutions

Semester VIII

S.No	Course Code	Course Title	Category	L	T	P	A	C	Remarks
1.	19EYY4XX	Interdisciplinary Elective II	ID	2/3	0	2/0		3	
2.	19EEC4XX	Program Elective V	PE	2/3	0	2/0		3	Program specific
3.	19EEC492	Project Phase II	PW			12		6	Common with ECE
4.	GSS115	Gandhi for 21st Century	PW					1	Online Course
						Total		**13**	

Total Number of Credits

Semester	I	II	III	IV	V	VI	VII	VIII	Total
Credits	17.5/ 18.5	23/22	21.5	23.5	21.5	22	20	13	162

Category and Credits

Category	Category Code	Courses	Credits GITAM	Credits suggested by AICTE
Humanities & Social Sciences	HS	Communicative English	11	12
		HS1 and HS2 (elective)		
		Comprehensive Skill Development II & III		
Basic Sciences	BS	Engineering Physics	24	25
		Engineering Chemistry		
		Mathematics (4 Courses)		
		Life Sciences for Engineers		
Engineering Sciences	ES	Problem Solving and Programming	24	24
		Basic Electrical and Electronics Engineering		
		AI Tools		
		Engineering Graphics		
		Workshop		
		Design Thinking and Product Innovation		
		Internet of Things		
Open Electives	OE	OE1, OE2	12	18
Interdis-ciplinary Electives	ID	ID1, ID2		
Program Electives	PE	PE1 – PE5	15	18
Program Core	PC	PC1 – PC16	61	48
Project	PW	Venture Discovery	15	15
		Gandhi for 21st Century		
		Internship		
		Comprehensive Skill Development IV –VII		
		Project Phase I		
		Project Phase II		
Mandatory	MC	Environmental Science, Constitution of India, Engineering Ethics	-	-
		Total	**162**	**160**

Mandatory Course

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMC181A	National Service Scheme	MC	0	0	2	0	Mandatory Course
2.	19EMC181B	National Cadet Corps	MC	0	0	2	0	Mandatory Course
3.	19EMC181C	National Sports Organization	MC	0	0	2	0	Mandatory Course
4.	19EMC181D	Yoga	MC	0	**0**	**2**	**0**	Mandatory Course

Engineering Mathematics-II

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMA102	Engineering Mathematics II (ODE, PDE and Multivariable Calculus)	BS	3	0	0	3	Offered for ECE, EEE, ME,CE and AE
2.	19EMA104	Engineering Mathematics II (Probability and Statistics)	BS	3	0	0	3	Offered for CSE and IT
3.	19EMA106	Mathematics for Biotechnology II	BS	3	0	0	3	Offered for BT

Engineering Mathematics-III

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMA201	Engineering Mathematics III (Applications of PDE, Complex Variables and Transform Techniques)	BS	3	0	0	3	Offered for ME,CE And AE
2.	19EMA203	Engineering Mathematics III (Complex Variables and Transform Techniques)	BS	3	0	0	3	Offered for ECE and EEE
3.	19EMA205	Engineering Mathematics III (Discrete Mathematical Structures)	BS	3	0	0	3	Offered for CSE and IT
4.	19EMA207	Mathematics for Biotechnology III	BS	3	0	0	3	Offered for BT

Engineering Mathematics-IV

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EMA202	Engineering Mathematics IV (Numerical Methods, Probability and Statistics)	BS	3	0	0	3	Offered for CE, ME and EEE
2.	19EMA204	Engineering Mathematics IV (Probability Theory and Random Processes)	BS	3	0	0	3	Offered for ECE
3.	19EMA206	Engineering Mathematics IV (Number Theory and Applications)	BS	3	0	0	3	Offered for CSE and IT
4.	19EMA208	Mathematics for Biotechnology IV	BS	3	0	0	3	Offered for BT

Engineering Physics

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19EPH131	Engineering Physics	BS	3	0	3	4.5	Offered for ECE, CSE, EEE and IT
2.	19EPH133	Applied Physics	BS	3	0	3	4.5	Offered for AE, CE and ME
3.	19EPH135	Physics for Biotechnology	BS	3	0	3	4.5	Offered for BT

Engineering Chemistry

S.No	Course Code	Course Title	Category	L	T	P	C	Remarks
1.	19ECY131	Engineering Chemistry	BS	3	0	3	4.5	Offered for ECE, CSE, EEE and IT
2.	19ECY133	Chemistry of Materials	BS	3	0	3	4.5	Offered for AE, CE and ME
3.	19ECY135	Chemistry for Biotechnology	BS	3	0	3	4.5	Offered for BT

OPEN ELECTIVES

Open Elective I

S.No.	Course Code	Course Title	Category	L	T	P	C
1.	19EOE301	Japanese for Beginners	OE	3	0	0	3
2.	19EOE303	French for Beginners	OE	3	0	0	3
3.	19EOE305	Biotechnology and Society	OE	3	0	0	3
4.	19EOE307	Contemporary Relevance of Indian Epics	OE	3	0	0	3
5.	19EOE309	Indian National Movement	OE	3	0	0	3
6.	19EOE313	Personality Development	OE	3	0	0	3
7.	19LOE301	Fundamentals of Cyber Law	OE	3	0	0	3
8.	19MOE303	Introduction to International Business	OE	3	0	0	3
9.	19EOE319	Introduction to Music	OE	3	0	0	3
10.	19EOE321	Environment and Ecology	OE	3	0	0	3
11.	19EOE323	Indian History	OE	3	0	0	3
12.	19EOE327	Professional Communication	OE	3	0	0	3
13.	GEL244	English for Higher Education	OE	3	0	0	3
14.	19EOE224	Virtual Reality	OE	1	0	4	3

Open Elective II

S. No.	Course Code	Course Title	Category	L	T	P	C
1.	19EOE302	German for Beginners	OE	3	0	0	3
2.	19EOE304	Chinese for Beginners	OE	3	0	0	3
3.	19EOE306	Analytical Essay Writing	OE	3	0	0	3
4.	19EOE308	Indian Economy	OE	3	0	0	3
5.	19EOE310	Public Administration	OE	3	0	0	3
6.	19EOE312	Environmental Management	OE	3	0	0	3
7.	19EOE327	Professional Communication	OE	3	0	0	3
8.	19MOE301	Basics of Finance	OE	3	0	0	3
9.	19LOE301	Fundamentals of Cyber Law	OE	3	0	0	3
10.	19EOE313	Personality Development	OE	3	0	0	3
11.	19MOE303	Basics of Marketing	OE	3	0	0	3
12.	GEL345	Work Place Communication – Basic	OE	3	0	0	3
13.	GEL347	Work Place Communication - Advanced	OE	3	0	0	3

INTERDISCIPLINARY ELECTIVES

Interdisciplinary Elective I

S.No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Professional Courses	19EEE373	Fundamentals of Power Electronics	ID	3	0	0	3
2.		19EEI373	Measurements and Instrumentation	ID	2	0	2	3
3.		19EEI371	Sensors and Signal Conditioning	ID	2	0	2	3
4.	Computer Oriented Courses	19EIT371	Programming with C	ID	2	0	2	3
5.		19ECS371	Introduction to Database Management Systems	ID	2	0	2	3
6.		19ECS472	Introduction to Augmented Reality and Virtual Reality	ID	3	0	0	3
7.	Management Courses	19EHS405	Operations Research	ID	3	0	0	3
8.		19EHS375	Business Ethics and Corporate Governance	ID	3	0	0	3
9.		19EME346	Project Management and Optimization	ID	3	0	0	3

Interdisciplinary Elective II

S.No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Professional Courses	19EEI475	Medical Instrumentation	ID	2	0	2	3
2.		19EEI471	Robotics and Automation	ID	2	0	2	3
3.		19EEI472	Introduction to MEMS	ID	2	0	2	3
4.		19EME361	3D Printing	ID	2	0	2	3
5.		19EEI473	Virtual Instrumentation	ID	2	0	2	3
6.	Computer Oriented Courses	19ECS478	Introduction to Data Science	ID	2	0	2	3
7.		19ECS475	Introduction to Web Technologies	ID	2	0	2	3
8.		19ECS477	Fundamentals of Data Structures	ID	2	0	2	3
9.		19ECS375	Introduction to Programming with Java	ID	2	0	2	3
10.		19ECS373	Object Oriented Programming with C++	ID	2	0	2	3
11.		19ECS471	Introduction to Operating Systems	ID	2	0	2	3
12.	Management Courses	19EME349	Total Quality Management	ID	3	0	0	3
13.		19EME357	Supply Chain Management	ID	3	0	0	3
14.		19EHS475	Entrepreneurship Development	ID	3	0	0	3
15.		19ECE371	Disaster Management	ID	3	0	0	3

Program electives for B.Tech ECE with All Specializations

Electives Stream	Programme Elective I	Programme Elective II	Programme Elective III	Programme Elective IV	Programme Elective V
Communication Engineering	Information Theory and Coding	Fiber Optic Communications	Satellite Communications	Global Positioning Systems	Software Defined Networks
Signal Processing	DSP Processors and Architectures	Real Time Signal Processing	Digital Image Processing	Biomedical Signal Processing	Speech Processing
Microwaves	Transmission lines and Waveguides	Microwave Engineering	RF Circuit Design	Radar Systems	EMI and EMC Techniques
Embedded Systems	Computer Organization and Design	Introduction to VLSI Design	Software Defined Radio	ARM System Development	TV Technology
AIML*	Data Structures and Algorithms	Machine Learning	Deep Learning	Advanced Artificial Intelligence	Data Analytics
Internet of Things**	IoT Applications	Cloud and Fog computing	Computer Vision	IoT security	Operating Systems
Medical Electronics***	Bio Mechanics	Signal Processing in Medical Electronics	Embedded Systems in Medical Devices	Diagnostic and Therapeutic Equipment	Wearable systems
VLSI Design****	Modern Semiconductor Devices	Analog IC Design	DSP Design with FPGAs	Computer Organization and Architecture	Fundamentals of VLSI Device Fabrication

Program Elective I

S.No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Communication Engineering	19EEC341	Information Theory and Coding	PE	2	0	2	3
2.	Signal Processing	19EEC343	DSP Processors and Architectures	PE	2	0	2	3
3.	Microwaves	19EEC347	Transmission lines and Waveguides	PE	3	0	0	3
4.	Embedded Systems	19EEC349	Computer Organization and Design	PE	3	0	0	3
5.	**AIML***	19EEC340	Data Structures and Algorithms	PE	2	0	2	3
	Internet of Things**	19EEC354	IoT Applications					
	Medical Electronics***	19EEC356	Bio Mechanics					
	VLSI Design****	19EEC358	Modern Semiconductor Devices					

Note: The faculty has to design the activity for each Program Elective.

Program Elective II

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Communication Engineering	19EEC362	Fiber Optic Communications	PE	2	0	2	3
2.	Signal Processing	19EEC344	Real Time Signal Processing	PE	3	0	0	3
3.	Microwaves	19EEC348	Microwave Engineering	PE	2	0	2	3
4.	Embedded Systems	19EEC350	Introduction to VLSI Design	PE	2	0	2	3
5.	**AIML***	19EEC360	Machine Learning	PE	2	0	2	3
	Internet of Things**	19EEC374	Cloud and Fog computing					
	Medical Electronics***	19EEC376	Signal Processing in Medical Electronics					
	VLSI Design****	19EEC465	Analog IC Design					

Note: The faculty has to design the activity for each Program Elective.

Program Elective III

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Communication Engineering	19EEC441	Satellite Communications	PE	2	0	2	3
2.	Signal Processing	19EEC364	Digital Image Processing	PE	2	0	2	3
3.	Microwaves	19EEC368	RF Circuit Design	PE	2	0	2	3
4.	Embedded Systems	19EEC370	Software Defined Radio	PE	2	0	2	3
5.	**AIML***	19EEC453	Deep Learning	PE	2	0	2	3
	Internet of Things**	19EEC455	Computer Vision					
	Medical Electronics***	19EEC457	Embedded Systems in Medical Devices					
	VLSI Design****	19EEC346	DSP Design with FPGAs					

Note: The faculty has to design the activity for each Program Elective.

Program Elective IV

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Communication Engineering	19EEC461	Global Positioning Systems	PE	2	0	2	3
2.	Signal Processing	19EEC463	Biomedical Signal Processing	PE	2	0	2	3
3.	Microwaves	19EEC467	Radar Systems	PE	2	0	2	3
4.	Embedded Systems	19EEC449	ARM System Development	PE	2	0	2	3
5.	**AIML***	19EEC473	Advanced Artificial Intelligence	PE	2	0	2	3
	Internet of Things**	19EEC475	IoT security					
	Medical Electronics***	19EEC477	Diagnostic and Therapeutic Equipment					
	VLSI Design****	19EEC479	Computer Organization and Architecture					

Note: The faculty has to design the activity for each Program Elective.

Program Elective V

S. No.	Stream	Course Code	Course Title	Category	L	T	P	C
1.	Communication Engineering	19EEC442	**Software Defined Networks**	PE	2	0	2	3
2.	Signal Processing	19EEC444	Speech Processing	PE	2	0	2	3
3.	Microwaves	19EEC448	EMI and EMC Techniques	PE	3	0	0	3
4.	Embedded Systems	19EEC469	TV Technology	PE	3	0	0	3
5.	**AIML***	19EEC460	Data Analytics	PE	2	0	2	3
	Internet of Things**	19EEC454	Operating Systems					
	Medical Electronics***	19EEC456	Wearable systems					
	VLSI Design****	19EEC458	Fundamentals of VLSI Device Fabrication					

Note: The faculty has to design the activity for each Program Elective.

* B.Tech ECE with Specialized Subjects in AI & ML
** B.Tech ECE with Specialized Subjects in Internet of Things
*** B.Tech ECE with Specialized Subjects in Medical Electronics
**** B.Tech ECE with Specialized Subjects in VLSI Design

S. No	Course Code	Course Title	Category	L	T	P	A	C	Semester	Content
1	19EHS122	Comprehensive Skill Development I	HS	0	0	0	6	1	II	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%)
2	19EHS221	Comprehensive Skill Development II	HS	0	0	0	6	1	III	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%)
3	19EEC292	Comprehensive Skill Development III	PW	0	0	0	6	1	IV	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%
4	19EEC391	Comprehensive Skill Development IV	PW	0	0	0	6	1	V	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) Coding (50%)
5	19EEC392	Comprehensive Skill Development V	PW	0	0	0	6	1	VI	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) **Domain Skills** (50%)
6	19EEC495	Comprehensive Skill Development VI	PW	0	0	0	6	1	VII	Verbal + Soft skills + Quantitative Aptitude and Reasoning (50%) **Domain Skills** (50%)

19EMA101: ENGINEERING MATHEMATICS I CALCULUS AND ALGEBRA
(Common to all branches of Engineering except Biotechnology)

L	T	P	C
3	0	0	3

This course is designed for the students of all B.Tech programmes except for Biotechnology as a prerequisite for the core programmes. The course imparts concepts of calculus and matrix algebra that are essential in applications in solving engineering problems.

Course Objectives:

- To familiarize the students with the theory of matrices and quadratic forms.
- To explain the series expansions using mean value theorems.
- To teach basic concepts of partial derivatives.
- To explain the evaluation of double integrals and its applications.
- To demonstrate the evaluation and applications of triple integrals.

Unit I: Matrices **10 L**

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous linear equations, eigenvalues, eigenvectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

Learning Outcomes:

After completion of this unit, the student will be able to

- solve system of homogeneous and non-homogeneous linear equations (L3).
- find the eigenvalues and eigenvectors of a matrix (L3).
- identify special properties of a matrix (L3).

Unit II: Mean Value Theorems **6 L**

Rolle's theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof).

Learning Outcomes:

After completion of this unit, the student will be able to

- demonstrate the given function as series of Taylor's and Maclaurin's with remainders (L3).
- illustrate series expansions of functions using mean value theorems (L3).

Unit III: Multivariable Calculus **8 L**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobian, maxima and minima of functions of two variables, method of Lagrange multipliers.

Learning Outcomes:

After completion of this unit, the student will be able to

- interpret partial derivatives as a function of several variables (L3).
- Apply Jacobian concept to deal with the problems in change of variables (L3).
- evaluate maxima and minima of functions (L3).

Unit IV: Multiple Integrals I **8 L**

Double integrals, change of order of integration, double integration in polar coordinates, area enclosed by plane curves.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply double integrals in cartesian and polar coordinates (L4).
- calculate the areas bounded by a region using double integration techniques (L3).

Unit V: Multiple Integrals II **8 L**

Evaluation of triple integrals, change of variables (cartesian, cylindrical and spherical polar co-ordinates), volume as triple integral.

Learning Outcomes:

After completion of this unit, the student will be able to

- apply multiple integrals in cartesian, cylindrical and spherical geometries (L3).
- evaluate volumes using triple integrals (L4).

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
3. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

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

- utilize the techniques of matrix algebra for practical applications (L3)
- apply mean value theorems to engineering problems (L3)
- utilize functions of several variables in optimization (L3)
- employ the tools of calculus for calculating the areas (L3)
- calculate volumes using multiple integrals (L3)

GEL131: COMMUNICATIVE ENGLISH

(Common to all)

L	T	P	C
2	0	2	3

The course is a unified approach to enhance language skills of the learners with an aim to hone their social skills and increase their employability. It is designed to acquaint the learners with the necessary LSRW (Listening / Speaking / Reading / Writing) skills needed either for recruitment or further studies abroad for which they attempt international exams like TOEFL, IELTS and GRE. It enables the learners improve their communication skills which are crucial in an academic environment as well as professional and personal lives.

Course Objectives

- To enable students to develop listening skills for better comprehension of academic presentations, lectures and speeches.
- To hone the speaking skills of students by engaging them in various activities such as just a minute (JAM), group discussions, oral presentations, and role plays.
- To expose learners to key Reading techniques such as Skimming and Scanning for comprehension of different texts.
- To acquaint the students with effective strategies of paragraph and essay writing, and formal correspondence such as email, letters and resume.
- To provide students with the critical impetus necessary to forge a path in an academic environment, on the job, and in an increasingly complex, interdependent world.
- To enable learners to understand the universality of human experience in literary texts and have a more significant insight into human values.

Unit I **14 L**

Reading: "Of Studies" by Francis Bacon. **Writing:** Principles of writing: clarity, simplicity, brevity, single focus, organization of thoughts. **Grammar, Vocabulary & Pronunciation:** Sentence Structure: use of phrases & clauses in sentences; punctuation, word formation, word families: nouns, verbs, adjectives adverbs. **Listening & Speaking (English Language Laboratory & Activity Lab):** Introduction to Phonetics: Vowels, Introducing Oneself.

Learning Outcomes

After completion of this unit, the student will be able to

- understand the importance of knowledge in terms of its practical application towards the individual and the society (L2).
- write with clarity, simplicity and brevity (L3).
- use phrases, clauses and punctuation appropriately (l3).
- apply the right parts of speech in a sentence (L3).
- recognize and utter vowel sounds in words correctly (L1).
- learn how to create a commendable impression through the right usage of words and expressions (L2).
- introduce themselves effectively in different social and professional contexts (L3).

Unit II **14 L**

Reading: "Scientist in Training: The Oxford Years" Stephen Hawking's Biography. **Writing:** Note Making- organizing techniques: providing a suitable title, headings and sub headings; methods of sequencing. **Grammar, Vocabulary & Pronunciation:** Articles, standard abbreviations. **Listening & Speaking (English Language Laboratory & Activity Lab):** Introduction to Phonetics: Consonants; JAM (Just – A – Minute speaking sessions)

Learning Outcomes:

After completion of this unit, the student will be able to

- think and perform against all odds and try to be successful (L3).
- comprehend and organize thoughts in a concise and meaningful way for making notes (L2).
- record and review information and develop time management skills (L5).
- use articles appropriately in writing (L3).
- use abbreviations in Note Making (L3).
- recognize and utter consonant sounds in words correctly (L1).
- organise thoughts and articulate relevant ideas in a sequential manner L3).
- speak spontaneously on a given topic (L6).

Unit III **14 L**

Reading: "The Teenage Years' by Sarah Gray. **Writing :** Paragraph Writing-Organization : topic sentence, supporting sentences, the concluding sentence, creating coherence. **Grammar, Vocabulary & Pronunciation:** Tense; prefixes & suffixes. **Listening & Speaking (English Language Laboratory & Activity Lab):** Listening for intonation, stress and rhythm & pronunciation; Common everyday situations: conversations and dialogues.

Learning Outcomes:

After completion of this unit, the student will be able to

- know how to become strong and wise with growing age (L5).
- understand and appreciate poetry for its diction, tone, rhythm, structure and be creative (L5).
- use pre-writing strategies to develop ideas and produce drafts of different types of paragraphs (L3).
- write a paragraph using appropriate cohesive devices (L3).
- use correct tense forms and appropriate structures in speech and written communication (L3).
- use prefixes and suffixes for effective communication (L1).
- select the requisite listening skills such as critical/evaluative / selective /empathetic or sympathetic / appreciative listening as per the context (L5).
- apply different listening skills needed for personal and professional situations (L3).
- take part in every day conversations confidently and comfortably (L3).

Unit IV **14 L**

Reading: "Unlock Your Own Creativity" by Robert Von Oech. **Writing:** Paraphrasing -techniques of paraphrasing: Replacement of words and phrases, change of sentence structures. **Grammar, Vocabulary & Pronunciation:** Subject-verb agreement; Synonyms. **Listening & Speaking (English Language Laboratory & Activity Lab):** Listening comprehension: listening for the main idea, listening for specific information; Discussion in pairs and small groups.

Learning Outcomes:

After completion of this unit, the student will be able to

- understand different dimensions of the term 'creativity' and can realize that they can be the pioneers of creativity by germinating new ideas on the fertile soil of soft thinking (L6).
- paraphrase short academic texts using apt strategies and avoid plagiarism (L3).
- construct grammatically correct sentences with proper subject-verb agreement (L3).
- enrich their vocabulary (L1).
- understand the significance of proper pronunciation (L1).
- speak using right intonation, stress and rhythm (L3).
- participate in group discussions and learn to speak clearly using suitable discourse markers (L3).
- comprehend and relate the importance of group dynamics for success (L4).

Unit V **14 L**

Reading: "A Talk on Advertising" by Herman Wouk Reading Comprehension: skimming & scanning. **Writing :** Writing Essays -writing introduction , body and conclusion. **Grammar, Vocabulary & Pronunciation :** Prepositions, antonyms. **Listening & Speaking (English Language Laboratory & Activity Lab):** Listening to discussions: focus on language devices; group discussions.

Learning Outcomes:

After completion of this unit, the student will be able to

- deal with the web of overwhelming advertisements (L2).
- experience unique style of expressing in English (L6).
- apply different reading skills to comprehend any given passage (L3).
- produce a well-organized essay with adequate supporting evidences(L3).
- use prepositions of time, place and position (L3).
- comprehend short lectures / speeches and summarize the content with clarity and precision (L2).
- identify important points in a discussion (L1).
- contribute valid ideas to a discussion with clarity and precision (L3).

Text Book(s) :

1. Avenues: Course Book I for Enhancing English Language and Communication Skills by Orient BlackSwan Private Limited, India, 2019.

References:

1. C Muralikrishna and Sunita Mishra, Communication Skills for Engineers, Dorling Kindesley Pearson Education, India, 2014.
2. Mamta Bhatnagar and Nitin Bhatnagar, Communicative English for Engineers and Professionals, Dorling Kindesley Pearson Education, India, 2010.
3. Adair, John. Effective Communication. London: Pan Macmillan Ltd., 2003.
4. Andrea J. Rutherford, Basic Communication Skills for Technology, 2nd Edition, Pearson India, 2001.

Course Outcomes

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

- communicate confidently in English in social and professional contexts with improved skills of fluency and accuracy (L6).
- write grammatically correct sentences employing appropriate vocabulary suitable to different contexts (L3).
- comprehend and analyze different academic texts (L4).
- effectively handle academic writing tasks such as paragraph writing, précis writing, paraphrasing and essay writing (L3).
- effectively handle formal correspondence like e-mail drafting and letter writing (L3).
- think critically, analytically, creatively and express ideas and content meaningfully (L6).

19EPH131: ENGINEERING PHYSICS (ECE, CSE, EEE and IT)

L	T	P	C
3	0	3	4.5

This course is designed with fundamentals of electromagnetism and properties of materials for advanced courses in their respective engineering branches. It introduces electromagnetic theory with relevant mathematical tools, optical fibers and their propagation characteristics, properties of dielectric and magnetic materials. It also introduces principles of semiconductors and some widely used semiconductor devices for various applications.

Course Objectives:

- To introduce mathematical principles to estimate forces, fields and waves.
- To familiarize students with electromagnetics in modern communication systems.
- To impart knowledge concerning the electrical behaviour of dielectric materials.
- To demonstrate the properties of magnets.
- To introduce semiconductor physics and devices.

Unit-I: Basics of Electromagnetics **9 L**

Electrostatic field: Coulomb's law and Gauss' law, derivation of Coulombs law from Gauss' law, applications of Gauss' law (line charge, thin sheet of charge and solid charged sphere), Gauss' law of electrostatics in dielectric medium, divergence and curl of electric fields, electric potential, relation between potential and force, Poisson's and Laplace equations.

Magnetostatic field: Biot–Savarts' law, divergence and curl of magnetic fields, Faraday's and Ampere's laws in integral and differential form, displacement current, continuity equation, Maxwell's equations.

Learning outcomes:

After completion of this unit, the student will be able to

- apply Coulomb's and Gauss' laws to electric field configurations from charge distributions (L3).
- apply the Biot-Savarts' law to derive magnetostatic field distributions (L3).
- use vector calculus to describe electromagnetic phenomena (L2).
- relate the law of conservation of charge to continuity equation (L3).
- evaluate the Maxwell's equations, Maxwell's displacement current and correction of Ampere's law (L2).

Unit II: Fiber Optics **7 L**

Introduction, advantages of optical fibers, principle and structure, acceptance angle, numerical aperture, modes of propagation, classification of fibers, fiber optic communication, importance of V-number, fiber optic sensors (Temperature, displacement and force), applications.

Learning outcomes:

After completion of this unit, the student will be able to

- apply the principle of propagation of light in optical fibers (L3).
- explain the working and classification of optical fibers (L2).
- analyze propagation of light through optical fibers based on the concept of modes (L4).
- summarize applications of optical fibers in medical, communication and other fields (L2).

Unit III: Dielectric and Magnetic Materials **10 L**

Dielectric materials: Introduction, electric polarization, dielectric polarizability, susceptibility and dielectric constant, types of polarizations (qualitative treatment only), frequency dependence of polarization, Lorentz (internal) field (quantitative), Clausius-Mossotti equation.

Magnetic materials: Introduction, magnetic dipole moment, magnetization, magnetic susceptibility and permeability, origin of permanent magnetic moment, classification of magnetic materials, Weiss theory of ferromagnetism (qualitative), domain theory, hysteresis, soft and hard magnetic materials.

Learning Outcomes:

After completing this unit the students will be able to

- explain the concept of dielectric constant and polarization in dielectric materials (L2).
- interpret dielectric loss, Lorentz field and Claussius- Mosotti relation (L2).
- classify the magnetic materials (L2).
- explain the phenomenon of hysteresis for a ferromagnetic material and summarize the properties of hard and soft magnetic materials (L3).

Unit IV: Semiconductor physics **8 L**

Introduction, origin of energy band, intrinsic and extrinsic semiconductors,mechanism of conduction in intrinsic semiconductors, generation and recombination, carrier concentration in intrinsic semiconductors, variation of intrinsic carrier concentration with temperature, n-type and p-type semiconductors, carrier concentration in n-type and p-type semiconductors.

Learning outcomes:

After completion of this unit, the student will be able to

- outline the properties of semiconductors (L2).
- interpret expressions for carrier concentration in intrinsic and extrinsic semiconductors (L3).
- assess the variation of carrier concentration in semiconductors with temperature (L4).

Unit – V: Semiconductor devices **8 L**

Drift and diffusion currents in semiconductors, Hall effect and its applications, magnetoresistance, p-n junction layer formation and V-I characteristics, direct and indirect band gap semiconductors, construction and working of photodiode, LED, solar cell.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the drift and diffusion currents and formation of junction layer(L2).
- state Einstein's relations (L1).
- explain Hall effect and its applications (L3).
- illustrate and interpret the V-I characteristics of a p-n junction diode(L2).
- describe applications of p-n junction diodes in photodiodes, LEDs andsolar cells (L3).

Text Book(s):

1. David J. Griffiths, "Introduction to Electrodynamics"- 4/e, Pearson Education, 2014.
2. Charles Kittel "Introduction to Solid State Physics", Wiley Publications, 2011.

References:

1. M.N. Avadhanulu, P.G.Kshirsagar "A Text book of Engineering Physics", 11/e, S. Chand Publications, 2019.
2. Gerd Keiser "Optical Fiber Communications"- 4/e, Tata Mc Graw Hill, 2008.
3. S.O. Pillai, "Solid State Physics" 8/e, New Age International, 2018.
4. S.M. Sze, "Semiconductor devices-Physics and Technology" - Wiley, 2008.

Course Outcomes:

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

- apply the fundamental laws of electricity and magnetism to currents and propagation of EM waves (L2).
- identify the mechanisms of polarization in dielectrics and magnetic materials, conduction in semiconductors and propagation of light in optical fibers. (L3).
- explain the principles of physics in dielectrics, magnetic materials and semiconductors useful to engineering applications (L2).
- summarize magnetic hysteresis curve (L2).
- analyze dielectric loss and carrier concentration in semiconductors (L4).
- classify solids and calculate conductivity of semiconductors (L4).
- demonstrate the functioning of solar cell, photodiode and loss mechanisms in optical fibers (L2).

Engineering Physics Laboratory (ECE, CSE, EEE, EIE and IT)

List of Experiments:

1. To determine the magnetic field along the axis of a circular coil carrying current.
2. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle.
3. To determine magnetic susceptibility by Gouy's method.
4. To determine the Hall coefficient using Hall effect experiment.
5. To determine the resistivity of semiconductor by Four probe method.
6. To determine the energy gap of a semiconductor.
7. To study the characteristics of PN Junction diode.
8. To study magnetic hysteresis loop (B-H curve).
9. To determine the dielectric constant of a substance by resonance method.
10. To determine hysteresis loss by CRO.
11. To study the characteristics of Photodiode.

12. To study the characteristics of Solar Cell.

References:

1. S. Balasubramanian, M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017

Learning Outcomes:

After completion of this unit the student will be able to

- utilize four probe set up and measure resistance (L3).
- determine the susceptibility of a paramagnetic substance (L5).
- understandthe characteristics of photodiode, p-n junction diode and solar cell (L2).
- demonstrate the importance of dielectric material in storage of electric field energy in the capacitors (L2).
- assess the intensity of the magnetic field of circular coil carrying current with varying distance (L5).
- evaluate the acceptance angle of an optical fiber and numerical aperture and loss (L5).
- determine hysteresis losses by B-H curve and measure magnetic parameters using hysteresis loop (L5).
- identify the type of semiconductor i.e., n-type or p-type using Hall effect (L3).
- determine the band gap of a given semiconductor (L5).

19ECY131: ENGINEERING CHEMISTRY (ECE, CSE, EEE and IT)

L	T	P	C
3	0	3	4.5

This course enables the students to gain knowledge on various aspects of renewable energy resources, electrochemical energy systems, construction of batteries, technological importance machining and etching, polymers, nano-materials, molecular machines and switches. The knowledge gained in this course can be applied to the latest problems in the above areas.

Course Objectives:

- To acquaint with electrochemical energy systems and their applications.
- To impart knowledge on the basic concepts of battery technology.
- To familiarize the students with various sources of renewable energy and their harnessing.
- To demonstrate the construction of photovoltaic cells.
- To introduce different types of nano-materials.
- To expose the students to latest instrumental techniques such as scanning electronic microscope (SEM) & transmission electron microscope (TEM).

Unit I: Electrochemical Energy Systems **9L**

Introduction Origin of electrode potential, Electrode Potentials, Measurement of Electrode Potentials, Nernst Equation for a single electrode, EMF of a cell, Types of Electrodes or Half Cells Hydrogen and Calomel electrode, Electrochemical Cell, Galvanic Cell vs Electrolytic Cell, Electrochemical conventions, Types of Ion Selective Electrodes- glass membrane electrode, polymer membrane electrodes, solid state electrodes, gas sensing electrodes (classification only), Concentration Cells.

Learning Outcomes:

After the completion of this unit, the student will be able to

- list the different types of electrodes (L1).
- illustrate the construction of concentration cells (L2).
- explain the significance of electrode potentials (L2).
- compare different types of cells and batteries (L2).
- classify the ion selective electrodes (L2).

Unit II: Battery Technology **8L**

Basic concepts, battery characteristics, classification of batteries, Important applications of batteries, Classical batteries-dry/Leclanche cell, Modern batteries-zinc air, lithium cells-Li MnO_2 cell- challenges of battery technology. Fuel cells Introduction - classification of fuel cells – hydrogen and oxygen fuel cell, propane and oxygen fuel cell- Merits of fuel cell.

Learning Outcomes:

After the completion of this unit, the student will be able to

- classify batteries into different types (L2).
- explain the concept involved in the construction of lithium cells (L2).
- compare the merits of different fuel cells (L2).
- identify the significance of batteries (L3).
- apply the redox principles for construction of batteries and fuel cell (L3).

Unit III: Renewable Sources of Energy **8L**

Introduction- sources of renewable energy

Solar energy – Introduction - Physical and Chemical properties of Silicon- Production of Solar Grade Silicon from Quartz - Doping of Silicon- p and n type semi conductors- PV cell / solar cell- Manufacturing of Photovoltaic Cells using Chemical Vapor Deposition Technique-applications of solar energy.

Learning Outcomes:

After the completion of this unit, the student will be able to

- list different renewable sources of energy. (L1).
- explain how photovoltaic cells convert light into energy. (L1).
- compare p and n type semi conductors. (L2).
- illustrate the construction of PV cell. (L2).

Unit IV: Metal Finishing **9L**

Technological importance of metal finishing, methods of metal finishing, manufacturing of electronic components, electrochemical techniques of forming, machining and etching, electrolytic cell, principle of electroplating, nature of electrodeposits, electroplating process, Electroplating of chromium, gold etc. Electroless plating of copper, nickel.

Learning Outcomes:

After the completion of this unit, the students will be able to

- explain the electrochemical techniques of forming (L2).
- extend it to electroless plating of some metals (L2).
- identify different methods of metal finishing (L3).
- apply the methods of metal finishing in the manufacture of electronic components (L3).

Unit V: Polymers, Nanomaterials and Molecular Machines & Switches **8L**

Polymers: Introduction, differences between thermoplastic and thermo setting resins, Preparation, properties and uses of polystyrene and Polyphosphazines.

Nanomaterials: Introduction to nanomaterial: nanoparticles, nanocluster, carbon nanotube (CNT) and nanowires. Chemical synthesis of nanomaterials: sol-gel method. Characterization: Principle and applications of scanning electron microscope (SEM) and transmission electron microscope (TEM).

Molecular machines & Molecular switches: Rotaxanes and Catenanes as artificial molecular machines; Molecular switches – cyclodextrin-based switches

Learning Outcomes:

After the completion of this unit, the students will be able to

- explain the concepts of artificial molecular machines and molecular switches (L3).
- identify different types of polymers (L3).
- distinguish between thermoplastic and thermo setting resins (L4).
- compare nanoclusters and nanowires (L4).

Text Book(s):

1. P.C. Jain and M. Jain, Engineering Chemistry, 15/e, Dhanapat Rai & Sons, Delhi, 2014.
2. B.K. Sharma, Engineering Chemistry, Krishna Prakashan, Meerut.
3. O G Palanna, Engineering Chemistry, Tata McGraw Hill, 2009.

References:

1. Sashichawla, A Textbook of Engineering Chemistry, Dhanapath Rai and sons, 2003.
2. B.S Murthy and P. Shankar, A Text Book of NanoScience and NanoTechnology, University Press, 2013.
3. S.S. Dara, A Textbook of Engineering Chemistry, S.Chand& Co, 2010.
4. N.Krishna Murthy and Anuradha, A text book of Engineering Chemistry, Murthy Publications, 2014.
5. K. Sesha Maheshwaramma and Mridula Chugh, Engineering Chemistry, Pearson India Edn services, 2016.

Course Outcomes:

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

- list various sources of renewable energy (L1).
- compare different types of cells (L2).
- explain the merits of fuel cells (L2).
- identify suitable methods for metal finishing (L3).
- distinguish between nanoclusters and nanowires, polymers, molecular machines & switches (L4).

Engineering Chemistry Laboratory (CSE, IT, ECE & EEE)

The course enables the students to gain knowledge on various, instrumental methods of analysis, measurements of physical parameters, volumetric analysis, preparation of polymers, analysis of water, and chromatographic separation techniques.

Course Objectives:

- To familiarize the students with the basic concepts of Engineering Chemistry lab.
- To train the students on how to handle the instruments.
- To demonstrate the digital and instrumental methods of analysis.
- To expose the students in practical aspects of the theoretical concepts.

List of Experiments

1. Determination of Mohr's salt by potentiometric method
2. Determination of strength of an acid by pH metric method
3. Determination of conductance by conductometric method
4. Determination of viscosity of a liquid
5. Determination of surface tension of a liquid
6. Determination of sulphuric acid in lead-acid storage cell
7. Determination of chromium (VI) in potassium dichromate
8. Determination of copper in a copper ore
9. Determination of Zinc by EDTA method.
10. Estimation of active chlorine content in Bleaching powder
11. Preparation of Phenol-Formaldehyde resinreparation of Urea-Formaldehyde resin
12. Thin layer chromatography
13. Preparation of TiO2/ZnO nano particles
14. SEM analysis of nano materials

Text books

1. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B Vogel's Quantitative Chemical Analysis 6/e, Pearson publishers 2000.
2. N.K Bhasin and Sudha Rani Laboratory Manual on Engineering
3. Chemistry 3/e, Dhanpat Rai Publishing Company 2007.

Course Outcomes:

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

- explain the functioning of the instruments such as pH, Conductometric and Potentiometric methods (L2).
- identify different ores (Cr & Cu) and their usage in different fields (industry, software devices, electronic goods) (L3).
- experiment with the physical parameter of organic compounds (L3).
- compare the viscosities of oils (L4).
- list the preparation of polymers and nano materials (L4).

19EID131: **PROBLEM SOLVING AND PROGRAMMING**

(Common to all)

L	T	P	C
3	1	3	5.5

This course focuses on problem solving using visual programming and flowchart tools. Python being simple and easy to learn syntax, it is used as an introductory coding platform to translate flow charts into programs. The course introduces fundamental programming concepts. Python language is used to present concepts including control structures, functions, data structures followed by important Python packages that will be useful in data analysis.

Course Objectives:

- To introduce programming through Visual programming tool - Scratch
- To teach problem solving through Flow charting tool - Raptor
- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Pythonic solution patterns

Unit I: Computational Thinking and Visual Programming Concepts

Introduction to computational thinking. Visual programming concepts. Scratch environment: sprites -- appearance and motion, angles and directions, repetition and variation, changing costumes, adding background. Input/Output, variables and operators.

Learning Outcomes

After completion of this unit the student will be able to

- develop a program, controlled by a loop. (L3)
- experiment with "costumes" to change the appearance of sprites. (L3)
- perform Input, Output Operations using scratch. (L3)
- perform computation using common mathematical formulas. (L3)
- develop programs by passing messages between sprites. (L3)

Unit II: Algorithms and Flowchart design through Raptor

Introduction to the idea of an algorithm. Pseudo code and Flow charts. Flow chart symbols, Input/Output, Assignment, operators, conditional if, repetition, procedure and sub charts. Example problems – Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD of 2 numbers Example problem -- Fibonacci number generation, prime number generation. Minimum, Maximum and average of n numbers, Linear search, Binary Search.

Learning outcomes:

After completion of this unit the student will be able to

- select flowchart symbols for solving problems. (L1)
- develop basic flowcharts for performing Input, Output and Computations (L3)
- solve numerical problems using Raptor (L3)
- analyze problems by modular approach using Raptor (L4)

Unit III: Introduction to Python

Python – Numbers, Strings, Variables, operators, expressions, statements, String operations, Math function calls, Input/Output statements, Conditional If, while and for loops, User defined Functions, parameters to functions, recursive functions, Turtle Graphics.

Learning outcomes:

After completion of this unit the student will be able to

- interpret numbers, strings, variables, operators, expressions and math functions using Python Interactive Mode. (L2)
- solve simple problems using control structures, input and output statements. (L3)
- develop user defined functions (recursive and non-recursive). (L3)
- build Python programs for section 1 raptor flowcharts. (L3)
- develop Python programs for creating various graphical shapes using turtle graphics. (L3)

Unit IV: Data Structures and Idiomatic Programming in Python

Lists, Tuples, Dictionaries, Strings, Files and their libraries. Beautiful Idiomatic approach to solve programming problems.

Learning outcomes:

After completion of this unit the student will be able to

- summarize the features of lists, tuples, dictionaries, strings and files. (L2)
- demonstrate best practices of "Beautiful Idiomatic Python". (L2)
- build Python programs for section 2 raptor flowcharts. (L3).

Unit V : Packages

Numpy -- Create, reshape, slicing, operations such as min, max, sum , search, sort, math functions etc.

Pandas -- Read/write from csv, excel, json files, add/ drop columns/rows, aggregations, applying functions

Matplotlib -- Visualizing data with different plots, use of subplots.

User defined packages, define test cases and perform unit testing

Learning outcomes:

After completion of this unit the student will be able to

- read data from files of different formats and perform operations like slicing, insert, delete, update (L3)
- visualize the data (L4)
- ability to define packages (L2)
- define test cases (L1)

Laboratory Experiments

1. Design a script in Scratch to make a sprite to draw geometrical shapes such as Circle, Triangle, Square, Pentagon.
2. Design a script in Scratch to make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result.
3. Design a Memory Game in Scratch which allows the user to identify positions of similar objects in a 3 x 3 matrix.
4. Construct flowcharts to
    a. calculate the maximum, minimum and average of N numbers
    b. develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
5. Construct flowcharts with separate procedures to
    a. calculate simple and compound interest for various parameters specified by the user
    b. calculate the greatest common divisor using iteration and recursion for two numbers as specified by the user
6. Construct flowcharts with procedures to
    a. generate first N numbers in the Fibonacci series
    b. generate N Prime numbers
7. Design a flowchart to perform Linear search on list of N unsorted numbers (Iterative and recursive)
8. Design a flowchart to perform Binary search on list of N sorted numbers (Iterative and recursive)
9. Design a flowchart to determine the number of characters and lines in a text file specified by the user
10. Design a Python script to convert a Binary number to Decimal number and verify if it is a Perfect number.
11. Design a Python script to determine if a given string is a Palindrome using recursion
12. Design a Python script to sort numbers specified in a text file using lists.
13. Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format (0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
14. Design a Python Script to determine the Square Root of a given number without using inbuilt functions in Python.
15. Design a Python Script to determine the time difference between two given times in HH:MM: SS format. (0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)
16. Design a Python Script to find the value of (Sine, Cosine, Log, PI, *e)* of a given number using infinite series of the function.
17. Design a Python Script to convert a given number to words
18. Design a Python Script to convert a given number to roman number.
19. Design a Python Script to generate the frequency count of words in a text file.
20. Design a Python Script to print a spiral pattern for a 2 dimensional matrix.
21. Design a Python Script to implement Gaussian Elimination method.

22. Design a Python script to generate statistical reports (Minimum, Maximum, Count, Average, Sum etc) on public datasets.
23. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.

Text Book(s):

1. Weingart, Dr. Troy, Brown, Dr. Wayne, An introduction to programming and algorithmic reasoning using raptor.
2. T R Padmanabhan, Programming with python, Springer.
3. Reema Thareja, Python Programming: Using Problem Solving Approach, Oxford University Press.
4. Wes McKinney , Python for Data Analysis, O.Reilly.

Course outcomes:

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

- create interactive visual programs using Scratch. (L3)
- develop flowcharts using raptor to solve the given problems. (L3)
- build Python programs for numerical and text based problems (L3)
- develop graphics and event based programming using Python (L3)
- build Python programs using beautiful Pythonic idiomatic practices (L3)

19EEE131 : BASIC ELECTRICAL AND ELECTRONICS ENGINEERING
(Common to all)

L	T	P	C
3	1	3	5.5

This course introduces the student, to the fundamental principles and building blocks of electrical and electronics engineering. The first three units cover the electric circuit laws, theorems and principles of electrical machines. The last two units cover semiconductor devices and their applications.

Course Objectives:

- To familiarize the basic DC and AC networks used in electrical and electronic circuits.
- To explain the concepts of electrical machines and their characteristics.
- To introduce the importance of transformers in transmission and distribution of electric power.
- To impart the knowledge about the characteristics, working principles and applications of semiconductor diodes, metal Oxide semiconductor field effect transistors (MOSFETs).
- To expose basic concepts and applications of Operational Amplifier and configurations.

Unit I: **10L**

Basic laws and Theorems: Ohms law, Kirchoff's Laws, series and parallel circuits, source transformations, delta-wye conversion. Mesh analysis, nodal analysis. Linearity and superposition theorem, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples.

Learning Outcomes

After completion of this unit the student will be able to

- state Ohms law and Kirchhoff's Laws (L1).
- identify and analyze series and parallel connections in a circuit (L1).
- predict the behavior of an electrical circuit (L2).
- determine the current, voltage and power in the given electrical circuit (L4).
- apply various techniques to analyze an electric circuit (L3).

Unit II: **10L**

DC Machines: Constructional features, induced EMF and torque expressions, different types of excitation, performance characteristics of different types of dc machines, Starters: 2-point, 3-point starters, losses and efficiency, efficiency by direct loading.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the constructional features of DC machines (L1).
- analyze EMF and torque expressions of DC machine (L4).
- demonstrate the performance characteristics of different types of dc machines (L3).
- explain types of starters used for starting of dc motors (L2).
- estimate losses and efficiency of electrical machine (L2).

Unit III: **12L**

Transformers: Constructional details, EMF equation, voltage regulation, losses and efficiency, open/short- circuit tests and determination of efficiency. **Three Phase Induction Motors**: Construction, working principle of three phase induction motor, Torque and Torque-Slip characteristics.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the constructional details of transformers (L1).
- demonstrate voltage regulation of transformer (L3).
- discuss about open and short- circuit tests of transformer (L2).
- explain the working principle of three phase induction motor (L5).
- describe torque and torque slip characteristics (L1).
- estimate losses and efficiency of three Phase Induction Motors (L2).

Unit IV: **12L**

Semiconductor Devices: p-n Junction diode - Basic operating principle, current-voltage characteristics, rectifier circuits (half-wave, full-wave, rectifier with filter capacitor), Zener diode as Voltage Regulator; Metal oxide semiconductor field effect transistor (MOSFET): Operation of NMOS and PMOS FETs, MOSFET as an amplifier and switch.

Learning Outcomes:

After completion of this unit, the student will be able to

- describe the device structure and physical operation of a diode (L1).
- discuss V-I characteristics of diodes (L2).
- explain the use of diode as switch and in electronic circuits (L2).
- describe the construction and operation of n-channel and p-channel MOSFETs (L1).
- explain the use of MOSFET as an amplifier and bidirectional switch(L2).

Unit V: **10L**

Operational Amplifiers: The Ideal Op-amp, The Inverting Configuration, The closed loop gain, Effect of Finite open-loop gain, The Noninverting Configuration, The closed loop gain, Characteristics of Non Inverting Configuration, Effect of finite open loop gain, the voltage follower, Difference amplifiers, A Single Op-amp difference amplifier.

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics of an ideal Op Amp (L1).
- explain the Inverting and Noninverting configurations of Op-Amp(L2).
- construct a single Op-amp difference amplifier (L3).

Basic Electrical and Electronics Engineering Laboratory List of Experiments:

1. Verification of Kirchhoff's Laws KVL and KCL.
2. Verification of DC Superposition Theorem.
3. Verification of Thevenin's Theorem and Norton's Theorem.
4. OCC and External characteristics of separately excited DC generators.
5. Swinburne's test on a DC shunt motor.
6. OC and SC Tests on single phase transformer.
7. Brake Test on DC shunt motor.
8. Current Voltage Characteristics of a p-n Junction Diode/LED.
9. Diode Rectifier Circuits.
10. Voltage Regulation with Zener Diodes.
11. Design of a MOSTFET amplifier and MOSFET inverter/NOR gate
12. Inverting and Non-inverting Amplifier Design with Op-amps.
13. Simulation experiments using PSPICE
    (a) Diode and Transistor Circuit Analysis.
    (b) MOSFET Amplifier design.
    (c) Inverting and Noninverting Amplifier Design with Op-amps.

Text Book(s):

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1/e, McGraw Hill Education (India) Private Limited, 2017.
2. B.L.Theraja, Fundamentals of Electrical Engineering and Electronics, 1/e, S.Chand Publishing,New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6/e, Oxford University Press, 2014.

References:

1. S.K. Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.

2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Course Outcomes:

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

- predict and analyze the behavior of an electrical circuit (L3).
- analyze the performance quantities such as losses, efficiency and identify applications of DC machines (L4).
- explain the use of transformers in transmission and distribution of electric power and other applications (L2).
- demonstrate the operation and applications of various electronic devices (L2).
- construct Inverting and Noninverting configurations of Op-amp (L3).

19EME121: WORKSHOP
(Common to all)

L	T	P	C
0	0	3	1.5

The objective of this course is to expose students common tools in engineering. This course enables the students to gain hands on experience and skills necessary to perform basic operations such as carpentry, sheet metal working and fitting. It also familiarizes the students with basic electrical house wiring concepts.

Course Objectives:

- Explain different tools used in carpentry.
- Impart the skills to do some carpentry operations.
- Demonstrate different types of tools used in fitting, soldering and brazing.
- Train fitting, soldering and brazing jobs.
- Familiarize different types of basic electric circuit connections.

Wood Working:

Familiarity with different types of woods and tools used in wood working and make following joints

a) Half – Lap joint.

b) Mortise and Tenon joint.

c) Corner Dovetail joint or Bridle joint.

Sheet Metal Working:

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing

Fitting:

Familiarity with different types of tools used in fitting and do the following fitting exercises

a) V-fit b) Dovetail fit c) Semi-circular fit

d) Bicycle tire puncture and change of two wheeler tire

Electrical Wiring:

Familiarities with different types of basic electrical circuits and make the following connections

a) Parallel and series b) Two way switch

c) Godown lighting d) Tube light

e) Three phase motor f) Soldering of wires

Course Outcomes:

After completion of this lab, the student will be able to

- summarize various carpentry operation required to create a product in real time applications (L2).
- develop different parts with metal sheet in real time applications (L3).
- demonstrate fitting operations in various applications (L3).
- preform soldering and brazing operations (L3).
- select different types of electric circuits in practical applications (L3).

19EME131: ENGINEERING GRAPHICS
(Common to all)

L	T	P	C
1	0	3	2.5

This course enables the students to convey the ideas and information graphically that come across in engineering. This course includes projections of lines, planes, solids sectional views, and utility of drafting and modeling packages in orthographic and isometric drawings.

Course Objectives:

- Create awareness of the engineering drawing as the language of engineers.
- Familiarize how industry communicates, practices for accuracy in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Demonstrate utility of drafting and modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3D modeling softwares.
- Impart graphical representation of simple components.

Manual Drawing: **7 L**

Introduction to Engineering graphics: Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions.

a) Conic sections - general method only,

b) Cycloid, epicycloids and hypocycloid

c) Involutes **2L**

Projection of points, lines and planes: Projection of points in different quadrants, lines inclined to one and both the planes, finding true lengths and angles made by line. Projections of regular plane surfaces. **2L**

Projections of solids: Projections of regular solids inclined to one and both the reference planes. **1L**

Sections of solids: Sectional planes and sectional view of right regular solids- prism, cylinder, pyramid and cone. True shapes of the sections. **1L**

Development of surfaces: Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts. **1L**

Computer Aided Drafting:

Introduction to AutoCAD: Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions. Dimensioning principles and conventional representations. **1L**

Orthographic Projections: Systems of projections, conventions and application to orthographic projections. **3L**

Isometric Projections: Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple and compound solids. **2L**

Text Book(s):

1. K.L. Narayana & P. Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, 2012.
2. N.D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers, 2016.

References:

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, 2009.
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education, 2009.
3. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers, 2000.
4. K.C. John, Engineering Graphics, 2/e, PHI, 2013.
5. Basant Agarwal and C.M. Agarwal, Engineering Drawing, Tata McGraw Hill, 2008.

Course Outcomes:

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

- utilize Engineering Graphics as Language of Engineers (L3).
- prepare drawings as per standards (BIS) (L3).
- identify various engineering curves (L3).
- solve geometrical problems in plane geometry involving lines and plane figures (L3).
- represent solids and sections graphically (L3).
- develop the surfaces of solids (L3).
- draw isometric and orthographic drawings using CAD packages (L3).

19EMC181A : NATIONAL SERVICE SCHEME (NSS)

L T P C
0 0 2 0

National Service scheme is a public service program encouraged by Ministry of Youth Affairs [1] and Sports of the Government of India. NSS is a voluntary association of young people in Colleges, Universities and at +2 level working for a campus-community linkage. The objective of this course is to expose the students to the activities of National Service Scheme, concept of social Service and principles of health, hygiene and sanitation.

UNIT I **2Hours**

Introduction and Basic concepts of NSS: History. Philosophy, aims and Objectives of NSS, Emblem, Flag, Motto, Song, Badge etc.: Organizational structure, role and responsibilities of variousNSSFunctionaries.

UNIT II **2Hours**

Regular activities: College campus activities, NSS, activities in Urban and Rural areas, NSS Annual Activities Calendar, Suggestive List of Activities, Role of Non-Government Organization (NGO) in social Reforms i) Red Cross ii) Rotary

UNIT III **2Hours**

Special Camp activities: Nature and its objectives: Selection of camp site -Identification of community problems- physical arrangement- Organization of N.S.S.camp through various committees and discipline in the camp- adaption of village-planning for pre -camp during and post campaigning. **Activities-** Activities to be undertaken during the N.S.S. camp- Use of the mass mediain theN.S.S activities.

UNIT IV **4hours**

Health, Hygiene and Sanitation: Definition, needs and scope of health education, food and Nutrition, Safe drinking water, Sanitation, Swachh Bharat Abhiyan. **Disaster Management:** Introduction to Disaster Management, Classification of Disasters. Role of Youth in Disasters Management, Home nursing, First Aid. **Civil Self Defense:** Civil Defense services, aims and objectives of civil defense, Need for self defence training

UNIT V **10hours**

Social Project: Problems Identification - Data Collection- Preparation of a Questionnaire-Observation-Schedule Interview-Qualitative Research-Quantities Research-Major Findings-Suggestions-Conclusion-Report Writing.

Text Book(s):

1) National Service Scheme Manual (Revised) 2006, Government of India, Ministry of Youth Affairs and Sports, New Delhi
2) NSS Diaries
3) Sanjay Bhattacharya, Social Work Interventions and Management-Deep and Deep Publications, New Delhi

19EMC181B : NATIONAL CADET CORPS

L T P C
0 0 2 0

UNIT I **5 hours**

Aims and objectives of NCC: Organization and training, NCC song, incentives for cadets. National integration and awareness: religion, culture, traditions and customs of India, national integration – importance and necessity, freedom struggle and nationalist movement in India, national interests, objectives, threats and opportunities, problems/ challenges of national integration, national integration and awareness, unity and diversity, national integration council, images/ slogans for national integration, contribution of youth in nation building

UNIT II **5 hours**

Drill Attention, stand at ease and stand easy, turning and inclining at the at the halt, ceremonial drill-guard mounting, guard of honour, platoon / company drill, instructional practice, weapon training stripping, assembling, care and cleaning and sight setting of .22 rifle, the lying position, holding and aiming, trigger control and firing a shot, short range firing, aiming – alteration of sight

UNIT III **5 hours**

Personality development: Introduction to personality development, factors influencing / shaping personality – physical , social, psychological and philosophical self-awareness – know yourself / insight, change your mindset, interpersonal relationship and communication communication skills – group discussion / lecturettes, leadership traits, types of leadership, attitude – assertiveness and negotiation, time management, personality development, effects of leadership with historical examples, stress management skills, interview skills, conflict motives – resolution, importance of group – team work, influencing skills, body language, sociability: social skills, values / code of ethics **Disaster Management:** Civil defence organization and its duties – ndma, types of emergencies / natural disasters, fire service and fire fighting, traffic control during disaster under police supervision, essential services and their maintenance, assistance during natural / other calamities / floods / cyclone / earth quake / accident, setting up of relief camp during disaster management, collection and distribution of aid material

UNIT IV **5 hours**

Social awareness and community development: Basics of social service, weaker sections of our society and their needs, social/ rural development projects – menrega , sgsy , nsap etc, ngos : role and contribution, contribution of youth towards social welfare, family planning, drug abuse and trafficking, civil responsibilities, causes and prevention of hiv/ aids role of youth, counter terrorism, corruption, social evils – dowry / female foeticide / child abuse and trafficking, rti and rte, traffic control organization and anti drunken driving, provision of protection of children from sexual harassment act 2012.

UNIT V **5 hours**

Health and Hygiene: Structure and functioning of the human body, hygiene and sanitation (personal and food hygiene), physical and mental health, infectious and contagious diseases and its prevention, basic of home nursing and first aid in common medical emergencies, wounds and fractures, introduction to yoga and exercises. **Adventure training:** Para sailing, slithering, rock climbing, cycling / trekking, environment awareness and conservation natural resources conservation and management, water conservation and rain water harvesting, waste management, pollution control, water, air, noise and soil, energy conservation, wildlife conservation – projects in India. obstacle training, obstacle course, practical

training

Text Book(s)

1. Cadet Hand Book (Common Subjects), published by DG NCC.
2. Cadet Hand Book (Specialized Subjects), published by DG NCC.

Reference Books

1. Grooming Tomorrow's Leaders, published by DG, NCC.
2. Youth in Action, published by DG, NCC.
3. The Cadet, Annual Journal of the NCC.

19EMC181C: NATIONAL SPORTS ORGANIZATION (Common to all)

L	T	P	C
0	0	2	0

National Sports Organization is intended by the Government of India to promote the development of athletics and sporting activities of the nation's youth. This activity enables physical fitness, teamwork and mental health within the students. This course teaches the rules and skills of below sports and games to the students. Each student shall be made proficient in one of the chosen sport from the below list:

1. Cricket
2. Volley Ball
3. Table Tennis
4. Foot Ball
5. Throw Ball (Only for Women)
6. Basket Ball
7. Athletics -100 Meters Run, Long Jump, Shot Put
8. Chess
9. Lawn Tennis
10. Kabaddi
11. Aerobics
12. Badminton

Text Book(s):

1. Myles Schrag, The Sport Rules Book, 4/e, Human Kinetics, 2018
2. Dhama Prakash Jyoti, Rules. Of. Games. And. Sports, Laxmi Book Publication, 2018

19EMC181D: YOGA (Common to all)

L	T	P	C
0	0	2	0

The course is designed to enable the student to know about yoga an ancient Indian tradition. It embodies unity of mind and body; thought and action; harmony between human and nature and a holistic approach to health and well-being. It is not only exercise but to discover the sense of oneness with ourselves, the world and nature. The student will be able to learn about Yoga and practice different Yoga asana which influences his lifestyle and creating consciousness, it can help a student to deal with health issues and climate change.

Course Objectives:

- Familiarize the student with YOGA and ancient Indian tradition.
- Enable the student to know the different asana their advantages and disadvantages.
- Explain with the features of different Yoga asana.
- Demonstrate and perform Yoga asana.
- Enable the student to perform pranayama and meditation.

- **Introduction to Yoga:** Evolution of Yoga and Schools of Yoga, Origin of Yoga, History and Development of Yoga; Etymology and Definitions, Misconceptions, Nature and Principles of Yoga.
- **Guidelines to yoga practice:** Prayer, warmup exercises/ loosening exercises
- **Yoga Theory:** Therapeutic Benefits of Yoga – primitive, preventive and curative aspects of Yoga
- **Application of Yoga to students,** Suryanamaskaras, Tadasan, Natarajasan, Vrikshasan, Padahasthasan, Ardhachakrasan, Trikonasan, Bramari pranayama.
- **Yoga for allround fitness,** Bhadrasan, Vajrasan, ArdhaUstrasan, Nadishuddhi pranayama, Navasan, Janusirasan, Paschimotthanasan, Shashankasan, Vakrasan, Bhujangasan, Kapalabhati..
- **Meditative Postures**: Sukhasan, Ardha Padmasan, Padmasan and Siddhasan,Meditation
- **Yoga Practice**: Makarasan, Sethubandhasan, Pavanmuktasan, Sarvangasan, Matsyasan, Halasan.

Text Book(s):

1. Swami MuktibodhandaSaraswathi Shay G.S., Hatha yoga Pradipika, Bihar School of yoga publications, Munger, 2000.
2. Hatha Yoga Pradeepika of Svatmarama, MDNY Publication, 2013
3. Svatmarama, Swami, The Hatha yoga Pradipika/ the original Sanskrit [by] Svatmarama; an English translation [by] Brian Dana Akers. Woodstock, NY:YogaVidya.com, 2002.

References:

1. Bharati, Swami Veda Reddy Venkata: Philosophy of Hatha Yoga (Englis), Himalayan, Pensylvania, Hatha Ratnavali.
2. Swami Satyananda Saraswathi - Asana, Pranayama, Mudra & Bandha. Bihar School of Yoga, Munger
3. B.KS.Iyenger - The Illustrated Light on Yoga. Harper Collins, New Delhi.

Course Outcomes:

After completion of this course the student will be able to

- understand history and evolution of Yoga (L2).
- list different schools of yoga (L2).
- interpret the aim and objectives of yoga to students (L2).
- perform yoga asana, pranayama, and meditation (L3).

19EMA102: ENGINEERING MATHEMATICS-II ODE, PDE AND MULTIVARIABLE CALCULUS (AE, CE, ECE, EEE and ME)

L	T	P	C
3	0	0	3

This course is designed to impart knowledge on ordinary, partial differential equations and vector calculus to understand the concepts like fluid mechanics, signals and systems etc., in engineering applications.

Course Objectives:

- To familiarize the students in the concepts of linear differential equations.
- To explain the concept of reducing linear differential equations with variable coefficients to constant coefficients and their applications.
- To demonstrate the concepts of partial differential equations.
- To explain the concepts of vector differentiation and integration.

Unit I: Linear Differential Equations of Higher Order **8 L**

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

Learning Outcomes:

After completion of this unit, the student will be able to

- classify the solutions of linear differential equations (L4).
- identify the essential characteristics of linear differential equations with constant coefficients (L3).
- solve the linear differential equations with constant coefficients by appropriate methods (L3).

Unit II: Equations Reducible to Linear Differential Equations and Applications **8 L**

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients, Applications: Mass-Spring system and L-C-R Circuit.

Learning Outcomes:

After completion of this unit, the student will be able to

- examine the special type of nonlinear differential equations (L4).
- analyze physical situations using higher order differential equations(L4).

Unit III: Partial Differential Equations **8 L**

Formation of partial differential equations, solutions of first order linear partial differential equations, Charpit's method, solutions to homogenous and non-homogenous linear partial differential equations.

Learning Outcomes:

After completion of this unit the student will be able to

- apply a range of techniques to find solutions of partial differential equations (L3).
- identify the basic properties of partial differential equations (L3).

Unit IV: Multivariable Calculus (Vector Differentiation) **8 L**

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate the physical interpretation of gradient, divergence and curl(L3).
- apply operator del to scalar and vector point functions (L3).

Unit V: Multivariable Calculus (Vector Integration) **10 L**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Gauss divergence theorem (without proof).

Learning Outcomes:

After completion of this unit, the student will be able to

- find the work done in moving a particle along the path over a force field (L3).
- construct the rate of fluid flow along and across curves (L3).
- apply Green's, Stokes and Gauss divergence theorem in evaluation of line, surface and volume integrals (L3).

Text Book(s):

1. Erwin Kreyszig, Advanced Engineering Mathematics,10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

References:

1. Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, 4/e, Jones and Bartlett Publishers, 2011.
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2016.
3. George B. Thomas, Maurice D. Weir and Joel R. Hass, Thomas' Calculus, 13/e, Pearson Publishers, 2014.
4. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5. Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson Publishers, 2011.

Course Outcomes:

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

- solve the differential equations related to various engineering fields (L3).
- identify methods of solution for partial differential equations (L3).
- interpret the physical meaning of gradient, divergence and curl (L4).
- determine the work done against a force field, circulation and flux using vector calculus (L4).

19EID132: DESIGN THINKING
(Common to all)

L	T	P	C
2	0	2	3

Design is a realization of a concept or idea into a configuration, drawing or a product. Design Thinking is cognitive and practical processes by which design concepts are developed by designers. Innovation is a new idea or a new concept. Product development is the creation of a new or different product that offers new benefits to the end user. This course introduces the design thinking in product innovation.

Course Objectives:

- To familiarize product design process
- To introduce the basics of design thinking
- To bring awareness on idea generation
- To familiarize the role of design thinking in services design

UNIT I **8 L**

Introduction to design, characteristics of successful product development, product development process, identification of opportunities, product planning, Innovation in product development.

Learning Outcomes:

After completing this unit, the student will be able to

- identify characteristics of successful product development(L3)
- identify opportunities for new product development(L3)
- plan for new product development(L3)

UNIT II **8 L**

Design Thinking: Introduction, Principles, the process, Innovation in Design Thinking, benefits of Design thinking, design thinking and innovation, case studies.

Learning Outcomes:

After completing this unit, the student will be able to

- explain the principles of Design Thinking(L2)
- identify the benefits of Design Thinking(L3)
- use innovations in Design Thinking(L3)

UNIT III **10 L**

Idea generation: Introduction, techniques, Conventional methods, Intuitive methods, Brainstorming, Gallery method, Delphi method, Synectics etc Select ideas from ideation methods, case studies.

Learning Outcomes:

After completing this unit, the student will be able to

- explain the techniques in idea generation(L2)
- select ideas from ideation methods(L3)
- identify the methods used in idea generation in some case studies(L3)

UNIT IV **10 L**

Design Thinking in Information Technology, Design Thinking in Business process model, Design Thinking for agile software development, virtual collaboration, multi user and multi account interaction, need for communication, TILES toolkit, Cloud implementation.

Learning Outcomes:

After completing this unit, the student will be able to

- use Design Thinking in business process model(L3)
- apply Design Thinking for Agile software development(L3)
- use TILES toolkit(L3)

UNIT V **8 L**

Design thinking for service design: How to design a service, Principles of service design, Benefits of service design, Service blueprint, Design strategy, organization, principles for information design, principles of technology for service design.

Learning Outcomes:

After completing this unit, the student will be able to

- use principles of service design(L3)
- explain the benefits of service design(L5)
- apply principles of technology for service design(L3)

Text Book(s):

1. Pahl, Beitz, Feldhusen, Grote – Engineering Design: a systematic approach, Springer, 2007
2. Christoph Meinel and Larry Leifer, Design Thinking, Springer, 2011
3. Aders Riise Maehlum - Extending the TILES Toolkit – from Ideation to Prototyping
4. http://www.algarytm.comA/it-executives-guide-to-design-thinking:e-book.
5. Marc stickdorn and Jacob Schneider, This is Service Design Thinking, Wiely, 2011

Course Outcomes:

At the end of this course, the student will be able to

- innovate new methods in product development(L6)
- apply Design Thinking in developing the new designs(L3)
- select ideas from ideation methods in new product development(L5)
- use Design Thinking in developing software products(L3)
- apply principles of Design Thinking in service design(L3)

19EID134: **AI TOOLS**
(Common to all)

L	T	P	C
2	0	2	3

The surge in the production of data has led to the development of various technologies. The term "Artificial Intelligence (AI)" has become ubiquitous in everyday applications from virtual assistants to self-driving cars. Several applications such as Healthcare, Finance, Bioinformatics etc. are benefitting from the advances in the domain. The global market for artificial intelligence is going to face a phenomenal growth over the coming years with organizations across the world capitalizing on the disruptive technologies that AI is offering. This course introduces the recent applications of AI namely, Virtual Assistants, Computer Vision, along with trending topics such as Deep Learning and Reinforcement Learning. The idea of the course is to introduce the basic concepts of AI as well as latest trends in the domain. This course is envisaged to provide a basic understanding on latest developments of AI to all disciplines engineering undergraduates.

Course Objectives:

- To provide a basic foundation on different concepts of Artificial Intelligence.
- To investigate various applications of AI such as Virtual Assistants, Computer Vision, as well as other Smart Applications.
- Explore the scope, advantages as well as limitations of intelligent systems.
- Experiment with different machine learning concepts such as Deep Learning and Reinforcement Learning
- To expose students to the AI-intensive computing and information system frameworks.

UNIT I **10 L**

Introduction to Artificial Intelligence: Basics of AI. Applications of AI. Advanced search, Constraint satisfaction problems, Knowledge representation & reasoning, Non-standard logics, Uncertain and probabilistic reasoning.

Conceptual introduction to **Machine Learning:** Introduction to Neural Networks, Supervised, Unsupervised, and Semi-Supervised Learning, Deep Learning, Reinforcement Learning, Linear Regression.

Conceptual introduction to **Natural Language Processing:** Natural language Understanding, Sentiment Analysis, Segmentation and recognition.

Conceptual introduction to **Speech Recognition & Synthesis:** Speech Fundamentals, Speech Analysis, Speech Modelling, Speech Recognition, Speech Synthesis**,** Text-to-Speech.

Conceptual introduction to **Image Processing & Computer Vision:** Introduction to Image processing, Image Noise, Removal of Noise from Images, Color Enhancement, Segmentation, Edge Detection, Optical Character Recognition, Feature Detection & Recognition

Learning Outcomes:

After completion of this unit, the student will be able to

- recognize various domains in which AI can be applied(L2)
- define machine learning and forms of learning(L1)
- describe natural language processing and concepts for converting speech to different forms(L2)
- identify the concepts of image processing(L3)

UNIT II **12 L**

BOT Technologies and Virtual Assistants: Catboats: Introduction to a Chabot, Architecture of a Chabot. NLP in the cloud, NL Interface, how to Build a Chabot, Transformative user experience of

catboats, Designing elements of a Chabot, Best practices for Chabot development. NLP components. NLP wrapper to catboats. Audiobots and Musicbots.

Virtual Assistants: Architecture of a Virtual Assistant.

Learning Outcomes:

After completion of this unit, the student will be able to

- analyze the architecture of a Chabot(L4)
- illustrate how to construct a Chabot(L2)
- differentiate various catboats(L4)
- interpret the architecture of a virtual assistant(L3)

UNIT III **12 L**

Image Processing & Computer Vision: Image - Definition and Tagging. Classification of images. Tagging. Image formation, Deep Learning algorithms for Object detection & Recognition. Face recognition, Instance recognition, Feature detection and matching, Segmentation, Recognition Databases and test sets Applications -- Feature extraction, Shape identification. Fane detection.

Applications: Automation, Agriculture [Crop and Soil Monitoring, grading farm produce, Predictive Analytics], Retail and Retail Security [Amazon Go], Autonomous vehicles.

Learning Outcomes:

After completion of this unit, the student will be able to

- classify the properties of images(L3)
- interpret the concepts of image processing(L2)
- implement the methods in processing an image(L3)
- analyze and apply the concepts of image processing in automation and agriculture(L4)

UNIT IV **12 L**

Reinforcement Learning: Introduction to Reinforcement Learning, Game Playing [Deep Blue in Chess, IBM Watson in Jeopardy, Google's Deep Mind in AlphaGo], Agents and Environment, Action-Value Function, Deep Reinforced Learning

Applications: Robotics, Gaming, Diagnostic systems, Virtual Assistants.

Learning Outcomes:

After completion of this unit, the student will be able to

- illustrate reinforcement learning(L2)
- employ the reinforcement learning in game playing(L3)
- use reinforcement learning in agent based environment(L3)
- practice learning process in diagnostic and virtual assistant systems(L3)

UNIT V **10 L**

Smart Applications: Smart Manufacturing, Smart Agriculture, Smart Healthcare, Smart Education, Smart Grids, Smart Transportation and Autonomous Vehicles, Smart Homes, Smart Cities.

Learning Outcomes:

After completion of this unit, the student will be able to

- understand the application of intelligence in various domains(L2)
- apply the artificial intelligence in various applications(L3)
- correlate the intelligence to advanced applications(L4)

Text Book(s)

- Tom Markiewicz& Josh Zheng, Getting started with Artificial Intelligence, O'Reilly Media, 2017.
- Stuart J. Russell and Peter Norvig, Artificial Intelligence A Modern Approach. Prentice Hall

References

1. AurélienGéron, Hands on Machine Learning with Scikit-Learn and Tensor Flow [Concepts, Tools, and Techniques to Build Intelligent Systems], Published by O'Reilly Media, 2017.
2. Build an AI Assistant with Wolfram Alpha and Wikipedia in Python. **https://medium.com/@salisuwy/build-an-ai-assistant-with-wolfram-alpha-and-wikipedia-in-python-d9bc8ac838fe**
3. Joseph Howse, Prateek Joshi, Michael Beyeler - Opencv_ Computer Vision Projects with Python-Packt Publishing (2016).
4. Curated Datasets on Kagglehttps://www.kaggle.com/datasets.

AI TOOLS LABORATORY

List of Practical Experiments:

1. Supervisely - Perform Data Labelling for various images using object recognition
2. Lobe.ai - Build custom models using the visual tool for Object recognition and sentiment analysis that can convert facial expressions into emoticons
3. Teachable Machine - In Browser Object Recognition through Brain.JS
4. Liv.ai - App for Speech recognition and Synthesis through APIs
5. Building a Chabot using AWSLex, Pandora bots
6. Configure an existing Neural Network by manipulating various parameters involved
7. Build a virtual assistant for Wikipedia using Wolfram Alpha and Python
8. Build a Convolutional Neural Network for Cat vs. Dog Image Classification

Online Resources:

Pytorch:
https://pytorch.org/
https://github.com/pytorch
Keras:
https://keras.io/
https://github.com/keras-team
Theano:
http://deeplearning.net/software/theano/
https://github.com/Theano/Theano
Cafee2:
https://caffe2.ai/
https://github.com/caffe2
Deeplearning4j:
https://deeplearning4j.org/

Scikit-learn:
https://scikit-learn.org/stable/
https://github.com/scikit-learn/scikit-learn
Deep Learning.Ai:
https://www.deeplearning.ai/
OpenCv:
https://opencv.org/

https://github.com/qqwweee/keras-yolo3

YOLO:

https://www.pyimagesearch.com/2018/11/12/yolo-object-detection-with-opencv/

nVIDIA:CUDA:

https://developer.nvidia.com/cuda-math-library

Course Outcomes

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

- distinguish the concepts of artificial intelligence, machine learning, natural language processing, image processing. (L4)
- illustrate the architectures of Chabot and virtual assistant(L2)
- analyze image based applications by using image processing concepts(L4)
- employ reinforcement learning in different applications(L3)
- identify smart applications(L3)

19EEC122: ELECTRONICS WORKSHOP (ECE)

L	T	P	C
0	0	3	1.5

This workshop will enable the student to know the basics of electronic components and devices, their identification and selection for a given cir- cuit. This lab makes the student to operate and use electronic devices, wire and fabricate various circuits on his own. The testing of the circuits wired / fabricated can be tested with the knowledge of various sources and power supplies introduced. Mini project is carried out towards end of the lab, which will inculcate good practice of hands on experience and experiential learning.

Course Objectives:

- to introduce and make use of Active and Passive electronic compo- nents.
- to impart knowledge of regulated power supplies, function generators and CRO and their applications.
- to enable wiring / soldering practice simple electronic circuits using various components on breadboard / PCB.
- to teach students about Diode as a switch, transistor as a switch and hardware components of a simple computer.
- to introduce solar panels and their wiring.
- to introduce hardware components like SMPS, switches, ports,input and output devices of a simple computer.
- to wire and test a mini project.

List of Experiments:

1. Study of resistance color codes, identification of active and passive electronic components.
2. Study and use of bread board trainer kit.
3. Study of multimeter and CRO.
4. Study of function generator and regulated power supply.
5. Soldering of electronic components on PCBs.
6. Function of diode as a switch.
7. Study of battery types, specifications, construction and ratings.
8. Voltage measurement using solar panel.
9. Design of battery charger using microcontroller.
10. Study of computer system hardware.
11. Mini project

Course Outcomes:

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

- decode the resistance / inductance / capacitance values & tolerances (L4).
- understand and use RPS, voltmeter, ammeter, multimeter, function generator and CRO (L4).
- study and use breadboard for various circuit wiring (L5).
- fabricate simple circuits on a PCB and test them (L6).
- understand various hardware parts of a computer (L2).
- complete a mini project and test it (L6).

19EHS122: COMPREHENSIVE SKILL DEVELOPMENT – 1

Course Objectives:

- To encourage the all-round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Part-1 **- 3 Hours per week**

A. Verbal and Soft Skills

Self Awareness and Motivation, Goal Setting and Time Management, Interpersonal Skills, Team Work.

	Verbal and Soft Skills	
Unit	Module/ Topics	Hrs
1.	Self-Awareness and Self-Regulation	4
2.	Social Awareness & Relationship Management	4
3.	Conflict Management	3
4.	Team Work	4
	Total	15

B. Quantitative Aptitude and Reasoning

Puzzles, Non-Verbal Reasoning, Data Sufficiency, Analytical Reasoning,

	Quantitative Aptitude and Reasoning	
Unit	**Module/ Topics**	**Hrs**
1.	Verbal Reasoning [Coding decoding, Blood relations, Ranking, Directions, Group Reasoning (Puzzle Test)]	6
2.	Analytical Reasoning [Cubes, Counting of Geometrical Figures)	2
3.	Logical Deductions [Venn diagrams, Syllogisms, Data Sufficiency]	4
4.	Puzzles [Puzzles from books i. Puzzles to puzzle you by Shakunthala devi	3

	ii. More puzzles by Shakunthala devi iii. Puzzles and Teasers by George Summers]	
	Total	**15**

Part-2 **- 3 Hours per week**

Coding: **GitHub** – Accepting assignments pull and push the code or resource, GitHub configuration,

Visual Studio code – Configuring, integrating Git for assignment submission

Online competitive coding platforms – Introduction to online coding platforms to get prepared for competitive coding.

Problem Solving with Python: Collections, Techniques for manipulating Strings, Recursion, Searching, Sorting, Stacks and Queues.

Problem Solving with C: Memory, C Syntax, Conditions and Loops, Functions and Recursion, Arrays, Techniques for manipulating Strings, Searching, Sorting, Stacks and Queues, Structures. sentation of graphs, Breadth First Search, Depth First Search, Dynamic Programming.

Scheme of Evaluation

Internal Assessments by Assignments , Quizzes(multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/

VDC111: VENTURE DISCOVERY

L	T	P	C
0	0	4	2

India as part of its Make in India initiative has been focusing on creating incubation centers within educational institutions, with an aim to generate successful start-ups. These start-ups will become employment creators than employment seekers, which is the need of the hour for our country.

This common course for all the disciplines is a foundation on venture development. It is an experiential course that lets students venture and find out what is a business, financial and operating models of a business are. How to design and prototype a solution that meets their customers' needs and generate revenue for the business.

COURSE OBJECTIVES

- Discover who you are – Values, Skills, and Contribution to Society.
- Gain experience in actually going through the innovation process.
- Conduct field research to test or validate innovation concepts with target customers.
- Understand innovation outcomes: issues around business models, financing for start-ups, intellectual property, technology licensing, corporate ventures, and product line or service extensions.

UNIT I **(6 sessions)**

Personal Values: Defining your personal values, Excite & Excel, build a Team, Define purpose for a venture. Four stages: Personal Discovery, Solution Discovery, Business Model Discovery, Discovery Integration.

UNIT II **(6 sessions)**

Solution Discovery: Craft and mission statement, Experience design, Gaining user insight, Concept design and positioning, Product line strategy, Ideation & Impact.

UNIT III **(6 sessions)**

Business Model Discovery: Prototyping solutions, Reality Checks, understand your industry, Types of business models, Define Revenue Models, Define Operating Models

UNIT IV **(6 sessions)**

Discovery Integration: Illustrate business models, validate business models, Define company impact

UNIT V **(6 sessions)**

Tell a Story: Can you make money, Tell your venture story.

Assessment methods

Task	Task type	Task mode	Weightage (%)
A1. Assignments	Individual	Report/Presentation	20
A2. Case / Project/Assignment	Groups* or Individual	Presentations/Report/Assignment	40
A3. Project	Individual/Group	Report/Pitch	40

Transferrable and Employability Skills

	Outcomes	Assessment
211	Know how to use online learning resources: G-Learn, online journals, etc.	A1 & A2
2	Communicate effectively using a range of media	A1 & A2
3	Apply teamwork and leadership skills	A2
4	Find, evaluate, synthesize & use information	A1 & A2
5	Analyze real world situation critically	A3
6	Reflect on their own professional development	A3
7	Demonstrate professionalism & ethical awareness	A2
8	Apply multidisciplinary approach to the context	A2

Learning and teaching activities

Mixed pedagogy approach is adopted throughout the course. Classroom based face to face teaching, directed study, independent study via G-Learn, case studies, projects and practical activities (individual & group)

Teaching and learning resources

Soft copies of teaching notes/cases etc. will be uploaded onto the G-learn. Wherever necessary, printouts, handouts etc. will be distributed in the class. Prescribed text book will be provided to all. However, you should not limit yourself to this book and should explore other sources on your own. You need to read different books and journal papers to master certain relevant concepts to analyze cases and evaluate projects. Some of these reference books given below will be available in our library.

***Prescribed Modules*:**
Access to NU-IDEA online modules will be provided.

***Referential text books and journal papers*:**

Personal Discovery Through Entrepreneurship, Marc H. Meyer and Chaewon Lee, The Institute of Enterprise Growth, LLC Boston, MA.

Suggested journals:

Vikalpa, Indian Institute of Management, Ahmedabad
Journal of General Management, Mercury House Business Publications, Limited
Harvard Business Review, Harvard Business School Publishing Co. USA

On successful completion of this course, students will be able to

	COURSE Outcomes	Assessment
1	Understand conceptual framework of the foundation of a venture	A1, A2
2	Understand the concept of purpose, mission and value-add service offered by a venture	A3
3	Analyze design and positioning of the product	A3
4	Demonstrate prototyping	A3
5	Analyze business, revenue and operating models	A3

19EMA203: ENGINEERING MATHEMATICS-III COMPLEX VARIABLES & TRANSFORM TECHNIQUES
(Common to EEE & ECE)

L	T	P	C
3	0	0	3

Preamble :*This course is designed to familiarize the students with complex variables,complexintegraton, fourier series expansions of periodic functions and Laplace,Z-transforms to understand the applications in engineering.*

Course Objectives:

- To explain the concepts of complex analysis and their applications.
- To demonstrate the concept of Laplace and inverse Laplace transforms.
- To teach Fourier series and Fourier transforms of functions.
- To teach Z-transforms and its applications.

Unit I: Complex Variables
10 L

Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate. Cauchy theorem, Caufchy integral formula, Taylor's series, Laurent's series, singularities, residues, Cauchy residue theorem (All theorems without proof).

Learning Outcomes:

After completion of this unit student able to

- Identify continuous and differentiable complex functions (L3)
- apply Cauchy-Riemann equations to complex functions in order to determine whether a given continuous function is analytic (L3)
- Analyze the Taylor and Laurent expansions of simple functions, determining the nature of the singularities and calculating residues (L4)
- make use of the Cauchy residue theorem to evaluate certain integrals (L3)

Unit II: Laplace transforms
9L

Definition of Laplace transform, existence conditions, properties of Laplace transforms, inverse Laplace transforms, transforms of derivatives, transforms of integrals, multiplication by t^n, division by t, convolution theorem, periodic functions, unit step function, unit impulse function, applications to ordinary differential equations. (Without proofs)

Learning Outcomes:

After completion of this unit student able to

- examine the properties of Laplace transformation (L4)
- apply the Laplace and inverse Laplace transformations for different types of functions (L3)
- solve ordinary differential equations by using Laplace transformation technique (L3)

Unit III: Fourier series **6 L**

Fourier series, Dirichlet's conditions, functions of any period, odd and even functions - half range series.

Learning Outcomes:

After completion of this unit student able to

- build the Fourier series expansion for different periodic functions (L3)
- analyze the nature of the Fourier series that represent even and odd functions and how derivation of a Fourier series can be simplified in this way (L4)

Unit IV: Fourier transforms **8 L**

Fourier integrals, Fourier cosine and sine integrals, Fourier transform, sine and cosine transform, properties, convolution theorem.

Learning Outcomes:

After completion of this unit student able to

- examine the properties of Fourier transformation (L4)
- apply Fourier transformation for different functions (L3)

Unit V: Z-Transforms
9L

Definition of Z-transform, elementary properties, linearity property, damping rule, shifting u_n to the right and left, multiplication by n, initial value theorem, final value theorem, inverse Z-transform, convolution theorem, solution of difference equations using Z-transforms.

Learning Outcomes:

After completion of this unit student able to

- summarize the properties of Z-transforms (L3)
- find Z and inverse Z-transformations for different functions (L3)
- solve difference equations by using Z-transforms (L3)

Text Books:

1. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2018.
2. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

References:

1. W. E. Boyce and R. C. DiPrima, Elementary Differential Equations and Boundary Value Problems, 9/e, Wiley India, 2009.
2. E. A. Coddington, An Introduction to Ordinary Differential Equations, Prentice Hall India,1995.

3. J. W. Brown and R. V. Churchill, Complex Variables and Applications, 7/e, Mc-Graw Hill, 2004.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, 2008.

Course Outcomes:

At the end of the course students will be able to

- Make use of differentiation and integration of complex functions in engineering problems (L3)
- apply the Laplace transform for solving differential equations (continuous systems) (L3)
- find the Fourier series of periodic signals (L3)
- know and be able to apply integral expressions for the forwards and inverse Fourier transform to a range of non-periodic waveforms (L3)
- solve discrete time systems using Z transform techniques (L3)

19EEC231: NETWORK THEORY AND ANALYSIS

L	T	P	C
3	0	2	4

This course aims to develop the basic concepts of network analysis, which are the pre-requisites for all the electronics engineering courses. The course deals with understanding various network reduction techniques such as source transformation, network theorems and apply these techniques to simplify different complex R-L-C networks. Design techniques of resonant circuits is imparted. Analysis and synthesis of two-port networks are dealt. Transient Response of complex electrical systems and design of stable system is also elaborated.

Course Objectives:

- To impart knowledge about solving different complex circuits using various network reduction techniques such as source transformation, network theorems.
- To explain the analysis AC and DC transient response for complex R-L-C circuits.
- To familiarize AC steady state response for complex R-L-C series and parallel circuits and to analyze the circuits.
- To distinguish between series and parallel resonance and design resonant circuits.
- To acquaint the students with evaluation of two port network parameters.

Unit I: **8L+6P**

Introduction: Ohms law, Kirchoff's laws, series and parallel circuits, source transformations, delta-wye conversion, linearity and superposition theorem with simple examples, Thevenin's and Norton's theorem with simple examples, maximum power transfer theorem with simple examples. mesh, super mesh analysis, nodal, super node analysis.

Learning outcomes:

After completion of this unit, the student will be able to

- define circuit laws(L1).
- apply circuit laws on electrical networks(L3).
- apply transformation techniques, mesh and nodal analysis to circuits (L3).
- analyze electrical networks using network theorems(L4).
- evaluate load resistance using network theorems(L4).

Unit II: **9L+3P**

Time domain analysis of circuits: transient analysis of first order and second order systems, initial and final conditions in networks. dc transients: source free and forced response of RL, RC and RLC circuits analysis using Laplace transform.

Learning outcomes:

After completion of this unit, the student will be able to

- analyze the transient behavior of electrical circuits (L3).
- determine the response of source free circuits (L3).
- analyze the forced response of RC /RL /RLC circuits (L3).
- apply Laplace transform to analyze RC / RL /RLC circuits (L3).

Unit III: **9L+9P**

Sinusoidal Steady-State Analysis: sinusoids, sinusoidal functions and complex functions, instantaneous power, average power, effective values of current and voltage, apparent power and power factor, complex power, phasors, phasor relationships for R, L and C and steady state analysis of RL, RC and RLC circuits.

Learning outcomes:

After completion of this unit, the student will be able to

- analyze sinusoidal or AC response of RC/RL /RLC series/parallel circuit (L4).
- determine real and reactive power and power factor in AC circuits (L3).
- demonstrate different states of the circuits using phasor relationships (L3).

Unit IV: **8L+6P**

Resonance: series resonance, parallel resonance, bandwidth, selectivity, quality factor.

Learning outcomes:

After completion of this unit, the student will be able to

- differentiate between series and parallel resonance (L1).
- design RLC resonant circuits for different frequencies (L3)
- evaluate Q factor, current and voltage variations across each component with respect to frequency (L4).

Unit V: **8L+6P**

Two Port Networks: impedance parameters, admittance parameters, hybrid parameters and transmission parameters, relationships between parameters.

Learning outcomes:

After completion of this unit, the student will be able to

- determine Z,Y, h and ABCD parameters of two port networks(L3)
- explain the relationship between parameters (L2).
- determine the parameters of interconnected two port networks (L3).

Network Theory and Analysis Laboratory

List of Experiments:

1. Experimental verification of Kirchhoff's voltage and current laws
2. Experimental verification of network theorems (Thevenin's, Norton's, Superposition and Maximum power transfer Theorem).
3. Study of CRO and measurement of sinusoidal voltage, frequency and power factor.
4. To study the step response of RL, RC & RLC circuits.
5. Experimental determination of time constant of series R-C electric circuits.
6. Experimental determination of frequency response of RLC circuits.
7. Design and Simulation of series resonance circuit.
8. Design and Simulation of parallel resonant circuits.
9. Determination of two port network parameters.
10. For the given network function, draw the pole zero diagram and hence obtain
11. The time domain response. Verify the result analytically. $V(s) = 5(s+5) / (S+2)(S+7)$

Text Book(s):

1. M.E.VanValkenburg, Network Analysis, 3/e , Pearson Education, 1974
2. A. Sudhakar, Shyammohan S.Palli, Circuits & Networks: Analysis and Synthesis, 3/e, Tata McGraw Hill Publication, 2006.

References:

1. William H Hayt, Jack E Kimmerly and Steven M.Durbin, Engineering Circuit Analysis, 8/e, Tata McGraw Hill, 2013.
2. A.Chakrabarti, Circuit Theory: Analysis & Synthesis, 3/e, Dhanpat Rai & Co, 2013.

Course Outcomes:

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

- analyze basic AC and DC circuits using nodal, mesh analysis and network theorems, retransformation and several methods of simplifying networks (L5).
- understand the concept of graphical solution to transient electrical network in time domain analysis and apply Laplace Transform for steady state and transient analysis (L4).
- analyze sinusoidal or AC response of circuits and determine power and power factor of circuits(L5)
- distinguish between series resonance and parallel resonance concepts and performance parameters (L2)
- derive two port network parameters Z, Y, ABCD, h and their interrelationships and determine for different network functions (L6).

19EEC237: ELECTROMAGNETIC WAVES

L	T	P	C
2	0	2	3

The concept of electromagnetism is evolved from static electric and magnetic fields when time is added as fourth dimension. Electromagnetism is the principle with which all electrical machines function. Electromagnetism is used as a mode of propagation of energy at very frequencies. This is a foundation course for understanding the concept of wave transmission in free space or in any media carrying data / message / voice / audio from transmitter to receiver.

Course Objectives:

- To demonstrate the concepts of static electric and magnetic fields and their importance in electromagnetics.
- To impart the knowledge of basic characteristics of an electromagnetic field.
- To explain the principle of transmission of energy using electromagnetic wave.
- To familiarize the electromagnetic fields and mechanism of transmission of energy in free space / dielectric medium.

Unit I: **8L**

Electrostatics: Coulomb's law, electric field intensity, field due to a line charge, electric flux density, Guass's law, electric potential, potential gradient, energy stored, Laplace's and Poison's equations.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the concept of static electric field and Electric Potential (L2).
- Interpret Laplace and Poisson's equations for static electric field (L2).
- apply Guass's Law to determine electric field of given charge distribution (L3).
- derive electric potential due to charge distribution and relate to electric field (L3).
- determine energy stored in any charge distribution / electric field (L3).

Unit II: **8L**

Magnetostatics: steady current, Biot-Savart's law, static magnetic field due to line current, magnetic flux density, Ampere's circuital law, Lorentz force equation, magnetic vector potential, energy stored.

Learning Outcomes:

After completion of this unit, the students will be able to

- identify magnetic field at a point due to current element(L1).

- apply Biot-Savart's law for magnetic field due to line current(L3).
- calculate flux per unit area(L3).
- evaluate magnetic field around a closed loop(L3).
- determine energy stored in a magnetic field region(L4).

Unit III: **10l**

Time-varying fields and Maxwell's equations: time varying fields, Faraday's law of electromagnetic induction, displacement current, Maxwell's equations in point form and integral form, boundary conditions of electromagnetic fields, polarization, magnetization.

Learning Outcomes:

After completion of this unit, the students will be able to

- determine how time varying electric and magnetic fields are generated by charges (L3).
- explain the generation of electric current in a conductor in the presence of changing *magnetic* field(L4).
- describe the relation between electric and magnetic field with Maxwell's equations(L2).
- explain the propagation of EM Wave with direction and magnitude(L2).
- describe the concept of magnetization (L2).

Unit IV: **8L**

Uniform Plane Wave: wave equation**,** wave propagation in free space, wave propagation in conductor and dielectrics, poynting theorem, skin effect, wave polarization, direction cosines.

Learning Outcomes:

After completion of this unit, the students will be able to

- state mathematical representation of EM wave(L1).
- explain wave propagation in different media(L2).
- determine the power flow through a selected surface(L3).
- calculate depth of penetration of wave through conductor(L2).
- analyze the significance of polarization(L4).

Unit V: **10L**

Plane Waves at Boundaries and in Dispersive Media: reflection of uniform plane waves by perfect conductor – normal and oblique incidence, standing wave ratio, reflection and transmission of uniform plane waves by perfect dielectric – normal and oblique incidence.

Learning Outcomes:

After completion of this unit, the students will be able to

- explain standing waves formation (L2)
- calculate the reflected wave characteristics for normal and oblique incidence (L3).
- determine the reflection of uniform plane wave for oblique incidence(L4).

Textbook(s):

1. William H. Hayt, Engineering Electromagnetics, 8/e, Tata McGraw Hill, 2012.

2. Matthew N.O. Sadiku, Elements of Electromagnetics, 4/e, Oxford University Press, 2014.

References:

1. E. C. Jordan, EM Waves and Radiating Systems, PHI, 2/e Prentice Hall, 2012
2. David K. cheng, Field and Wave Electromagnetics, 2/e, Pearson Education, 1989.
3. Electromagnetics with Applications, J.D. Kraus, D. A. Fleish, 5/e, McGraw Hill, 1999.

Course Outcomes:

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

- apply vector calculus to understand the behavior of static electric fields in standard configurations. (L3)
- apply vector calculus to understand the behavior of static magnetic fields in standard configurations. (L3)
- describe and analyze electromagnetic wave propagation in free-space, conductor and dielectric media. (L2)
- justify the concept of electromagnetic waves in terms of transporting energy or information (L6)
- describe the reflection of plane wave at normal and oblique incidence in free space and dispersive media (L4).

19EEC233: ELECTRONIC DEVICES AND AMPLIFIER CIRCUITS

L	T	P	C
3	0	3	4.5

This course familiarizes the student with structure, operation, modeling and design of semiconductor devices and circuits. Laboratory experiments of this course includes hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Study of these basic circuits is helpful to train the student to designamplifier circuits, digital switches and balanced amplifiers.

Course Objectives:

- To introduce the physical construction of bipolar junction transistors (BJTs) and metal oxide field effect transistors (MOSFETs).
- To impart the knowledge on design and simulation of current mirror circuits.
- To familiarize the analysis of the input impedance, output impedance, voltage gain and bandwidth of MOSFET amplifier configurations.
- To explain the analysis and design of differential amplifiers.
- To expose the student to semiconductor technology evolution, amplifier design principles and circuit analysis techniques.

Unit I: **8L + 6P**

Bipolar Junction Transistors: device structure and physical operation, current-voltage characteristics, the BJT as an amplifier and as a switch, BJT circuits at dc, biasing in BJT amplifier circuits, small-signal operation and models.

Learning Outcomes:

After completion of this unit the student will be able to

- describe the device structure, physical operation and current-voltage characteristics of a BJT (L1).
- derive the small signal parameters of a BJT at a given operating point (L2).
- appreciate the use of BJT in an amplifier and logic gates as switch (L3).

Unit II: **8L + 9P**

MOS Field-Effect Transistors: device structure and physical operation, current-voltage characteristics, MOSFET circuits at dc, the MOSFET as an amplifier and as a switch, biasing in MOS amplifier circuits, small signal operation and models.

Learning Outcomes:

After completion of this unit the student will be able to

- explain the device structure, physical operation and current-voltage characteristics of MOSFET (L2).
- make use of MOSFET as a transconductor in an amplifier and switch in a logic gates (L3).
- estimate the small signal parameters of a MOSFET at a given operating point (L3)

Unit III: **8L+6P**

IC Design Philosophy: comparison of the MOSFET and the BJT, IC biasing-current sources, current mirrors and current-steering circuits, current-mirror circuits with improved performance.

Learning Outcomes

After completion of this unit the student will be able to

- compare the relative merits and demerits of MOSFETs and BJTs in terms of transconductance, output resistance, intrinsic gain and transition frequency (L2).
- design a MOSFET current sink/source for desired current, voltage headroom, output current and output resistance (L5).
- analyze the voltage headroom, output resistance of cascode current mirror and Wilson current mirror (L4).

Unit IV: **8L + 9P**

Single Stage MOSFET Amplifiers: basic MOSFET amplifier configurations, MOSFET internal capacitances and high frequency model, frequency response of the CS amplifier, discrete circuit MOS Amplifiers.

Learning Outcomes:

After completion of this unit the student will be able to

- describe the dominant pole approach, open circuit time constants method for estimating 3dB frequency of amplifiers (L2).
- estimate the input impedance, output impedance and voltage gain of common source/common gate and common drain amplifiers using small signal models (L3).
- design a source follower circuit for given output impedance or required level shift (L4).
- analyze the 3dB frequency of MOSFET amplifier circuits using open circuit time constants method (L4).

Unit V: **8L + 6P**

Differential Amplifiers: the MOS differential pair, small-signal operation of the MOS differential pair, other non-ideal characteristics of MOS differential amplifier, the MOS differential amplifier with active load.

Learning Outcomes:

After completion of this unit the student will be able to

- explain single ended signaling and differential signaling and compare their merits/demerits (L2).
- demonstrate a MOS differential pair(L2).
- estimate the differential mode gain, common mode gain and CMRR using small signal analysis (L3).
- analyze the source of offset voltages in MOS differential pairs (L4).

Electronic Devices and Amplifier Circuits Laboratory

List of Experiments:

1. Current-Voltage Characteristics of BJT / Measurement of scale current & common emitter current gain.
2. Measurement of small signal parameters (g_m, r_o, r_π, r_e) of BJT at a given operating point Ic.
3. Design, Simulate and Implement BJT amplifier and Inverter logic gateCurrent-Voltage Characteristics of MOSFET / Measurement of threshold voltage.
4. Measurement of small signal parameters (g_m, r_o, g_{mb}) of MOSFET at a given operating point (I_d,V_{ds}).
5. Design and simulation of basic NMOS current mirror, cascode NMOS current mirror and current steering circuit.
6. Design, Simulation and Implementation of Common Source Amplifier for Gain, Power dissipation requirements.
7. Design, Simulation and Implementation of Common Drain Amplifier (Voltage Buffer) for Gain, Output Impedance, Level Shift requirements.
8. Analysis and Verification of Basic NMOS Differential Pair for Gain, Input Common Mode Range, Maximum Input differential voltage requirements.
9. Design, Simulation and Implementation of Differential Amplifier with active current mirror load for gain, power dissipation CMRR requirements.
10. Design, Simulation and PCB fabrication of BJT Astable Multivibrator Circuit.

Text Book(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuits Theory, 10/e, Pearson Education, 2009.
3. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.

Course Outcomes:

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

- describe the device structure/physical operation, analyze BJT/MOSFET circuits using their large signal and small signal models (L1).
- distinguish between discrete component circuit design and integrated circuit design and appreciate the relative merits and demerits of BJT and MOSFET devices (L2).
- design current mirror circuits given the output resistance, voltage headroom and output current requirements (L5).
- derive the low frequency and high frequency characteristics of common source, common gate, common drain amplifiers (L4).
- analyze and design differential amplifier circuits for gain and linearity requirements (L4/L6).

19EEC235: SIGNALS AND SYSTEMS

L	T	P	C
2	0	2	3

Signals contain information about the behavior or nature of some phenomenon and are functions of one or more independent variables. A system processes the signal for producing desired behavior. Signal processing plays an extremely important and continually growing role in areas of science and technology such as communications, aeronautics and astronautics, acoustics, seismology, biomedical engineering and speech processing. This course introduces the basic concepts and mathematical tools required for signal processing.

Course Objectives:

- To explain the mathematical representation /classification of continuous-time and discrete-time signals and systems
- To provide an understanding of characterization of linear-time invariant systems using impulse response and convolution function.
- To familiarize the application of Fourier series, Fourier transform and their properties to continuous-time and discrete time signals and systems.
- To impart the knowledge of Laplace and Z-transform and their properties to analyze continuous-time and discrete-time signals respectively.

Unit I: **8L**

Signals and Systems: continuous-time and discrete-time signals, transformations of the independent variable, exponential and sinusoidal signals, the unit impulse and unit step functions, continuous-time and discrete-time systems, basic system properties.

Learning Outcomes:

After completion of this unit, the student will be able to

- express continuous and discrete time signals and systems in mathematical form (L1).
- perform mathematical operations on the signals covering dependent and independent variable(L1).
- classify continuous and discrete time signals and systems based on their properties (L3).

Unit II: **7L**

Linear Time Invariant Systems: discrete-time lti systems: the convolution sum, continuous time lti systems: the convolution integral, properties of linear time-invariant systems.

Learning Outcomes:

After completion of this unit, the student will be able to

- represent continuous - time and discrete - time signals in terms of impulses (L1).

- find output response of continuous time and discrete time LTI systems using convolution integral and convolution sum (L2).
- analyze the property of a continuous time and discrete time system based on the impulse response of the system(L3).

Unit III: **11L**

Fourier analysis of Continuous Time Signals and Systems: Fourier series representation of continuoustime periodic signals, convergence of the Fourier series, properties of continuous-time Fourier series (CTFS).

Representation of Aperiodic signals: the continuous-time Fourier transform (CTFT), the Fourier transform for periodic signals. properties of the continuous-time Fourier transform, systems characterized by linear constant-coefficient differential equations.

Learning Outcomes:

After completion of this unit, the student will be able to

- compute the Fourier series and Fourier Transform for periodic and aperiodic signals (L2).
- apply the properties of CTFT to compute the Fourier transform of a broader class of signals (L3).
- analyze continuous time LTI systems using Fourier Transforms (L4).

Unit IV: **(8L)**

Fourier analysis of Discrete Time Signals and Systems: representation of aperiodic signals: the discrete-time Fourier transform, properties of the discrete-time Fourier transform, the Fourier transform for periodic signals, systems characterized by linear constant-coefficient difference equations.

Learning Outcomes:

After completion of this unit, the student will be able to

- compute the Fourier Transform (DTFT) of discrete - time aperodic and periodic signals (L2).
- apply DTFT and its properties to broader class of discrete time signals (L3).
- analyze LTI systems using DTFT (L4).

Unit V: **8L**

Analysis of Continuous time and Discrete time signals using Laplace Transform and Z Transform: The Laplace Transform: the region of convergence (roc) for Laplace transforms, the inverse Laplace transform, properties of the Laplace transform.

The Z-Transform: The region of convergence for the z-transform, the inverse-z transform, properties of the z-transform.

Learning Outcomes:

After completion of this unit, the students will be able to

- apply Laplace Transform and Z Transform equations and their properties to continuous time/ discrete time signals (L3).

- explain ROC of Laplace - Transform/ Z - Transform(L2).
- construct continuous time and discrete time signals from their transforms (L3).

Text Book(s):

1. Alan V. Oppenheim, S. Willsky with S.Hamid Nawab, Signals and Systems, 2/e, Pearson Education, 1997.

References:

1. Bhagawandas P. Lathi, Linear Signals and Systems, Oxford University Press, 2009

2. Simon Haykin, Barry Van Veen, Signals and Systems, 2/e, Wiley Student Edition, 2007.

Course Outcomes:

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

- describe the mathematical model of continuous - time/discrete - time signals and systems and perform mathematical operations on signals (L2).
- determine the output response of continuous time/ discrete time LTI system using convolution integral and convolution sum(L2).
- analyze the characteristics of linear – time invariant systems(L4).
- derive the frequency domain representation of signals and systems using transform techniques(L3).
- determine the output response of LTI systems using CTFT and DTFT(L2).

19EMC281: CONSTITUTION OF INDIA (Elective)

L	T	P	C
3	0	0	0

Unit I **10 L**

Introduction to Indian Constitution: Constitutional history, constituent assembly, salient features of the constitution, significance of preamble, amending process of the constitution.

Unit II **8 L**

Rights and Duties: Citizenship, fundamental rights and directive principles, fundamental duties.

Unit III **8 L**

Union Government: President and vice president, election, removal andpowers, prime minister and council of ministers, parliament, supreme court, union, state relations, emergency provisions.

Unit IV **8 L**

State and Local Governments: Governor, state legislature, assembly andcouncil, chief minister and council of ministers, high court, rural and urban local governments with special reference to 73rd and 74th constitutional amendment acts.

Unit V **8L**

Other Constitutional and Statutory Bodies: Comptroller and auditor gen-eral, election commission, finance commission, attorney general and advocate general, union public service commission (UPSC), state public service commissions (SPSCs), tribunals, national human rights commis-sion (NHRC).

Text Book(s)

1. J. C. Johari, Indian Government and Politics, Vishal Publications, Delhi, 2009.
2. M. V. Pylee, Introduction to the Constitution of India, 5/e, Vikas Publishing House, Mumbai, 2007.

References

1. D.D. Basu, Introduction to the Indian Constitution, 21/e, Lexis Nexis, Gurgaon, India, 2011.
2. Subhas C. Kashyap, Our Constitution, 2/e, National Book Trust India, New Delhi, 2013.

19EMC282 - ENVIRONMENTAL SCIENCES

(COMMON SYLLABUS FOR ALL BRANCHES)

L T P C

3 0 0 0

The course enables the students to adapt eco-centric thinking and actions rather than human-centric thinking on natural resources, their utilization and conservation. The course also focuses on the importance of ecosystems, biodiversity and their degradation leads to pollution, finding solutions through application of control measures to combat pollution and legal measures to achieve sustainable development.

Course Objectives:

- To familiarize the students about the importance of the environmental studies.
- To acquaint with different natural resources and their associated problems.
- To introduce various ecosystems, values of biodiversity and their conservation.
- To expose to today's pollution levels and their impacts.
- To create awareness on different social issues such as conservation of water, green building concept.
- To impart knowledge on present population scenario, its impacts and role of informational technology on environment and human health.

Unit I: **10 L**

Introduction to environment and natural resources: Introduction to environment: Definition, scope and importance, multidisciplinary nature of environment, need for public awareness. Natural Resources: Renewable and non-renewable resources, natural resources and associated problems. Forest resources: Uses, Reasons for over-exploitation, deforestation effects, timber extraction, case studies. Water resources: Use and over – utilization of surface and ground water, floods, drought, conflicts over water, dams- benefits and problems. Mineral resources: Uses, environmental effects of extracting and using mineral resources, case studies. Food resources: World food problems, Impacts of overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. Energy resources: Growing energy needs, use of renewable and non renewable energy sources, case studies. Role of an individual in conservation of natural resources.Equitable use of resources for sustainable lifestyles.

Learning outcomes:

After the completion of this unit the student will be able to

- list different renewable and non-renewable resources (L1).
- learn how the over-exploitation of natural resources impact human life (L1).
- demonstrate the role of an individual in the conservation of natural resources (L1).

- explain the equitable use of natural resources for sustainable lifestyles (L2).

Unit II: **9 L**

Ecosystems and biodiversity: Structure components of ecosystem: Biotic and Abiotic components. Functional components of an ecosystem: Food chains, Food webs, Ecological pyramids, Energy flow in the ecosystem (10% law), Ecological succession. Biogeochemical cycle: (Nitrogen, carbon, Phosphorus cycle). Introduction, types, structure and function of the following ecosystem:- Forest ecosystem. Grassland ecosystem.Desert ecosystem.Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity: Definition, Levels of biodiversity: genetic, species and ecosystem diversity. Biogeographical classification of India, Values of biodiversity: consumptive use, productive use, social, ethical, aesthetic and optional values. India as a mega – diversity nation.Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Conservation of biodiversity: In – situ and Ex-situ conservation of biodiversity.

Learning outcomes:

After the completion of this unit the student will be able to

- learn how ecosystem functions (L1).
- explain the structure and function of terrestrial and aquatic ecosystems (L2).
- illustrate the values and threats to biodiversity (L2).
- explain the importance of conservation of biodiversity (L2).

Unit III: **8 L**

Environmental pollution and control: Environmental Pollution: Definition, causes, effects and control measures: Air Pollution, Water pollution, Soil pollution, Marine pollution, Thermal pollution, Nuclear hazards, Solid waste Management, e-waste, Hazardous waste management. Role of an individual in prevention of pollution. Pollution case studies. Disaster Management: floods, earthquake, cyclone and landslides.

Learning outcomes:

After the completion of this unit the student will be able to

- list causes, effects and control measures of pollution (air, water & soil) (L1).
- classify different types of pollutants (L2).
- explain disaster management of floods, earthquake, cyclone and landslides (L2).
- identify the pollution related case studies (L3).
- demonstrate the role of an individual in prevention of pollution (L3).

Unit IV: **9L**

Social issues and global environment problems and efforts: From unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed

management, Remote sensing and GIS methods. Resettlement and rehabilitation of people: its problems and concerns. Case Studies, Environmental ethics: Issues and possible solutions. Green building concept, Environmental Impact Assessment (Checklists, matrix methods), Environmental Management Plan, Climate change: global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust.

Learning outcomes:

After the completion of this unit the student will be able to

- explain different water conservation methods (L2).
- compare remote sensing and GIS methods (L2).
- apply green building concept (L3).
- demonstrate the consequences of global warming, acid rains and ozone layer depletion (L3).
- analyze environmental impact assessment and management plan (L4).

Unit V: **6 L**

Human population and environment legislation: Population growth, variation among nations. Family Welfare programme.Environment and human health.HIV/AIDS, Human rights.Value Education.Women and Child Welfare.Role of Information Technology in Environment and human health.Environment Legislation.Air (Prevention and Control of Pollution) Act.Water (Prevention and Control of Pollution) Act.Wildlife Protection Act.Forest Conservation Act. Environmental Protection Act, Pollution prevention act. Issues involved in enforcement of environmental legislation. Public awareness.Project Work.

Learning outcomes:

After the completion of this unit the student will be able to

- compare population growth and variation among nations (L2).
- apply value education (L3).
- classify women and child welfare (L3).
- distinguish different environmental legislation acts and issues involved in enforcement of legislation (L4).
- analyze the role of information technology in environment and human health (L4).

Text Book (s):

1. AnubhaKaushik and C.P. Kaushik, Text book of environmental studies New Age International Publisher (2014).
2. ErachBarucha, Text book of environmental studies for undergraduates courses, published by – University Grants Commission, University Press(2005)
3. AninditaBasak, Environmental Studies. Pearson (2009)

References:

1. D.K. Asthana and MeeraAsthana, A Text book of Environmental Studies, S. Chand (2010).
2. P.M Cherry Solid and Hazardous waste Management, CBS Publisher (2016).
3. Charles H. Ecclestion, Environmental Impact Assessment, CRC Press (2011).
4. K.K. Singh, Natural Resources Conservation and Management, MD Publications (2008).
5. J. Jeffrey Peirce, Ruth F. Weiner and P. AarneVesilind, Environmental Pollution and Control, Butterworth-Heinemann (1998).
6. James Maclaurin and Kim Sterelny, What is Biodiversity, The University of Chicago Press (2008).
7. R.B. Mandal, Introductory Methods in Population Analysis, Concept Publishing Co, (2007).

Course Outcomes:

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

- explain about environment and natural resources (L2).
- illustrate the values and threats to biodiversity (L2).
- identify the pollution related case studies (L3).
- demonstrate the consequences of global warming, acid rains and ozone layer depletion (L3).
- analyze the role of information technology in environment and human health (L4).

19EHS221: COMPREHENSIVE SKILL DEVELOPMENT II

L T P A C
0 0 0 6 1

Course Objectives:

- To encourage the all-round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self-motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Part-1 **3 Hours per week**

A. Verbal and Soft Skills:

Communication Skills, Presentation Skills, Decision Making and Problem-Solving, Group Discussion.

Unit	**Module/ Topics**	**Hrs**
1.	Communication Skills	4
2.	Presentation Skills	4
3.	Decision Making and Problem-Solving	3
4.	Group Discussion	4
	Total	**15**

B. Quantitative Aptitude and Reasoning

Puzzles, Numbers, Arithmetic, Data Interpretation.

Unit	**Module/ Topics**	**Hrs**
1.	Non-Verbal Reasoning	5
2.	Data Sufficiency	2
3.	Analytical Reasoning	3
4.	Puzzles	5
	Total	15

Unit	Module/ Topics	Hrs
1.	Numbers [Number System, Divisibility rules, Remainders, LCM & HCF]	3
2.	Numerical Computation and Estimation-1 [i. Chain Rule ii. Ratio Proportions iii. Partnerships & Averages iv. Percentages v. Profit-Loss, and discounts vi. Mixtures]	6
3.	Data Interpretation [Pie diagrams, Line Graph, Bar Graph, Tabular forms, and Caselets]	3
4.	Progressions and Series	3
	Total	15

Part-2 **3 Hours per week**

Coding: Complex problem solving using Data Structures in terms of improving efficiency:
Time Complexity and Space Complexity, Linked List, Stacks and Queues using Linked List, Binary Trees, Binary Search Trees, Trie, Representation of graphs, Breadth First Search, Depth First Search, Dynamic Programming.

Scheme of Evaluation

Internal Assessments by Assignments, Quizzes (multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/

19EMA104: ENGINEERING MATHEMATICS IV
(PROBABILITY AND STATISTICS)

L	T	P	C
3	0	0	3

This course is designed to impart knowledge on the concepts of Data Science, fundamental properties of probability, distributions, correlation, regression, testing of hypothesis for small and large samples in engineering applications.

Course Objectives:

- To familiarize the students with the foundations of Data Science, probability and statistical methods.
- To explain the concepts in random variables and several distributions in engineering applications.
- To teach the concepts of correlation, regression and estimations and their properties.
- To explain the concept of testing of hypothesis for large samples.
- To impart knowledge on small sample tests.

UNIT I: Data Science and Probability
10 L

Data Science: Introduction to statistics, population vs sample, collection of data, primary and secondary data, types of variables: dependent, independent, categorical and continuous variables, data visualization, measures of central tendency, measures of dispersion (variance).

Probability: Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem (without proof).

Learning Outcomes:
After completion of this unit the student will be able to

- summarize the basic concepts of data science and its importance in engineering (L2)
- analyze the data quantitatively or categorically, measure of averages, variability (L4)
- define the terms trial, events, sample space, probability and laws of probability (L2)
- make use of probabilities of events in finite sample spaces from experiments (L3)
- apply Baye's theorem to practical problems (L3)

UNIT II: Random Variable and Probability Distributions
8 L

Random variables (discrete and continuous), probability mass and density functions, probability distribution Binomial, Poisson, normal distribution- and their properties (mathematical expectation and variance).

Learning Outcomes:

After completion of this unit the student will be able to

- explain the notion of random variable, distribution functions and expected value (L2)
- apply Binomial and Poisson distributions to compute probabilities, theoretical frequencies (L3)
- explain the properties of normal distribution and its applications (L3)

UNIT III: Correlation, Regression and Estimation 8 L

Correlation, correlation coefficient, rank correlation, regression, lines of regression, regression coefficients, principle of least squares and curve fitting (straight line, parabola and exponential curves).

Estimation: Parameter, statistic, sampling distribution, point estimation, properties of estimators, interval estimation.

Learning Outcomes:

After completion of this unit the student will be able to

- identify different trends in scatter plots, strengths of association between two numerical variables (L3)
- make use of the line of best fit as a tool for summarizing a linear relationship and predicting future observed values (L3)
- estimate the value of a population parameter, computation of point and interval estimation (L3)

UNIT IV: Testing of Hypothesis and Large Sample Tests 8 L

Formulation of null hypothesis, alternative hypothesis, critical region, two types of errors, level of significance and power of the test. **Large Sample Tests**: Test for single proportion, difference of proportions, test for single mean and difference of means confidence interval for parameters in one sample and two sample problems.

Learning Outcomes:

After completion of this unit the student will be able to

- identify the difference between one-tailed and two-tailed hypothesis tests (L3)
- analyze the testing of hypothesis for large samples (L4)

UNIT V: Small Sample Tests 6 L

Student t-distribution (test for single mean, two means and paired t-test), testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

Learning Outcomes:

After completion of this unit the student will be able to

- analyze the testing of hypothesis for small samples (L4)

- test for the $\chi 2$ square goodness of fit and independence of attributes (L4)

Text Book(s):

1. Richard A. Johnson, Iswin Miller and John Freund, Miller &Freund's probability & statistics for engineers, 7/3, Pearson, 2008.
2. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
3. S.C. Gupta and V.K. Kapoor, Fundamentals of Mathematical Statistics, 11/e, Sultan Chand & Sons Educational Publications, 2012.

References:

1. S. Ross, A First Course in Probability, Pearson, 2002.
2. W. Feller, An Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.

Course Outcomes:

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

- classify the concepts of Data Science and its importance (L2)
- apply discrete and continuous probability distributions (L3)
- explain the association of characteristics through correlation and regression tools (L3)
- identify the components of a classical hypothesis test (L3)

use the statistical inferential methods based on small and large sampling tests (L4)

19EMA204: ENGINEERING MATHEMATICS-IV

PROBABILITY THEORY AND RANDOM PROCESSES

L	T	P	C
3	0	0	3

Unit I: Probability **8 L**

Probability introduced through sets and relative frequency, joint and conditional probability, independent events, combined experiments, Bernoulli trials.

Unit II: Random Variable **9 L**

Introduction, random variable concept, distribution function, density function, the Gaussian random variable, other distribution and density examples, conditional distribution and density functions. **Operation on One Random Variable:** Introduction, expectation, moments, functions that give moments, transformations of a random variable.

Unit III: Multiple Random Variables **9 L**

Vector random variables, joint distribution and density functions, properties, conditional distribution and density, statistical independence, distribution and density of a sum of random variables, central limit theorem. **Expected Value of a Function of Random Variables:** Joint moments about the origin, joint central moments, jointly Gaussian random variables - two random variables case, N random variable case.

Unit IV: Random Process-I **8 L**

Temporal characteristics - the random process concept, stationary and statistical independence, correlation functions, Gaussian random processes, Poisson random process.

Unit V: Random Process-II **8 L**

Spectral characteristics, the power spectrum: Properties, relationship between power spectrum and autocorrelation function, the cross-power density spectrum: Properties, relationship between crosspower spectrum and cross-correlation function.

Text Books

1. Peyton Z. Peebles, Probability, Random Variables and Random Signal Principles, 4/e, Tata McGraw Hill, 2002.
2. Athanasios Papoulis, S. Unnikrishna Pillai, Probability, Random Variables and Stochastic Processes, 4/e, Tata McGraw Hill, 2002.

References

1. Simon Haykin, Communication Systems, 4/e, Wiley Student Edition, 2006.
2. Henry Stark, John W. Woods, Probability and Random Processes with Application to Signal Processing, 3/e, Pearson Education, 2002.

19EID232 : **INTERNET OF THINGS**

(Common to all)

L	T	P	C
2	0	2	3

The Internet of Things (IoT) is a network of a wide variety of devices like vehicles, humans, soil etc. These devices gather data using sensors, which can be used for monitoring or control. This course is an introduction to the embedded devices, communication protocols and APIs used in IoT.

Course Objectives

- Introduce the fundamental concepts of IoT and physical computing
- Expose the student to a variety of embedded boards and IoT Platforms
- Create a basic understanding of the communication protocols in IoT communications.
- Familiarize the student with application program interfaces for IoT.
- Enable students to create simple IoT applications.

UNIT I **5 L**

Overview of IoT: The Internet of Things: An Overview, The Flavor of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things? Design Principles for Connected Devices, Calm and Ambient Technology, Privacy, Keeping Secrets, Whose Data Is It Anyway? ,Web Thinking for Connected Devices, Small Pieces, Loosely Joined, First-Class Citizens On The Internet, Graceful Degradation, Affordances.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain IoT architecture(L2)
- interpret the design principles that govern connected devices(L2)
- summarize the roles of various organizations for IoT(L2)

UNIT II **6 L**

Embedded Devices - I: Embedded Computing Basics, Microcontrollers, System-on-Chips, Choosing Your Platform, Arduino, Developing on the Arduino, Some Notes on the Hardware, Openness.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the basics of microcontrollers(L2)
- outline the architecture of Arduino(L2)
- develop simple applications using Arduino(L3)

UNIT III **6 L**

Embedded Devices - II: Raspberry Pi , Cases and Extension Boards, Developing on the Raspberry Pi, Some Notes on the Hardware, Openness, Other notable platforms, Mobile phones and tablets, Plug Computing: Always-on Internet of Things.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline the architecture of Raspberry Pi(L2)
- develop simple applications using Raspberry Pi(L3)
- select a platform for a particular embedded computing application(L3)

UNIT IV **6 L**

Communication in the IoT: Internet Principles, Internet Communications: An Overview, IP, TCP, The IP Protocol Suite (TCP/IP), UDP, IP Addresses, DNS, Static IP Address Assignment, Dynamic IP Address Assignment, IPv6, MAC Addresses, TCP and UDP Ports, An Example: HTTP Ports, Other Common Ports, Application Layer Protocols- HTTP, HTTPS: Encrypted HTTP, Other Application Layer Protocols.

Learning Outcomes:

After completion of this unit, the student will be able to

- interpret different protocols and compare them(L2)
- select which protocol can be used for a specific application(L3)
- utilize the Internet communication protocols for IoT applications(L3)

UNIT V **5 L**

Prototyping Online Components: Getting Started with an API, Mashing Up APIs, Scraping, Legalities, writing a New API, Clockodillo, Security, Implementing the API, Using Curl to Test, Going Further, ReaLTime Reactions, Polling, Comet, Other Protocols, MQ Telemetry Transport, Extensible Messaging and Presence Protocol, Constrained Application Protocol.

Learning Outcomes:

After completion of this unit, the student will be able to

- select IoT APIs for an application(L3)
- design and develop a solution for a given application using APIs(L6)
- test for errors in the application(L4)
- judge the security issues in Real time applications. (L5)

INTERNET OF THINGS LABORATORY

List of Practical Experiments:

1. Select any one development board (Eg., Arduino or Raspberry Pi) and control LED using the board.
2. Using the same board as in (1), read data from a sensor. Experiment with both analog and digital sensors.
3. Control any two actuators connected to the development board using Bluetooth.
4. Read data from sensor and send it to a requesting client. (using socket communication)

Note: The client and server should be connected to same local area network.

5. Create any cloud platform account, explore IoT services and register a thing on the platform.
6. Push sensor data to cloud.
7. Control an actuator through cloud.
8. Access the data pushed from sensor to cloud and apply any data analytics or visualization services.
9. Create a mobile app to control an actuator.
10. Identify a problem in your local area or college which can be solved by integrating the things you learned so far and create a prototype to solve it (Mini Project).

Text Book(s):

1. Adrian McEwen, Hakim Cassimally, Designing the Internet of Things, Wiley Publications, 2012.

References

1. ArshdeepBahga, Vijay Madisetti, Internet of Things: A Hands-On Approach, Universities Press, 2014.
2. Pethuru Raj, Anupama C. Raman, The Internet of Things, Enabling technologies and use cases – CRC Press, 2017.

Web Sources

https://www.arduino.cc/

https://www.raspberrypi.org/

Course Outcomes:

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

- choose the sensors and actuators for an IoT application(L1)
- select protocols for a specific IoT application(L2)
- utilize the cloud platform and APIs for IoT application(L3)
- experiment with embedded boards for creating IoT prototypes(L3)
- design a solution for a given IoT application(L6)

19EID234: **LIFE SCIENCES FOR ENGINEERS**

(Common to all)

L	T	P	C
2	0	2	3

Life sciences have been introduced in to curriculum of all engineering branches. Students in engineering programs should be aware of fundamentals of biology so as to relate to their field. This course is a critical application area for engineering analysis and design, emphasizing concepts, technology, and the utilization of living things. Further it is important to know how living things work and act.

Course Objectives

- Introduce the molecular basis of life.
- Provide the basis for classification of living organisms.
- Describe the transfer of genetic information**.**
- Introduce the techniques used for modification of living organisms**.**
- Describe the applications of biomaterials

UNIT I **10 L**

Introduction to Biology: Comparison of eye and camera, flying bird and aircraft, Biological observations and major discoveries- genera, species and strains, and Classification of living organisms: Cellularity, Ultrastructure, carbon and energy sources, excretion, habitat and molecular taxonomy.

Learning Outcomes:
After completing this unit, the student will be able to

- summarize the basis of life (L2).
- distinguish prokaryotes from eukaryotes (L4).
- compare biological organisms and manmade systems (L2).
- classify organisms (L2).

UNIT II **12 L**

Water, Biomolecules: sugars, starch and cellulose, Amino acids and proteins, lipids, Nucleotides and DNA/RNA, structure and functions of proteins and nucleic acids, hemoglobin, antibodies and enzymes, Industrial applications of enzymes, Fermentation and its industrial applications.

Learning Outcomes:

After completing this unit, the student will be able to

- outline the importance of water (L2).

- explain the relationship between monomeric units and polymeric units (L2).
- explain the relationship between the structure and function of proteins (L2).
- interpret the relationship between the structure and function of nucleic acids (L2).
- summarize the applications of enzymes in industry (L2).
- explain the applications of fermentation in industry (L2).

UNIT III **12 L**

Bioenergetics, Respiration: Glycolysis and TCA cycle, Electron transport chain and oxidative phosphorylation, Mechanism of photosynthesis, Human physiology, neurons, synaptic and neuromuscular junctions.

Learning Outcomes:

After completing this unit, the student will be able to

- apply thermodynamic principles to biological systems (L3).
- explain the mechanism of respiration and photosynthesis (L2).
- summarize the principles of information transfer and processing in humans (L2).

UNIT IV **12 L**

Mendel's laws, gene mapping, Mitosis and Meiosis, Epistasis, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation.

Learning Outcomes:

After completing this unit, the student will be able to

- define Mendel's laws (L1).
- demonstrate the mapping of genes (L2).
- explain interactions among genes and their significance (L2).
- differentiate the mitosis and meiosis (L4).
- explain the medical importance of gene disorders (L2).
- Identify DNA as a genetic material in the molecular basis of information transfer (L3).

UNIT V **10 L**

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

Learning Outcomes:

After completing this unit, the student will be able to

- outline the principles of recombinant DNA technology (L2).
- appreciate the potential of recombinant DNA technology (L2).
- summarize the use of biological materials for diagnostic devises (L2).

Lab Experiments (Virtual or Field Experiments)

1. Microscopy, Mendel's laws, mapping, interactions, - 4 lab experiments
2. Nitrogen cycle, Species interactions, Sterilization, Bacterial population growth, - 4 lab experiments

Text Book(s):

1. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2018.
2. Arthur T Johnson, Biology for Engineers, CRC press, 2011.

Reference Books:

1. Alberts et.Al., The molecular biology of the cell, 6/e, Garland Science, 2014.
2. E. E. Conn, P. K. Stumpf, G. Bruening and R. H. Doi, "Outlines of Biochemistry", John Wiley and Sons, 2009.

Course Outcomes

After studying the course, the student will be able to:

- explain catalytic properties of enzymes (L2).
- summarize application of enzymes and fermentation in industry (L2).
- identify DNA as a genetic material in the molecular basis of information transfer (L3).
- apply thermodynamic principles to biological systems. (L3)
- analyze biological processes at the reductionistic level (L4).
- appreciate the potential of recombinant DNA technology (L2).

19EEC232: DIGITAL LOGIC DESIGN

L	T	P	C
3	0	3	4.5

Digital Logic Design is an introductory course which provides the basic concepts used in the design and analysis of digital circuits. A digital circuit is constructed using logic gates which are the basic building blocks. This course deals with the design of various combinational and sequential circuits used in the present day world. This course is a prerequisite to many other courses like Digital Communications, Computer Organization, Digital System design, Digital IC design, etc.

Course objectives:

- To introduce number systems, conversion used for representing numbers in computational structures
- To familiarize the implementation of simple logical operations using Combinational circuits
- To acquaint the student with the design of combinational and sequential logic circuits with practical design examples
- To expose different types of memories used in digital systems
- To impart the design of synchronous and asynchronous digital systems.

Unit I: **8L+6P**

Binary Systems: digital systems, binary numbers, number base conversions, octal and hexadecimal numbers, complements, signed binary numbers, binary codes, binary logic. **Boolean Algebra and Logic Gates:** basic definitions, axiomatic definition of boolean algebra, basic theorems and properties of boolean algebra, boolean functions, canonical and standard forms, digital logic gates.

Learning outcomes:

After completion of this unit the student will be able to

- identify the symbols of different logic gates and write their truth tables (L1).
- convert a number into different base representations (L2).
- construct the given Boolean function using logic gates (L3).

Unit II: **8L+3P**

Simplification of Boolean functions

the map method, four-variable map, five-variable map, product of sums simplification, don't-care conditions, NAND and NOR implementation, exclusive-OR function.

Learning outcomes:

After completion of this unit the student will be able to

- determine the simplified Boolean expression using map method (L3).
- construct digital circuits using only NAND/NOR logic gates (L3).
- design parity generator and checker circuits using exclusive-OR function (L5).

Unit III: **10L+9P**

Combinational Logic: combinational circuits, analysis procedure, design procedure, binary adder-subtractor, decoders, encoders, multiplexers. **Memories: r**andom-access memory, memory decoding, error detection and correction, read-only memory.

Learning outcomes:

After completion of this unit the student will be able to

- analyze the truth table of a given combinational logic circuit (L3).
- design combinational circuit from the given specifications (L5).
- correct the bit error in the given data word using Hamming code (L5).

Unit IV: **8L+3P**

Synchronous Sequential Logic: sequential circuits, latches, flip-flops, analysis of clocked sequential circuits, state reduction and assignment, design procedure.

Learning outcomes:

After completion of this unit the student will be able to

- explain the operation of latches and flip flops (L2).
- analyze the behavior of sequential circuits (L4).
- evaluate a clocked sequential circuit from its state diagram (L6).

Unit V: **8L+6P**

Registers and Counters: registers, shift registers, ripple counters, synchronous counters, ring counter.

Digital Integrated circuits: special characteristics, complementary MOS(CMOS), CMOS transmission gate circuits.

Learning outcomes:

After completion of this unit the student will be able to

- differentiate asynchronous and synchronous counters (L4).
- design Synchronous and Ripple counters using D, JK and T flip-flops (L5).
- construct multiplexer and D-latch using CMOS transmission gates circuits (L5).

Text Book(s):

1. Michael D. Ciletti, M. Morris Mano, Digital Design, 4/e, Pearson Education, 2007.

References:

1. Zvi Kohavi, Switching and Finite Automata Theory, 2/e, Tata McGraw-Hill, 2008.
2. John F. Wakerly, Digital Design Principles and Practices, 4/e, Pearson Education, 2008.
3. Frederick J. Hill and Gerald R. Peterson, Introduction to Switching Theory and Logic Design, 3/e, John Willey and Sons, 1981.
4. Charles Roth, Jr., Larry Kinney, Fundamentals of Logic Design, 7/e, Cengage Learning, India, 2013.

Digital Logic Design Laboratory

List of Experiments:

1. Verification of Truth Tables of Logic gates and implementation of Basic gates using Universal Gates
2. Implementation of the given Boolean functions using logic gates in both SOP and POS form.
3. Simplification of the given Boolean function using K-map and implement using logic gates.
4. Realization and verification of Full adder and Full Subtractor using logic gates.
5. Implementation of the given function using decoder and logic gates.
6. Implementation of the given function using Multiplexer and logic gates.
7. Verification of State Tables of SR, D, JK and T-Flip-Flops.
8. Verify the operation of Shift Registers using D flip-flops.
9. Design and Verify the operation of 4-bit and Mod-N Ripple Counters using JK flip-flops.
10. Mini Project.

Course Outcomes:

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

- convert any number into different base representations(L2).
- simplify logic expressions using Boolean laws and realize using basic and universal logic gates(L3).
- design combinational circuits for the given specifications(L4).
- design synchronous sequential circuits for the given specifications (L4).
- differentiate asynchronous and synchronous counters and implement Multiplexers and D flip flops using CMOS technologies(L3).

19EEC234: ANALOG CIRCUITS

L	T	P	C
3	0	3	4.5

This course equips the student with design principles of electronic system building blocks including amplifiers , oscillators, negative feedback based operational amplifiers .Laboratory experiments of this course shall include hardware experiments, SPICE simulations and end-to-end circuit design using EDA/PCB design software. Skills learnt in this course shall help the student in improving existing circuits using negative feedback, building power Amplifiers, op-amp signal processing circuits etc.

Course Objectives

- To acquaint the studentswith the advantages and techniques of different negative feedback circuit configurations.
- To introduce the basic principles of oscillator circuits and design/simulate discrete component and op-amp oscillator circuits.
- To impart knowledge on analysis of the linearity, power efficiency and power dissipation of different output stages/power amplifiers.
- To explain the configuration and use of operational amplifier in designing several signal processing building blocks.
- To familiarize the analysis and classification of different ADC/DAC architectures based on working principle, conversion time and resolution characteristics.

Unit I: **8L + 3P**

Feedback Amplifiers: the general feedback structure, properties of negative feedback, basic feedback topologies, the series-shunt feedback amplifier, the series-series feedback amplifier, shunt-shunt and shunt-series feedback amplifiers, determining loop gain.

Learning Outcomes:

After completion of this unit the student will be able to

- summarize the basic building blocks of negative feedback systems and list their properties (L2).
- classify the different negative feedback topologies and identify/quantify the improvement in their characteristics (L2).
- determine the input impedance, output impedance, gain and bandwidth of feedback amplifiers (L4).
- identify the kind of feedback configuration employed in a given circuit (L3).

Unit II: **8L + 9P**

Oscillators: basic principles of sinusoidal oscillators, op amp RC oscillator circuits, LC and crystal oscillators.**Power amplifiers:** Classification of output stages, classA output stage, class B output stage, class AB output stage,class C output stage.

Learning Outcomes:

After completion of this unit the student will be able to

- explain Barkhausen's criteria for sustained oscillations (L2).
- explain the operation of RC phase shift and op-amp RC oscillators (L1).
- identify the usage of RC, LC and Crystal oscillators (L3).
- classify different output stages based on linearity, power efficiency and conduction angle (L2).
- analyze the transfer function, signal waveforms and power efficiency of Class A/B/AB output stages (L4).

Unit III: **10L + 9P**

Operational Amplifiers: The ideal op-amp, the inverting and non-inverting configuration, difference and instrumentation amplifiers, summing, scaling and averaging amplifiers, integrators, differentiators, logarithmic amplifiers, V/I and I/V converters, Comparator, regenerative comparator, Astable and Monostable multivibrators, Triangular wave generator.

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics of ideal Op-amp (L1).
- draw the op-amp inverting and non-inverting configurations and analyze them for their closed loop gain under ideal and non-ideal conditions (L2).
- describe the use of Op-amp in building analog signal processing blocks (L3).
- summarize the characteristics of comparators and analyze the Op-amp based comparators (L2).

Unit IV: **8L + 9P**

IC Timers (555): Introduction, Description of functional diagram, Monostable operation, Astable operation. **Active Filter Design:** LPF, HPF, BPF, BEF, all-pass filters. **Voltage Regulators:** Fixed voltage Regulators, Adjustable voltage Regulators.

Learning Outcomes:

After completion of this unit the student will be able to

- describe the architecture and list the operating modes of 555 timer (L1).
- design an active low- pass,high-pass,band-pass filter for given specifications(L5).
- describe the characteristics of voltage regulators and corresponding Opamp based circuits (L2).

Unit V: **8L + 6P**

Data Converters: Introduction, DAC characteristics, digital to analog conversion process, voltage output DACs, multiplying DAC, 8-bit digital to analog converter DAC-08. **Analog to Digital Converters**: ADC characteristics, integrating ADC, successive approximation ADC, Flash converters: Principle of operation, conversion time.

Learning Outcomes:

After completion of this unit the student will be able to

- list the characteristics and operation of DACs and ADCs (L1).
- classify different DAC and ADC configurations(L2).
- explain the operation of voltage output and multiplying DACs (L1).
- describe the principle of operation of flash converters and analyze its conversion time (L1).

Analog Circuits Laboratory

List of Experiments

1. Feedback Amplifier - calculation of gain, input resistance, output resistance with and without feedback, frequency response characteristic.
2. Design and Implementation of Two stage RC Coupled amplifier.
3. Oscillators (Colpitts, RC phase-shift, Wein-bridge)
4. Class A power amplifier.
5. Class B Push - pull power amplifier.
6. Tuned voltage amplifier.
7. Analysis and simulation of RC differentiator/integrator
8. Bistable/Monstable/Astablemultivibrators with 555 timer
9. Operational Amplifier Circuits (Adders, Integrators, Differentiators, Filters).
10. Op-amp based AM/FM Modulator/Demodulator Circuits.
11. Data Converters
12. Active Filter Design

Text Book(s):

1. Adel S. Sedra, Kenneth C. Smith, Arun N. Chandorkar, Microelectronic Circuits, 6/e, Oxford University Press, 2013.
2. D Choudhury Roy, Shail B. Jain, Linear Integrated Circuits, New Age International, 2003.
3. Ramakanth Gayakward, Op-Amps and Linear Integrated Circuits, 4/e, Pearson Education, 2007.

References:

1. Behzad Razavi, Fundamentals of Microelectronics, 2/e, Wiley Student Edition, 2013.
2. R.F Coughlin, F.F Driscoll, Op-Amps and Linear Integrated Circuits, 6/e, Pearson Education, 2008.
3. S. Salivahanan, V.S. KanchanBhaskaran, Linear Integrated Circuits, Tata Mc- Graw Hill, 2008.
4. Sergio Franco, Design with Operational Amplifiers and Analog Integrated Circuits, 3/e, Tata Mc-Graw Hill, 2002.

Course Outcomes:

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

- analyze the characteristics of different negative feedback amplifier configurations (L4).
- choose and design negative feedback circuits to improve the characteristics of given open loop amplifier (L3).
- describe the basic principle of sinusoidal oscillators and identify the usage of different oscillator circuits (L1).
- design active filters for the given design specification (L5).
- describe different DAC/ADC architectures and their design issues (L2).

19EEC236: ANALOG AND DIGITAL COMMUNICATIONS

L	T	P	C
3	0	3	4.5

This is an introductory course on communications which starts from the necessity of modulation in communication of signals. Fundamental concepts of both analog and digital modulation schemes are discussed and elaborated. Mathematical treatment of communication systems which enable one to implement them in practice is introduced. Possible errors in modulations are explored and methods for minimizing the same are discussed.

Course objectives:

- To introduce the need for modulation to communicate signals
- To familiarize the different modulation schemes and their tradeoffs
- To impart knowledge on the characterization, generation and detection of various modulation schemes
- To provide an understanding of the various digital modulation schemes and their trade off to characterize the bit error performance.
- To explain characteristics of superhetrodyne and to implement to a generalized receiver as a building block.

Unit I: **8L+3P**

Amplitude Modulation Systems: generation and detection of AM, Power relations, Spectral Characteristics, generation and detection of DSBSC, SSB, VSB, Frequency division multiplexing.

Learning Outcomes:

After completion of this unit, the student will be able to

- identify the necessity of modulation to communicate signals (L1).
- distinguish the various modulation schemes like AM, DSBSC, SSB,VSB (L2).
- demonstrate the various modulation schemes for the generation and detection models (L3).
- formulate the power requirements and bandwidth of the modulation schemes (L4).
- summarize the applications of various modulation schemes with power and bandwidth constraints (L2).

Unit II: **8L+3P**

Angle Modulation systems: properties of angle modulation, representation of FM and PM signals, NBFM, WBFM, transmission bandwidth of FM systems, generation of FM, detection of FM using PLL, receiver characteristics, super heterodyne receivers.

Learning Outcomes:

After completion of this Unit, the student will be able to

- differentiate linear and non linear modulation schemes (L2).
- distinguish the frequency modulation and phase modulation (L4).
- demonstrate the NBFM and WBFM for the generation and detection models(L4).
- estimate bandwidth of the NBFM and WBFM (L4).
- explain the characteristics and demonstrate the Super heterodyne receiver (L2).

Unit III: **8L+15P**

Analog to Digital Conversion: sampling process, pulse modulation schemes- pulse amplitude, pulse width, pulse position modulation. pulse code modulation (PCM), differential pulse code modulation, delta modulation, time division multiplexing.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the sampling theorem (L2).
- distinguish various pulse modulation schemes like PAM, PWM, PPM (L4).
- demonstrate the PCM, DPCM and DM with block diagrams (L2).
- explain the use of time division multiplexing (L2).

Unit IV: **9L+9P**

Baseband Transmission Of Digital Data: intersymbol interference, nyquist criterion, digital band pass modulation schemes- amplitude shift keying, phase shift keying, frequency shift keying, QPSK, M-ary digital modulation schemes.

Learning Outcomes:

After completion of this unit, the student will be able to

- interpret the baseband transmission of digital data (L2).
- explain the phenomenon of the Intersymbol interference (L2).

- describe various digital modulation schemes ASK, PSK, FSK, QPSK (L2).
- categorize the applications of various digital modulation schemes (L4).

Unit V: **9L+6P**

Noise in Digital communications: BER, detection of a single pulse in noise, optimum detection of BPAM, BPSK, BFSK, comparison of BER performance of various digital modulation schemes.

Learning Outcomes:

After completion of this unit, the student will be able to

- identify the noise in digital communication systems (L2).
- formulate the BER in digital communication systems (L4).
- demonstrate the various binary modulation schemes detection BPAM, BPSK, BFSK models (L5).
- formulate the power requirements and bandwidth of the digital modulation schemes (L4).
- evaluate the performance of BER in digital modulation schemes (L4).

Analog and Digital Communications Laboratory

List of Experiments:

1. AM/ DSBSC/ SSB Modulation and Demodulation.
2. Frequency Modulation and Demodulation.
3. Sampling and reconstruction of analog signals.
4. Generation and detection of PAM, PWM, PPM.
5. Time division multiplexing and demultiplexing.
6. PCM transmission
7. Differential PCM
8. Generation of ASK signals and detection.
9. Generation of PSK signals and detection.
10. Generation of FSK signals and detection
11. Simulation of Analog Modulation schemes using SIMULINK/ LABVIEW/MULTISIM
12. Simulation of Digital modulation schemes using MATLAB/LABVIEW/MULTISIM.

Text Book(s):

1. Simon Haykin, Michael Moher, Introduction to Analog and Digital Communications, 2/e Wiley, 2007.
2. P. Rama Krishna Rao, Analog Communication 1/e, Tata McGraw Hill, 2011.

References:

1. Taub H, Schilling D, Principles of Communication Systems, Tata McGraw Hill, 2010.
2. Simon Haykin, Communication Systems 4/e, Wiley, 2001
3. Kennedy,david, Electronic Communication System 4/e, Tata McGraw Hill,2012.

Course outcomes:

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

- explain the time domain and frequency domain description of different AM modulations schemes and compare them (L2).
- describe the characteristics of FM and PM schemes and functional operation of super heterodyne receiver(L2).
- explain the basic concepts of digital communications and distinguish various pulse modulation schemes(L2)
- describe various digital modulation schemes and their applications(L2)
- evaluate BER in digital modulation schemes and comparison (L4).

19EEC238: CONTROL SYSTEMS ENGINEERING

L	T	P	C
2	0	2	3

In everyday life many applications of control like control of temperature in air conditioners, water level maintenance, steering of car course etc., a never ending list are encountered. These controls may be manual or automatic. Human body is an excellent example of automatic control system. Control system engineering deals with set of devices that control the behavior of other devices or systems to achieve desired results. This course introduces the student to the principles and applications of control systems in everyday life.

Course Objectives:

- To expose various concepts of block diagram reduction techniques.
- To create mathematical modeling of the system.
- To demonstrate stability of the system in time domain.
- To impart knowledge on stability of the system in frequency domain.
- To get acquainted with state variable analysis.

UNIT I: **8L**

Introduction: Concepts of control systems, different examples of control systems, open loop and closed loop control systems and their differences, block diagram representation of systems considering electrical systems as examples, block diagram algebra, representation by signal flow graph, reduction using Mason's gain formula, feedback characteristics, effects of feedback.

Learning Outcomes:

After completion of this unit, the student will be able to

- outline concepts of control systems (L1).
- contrast the difference between open loop and closed loop systems (L1).
- apply the different block diagram reduction techniques to a given block diagram (L3).
- apply Masons gain formula for obtaining transfer functions (L3).
- analyze effect of feedback on performance of a system (L4).

UNIT II: **9L**

Mathematical Modeling and Control System Components: Introduction to mathematical modeling of physical systems, impulse response and transfer functions, equations of electrical networks, modeling of translational and rotational mechanical systems, time response of first and second order systems with standard input signals, time domain specifications, steady state error and error constants.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the impulse response and transfer functions (L1).
- categorize steady state error and error constants based on input (L1).
- analyze the time response of second order system for different signals (L4).
- develop equations of different time domain specifications (L4).
- model different components of a system using Laplace transform method (L4).
- model different components of an electrical and mechanical system using Laplace transform method (L4).

UNIT III:
8L

Concept of stability, Routh Hurwitz criterion, construction of root locus, correlation between time and frequency responses, determination of frequency domain specifications, effects of P, PI, PD and PID Controllers.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the concept of stability and their definitions (L1).
- apply Routh Hurwitz criterion for checking the stability of a system based on characteristic equation (L3).
- analyze effect of PID controllers on performance of system (L4).
- relate time and frequency responses specifications (L5).
- develop equations of different frequency domain specifications (L6).
- construct root locus of given system and check its stability (L6).

UNIT IV: **8L**

Stability of control systems from Bode plots, polar plots and Nyquist plots, all pass and minimum phase systems, numerical examples.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain all pass and minimum phase systems (L1).
- construct Bode plots of given system and check its stability (L6).
- construct polar plots of given system and check its stability (L6).

- Construct Nyquist plots of given system and check its stability (L6).

UNIT V: **9L**

State Variable Analysis: State, state variables, state variable representation, transfer function form to state variable form (diagonal form), state variable form to transfer function form, transfer function form to canonical form.

Learning Outcomes:

After completion of this unit, the student will be able to

- explain the concept of state and state variables (L3).
- model different components of a mechanical/electrical system in state variable form (L4).
- translate transfer function form to State variable form and state variable form to transfer function form (L6).
- translate an equation in State variable form to transfer function form (L6).
- translate an equation in transfer function form to canonical form (L6).

Textbooks:

1. Benjamin C. Kuo, Automatic Control Systems, 7/e , Prentice Hall of India, 1997.
2. M. Gopal, Control Systems Engineering, 3/e, Wiley Eastern Ltd., TMH, 2008.

References:

1. Ogata, Modern Control Engineering , 2/e, Prentice Hall of India, 2011.
2. R.C. Sukla, Control Systems, 3/e, Dhanpatrai and Sons,1998.

Course Outcomes:

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

- solve numerical on block diagrams reduction techniques (L3).
- represent the mathematical model of a given system (L2).
- determine the response of different order systems for various step inputs (L4).
- analyze the stability of the system (L4).
- comprehend solution of state equation (L3).

19EEC292: COMPREHENSIVE SKILL DEVELOPMENT III

L T P A C
0 0 0 6 1

Course Objectives:

- To encourage the all round development of students by focusing on soft skills, Coding & domain skills.
- To make the engineering students aware of the importance, the role and the content of soft skills, Coding and domain skills through instruction, knowledge acquisition, demonstration and practice.
- To develop and nurture the soft skills, coding and domain skills of the students through individual and group activities.
- To expose students to right attitudinal and behavioral aspects and to build the same through activities

Course Outcomes:

- On completion of the course, student will be able to– Effectively communicate through verbal/oral communication and improve the listening skills
- Write precise briefs or reports and technical documents, actively participate in group discussion / meetings / interviews and prepare & deliver presentations. Become more effective individual through goal/target setting, self motivation and practicing creative thinking.
- Student will be able to understand the problems and develop his competitive coding skills.
- Apply the skills in various domains and will be able to solve complex problems faced by the industry.
- Function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, conflict management and leadership quality

Part-1 **- 3 Hours per week**

A. Verbal and Soft Skills:

Vocabulary Builder, Reading Comprehension, Fill-in-the-Blanks, General Usage

Unit	Module/ Topics	Hrs
1.	Vocabulary Builder	4
2.	Reading Comprehension	4
3.	Paragraph Jumbles	3
4.	General Usage	4
	Total	**15**

B. Quantitative Aptitude and Reasoning

Puzzles, Arithmetic, Geometry, Mensuration.

Unit	Module/ Topics	Hrs
1.	Numbers	3
2.	Arithmetic	6
3.	Data Interpretation	3
4.	Puzzles	3
	Total	15

Unit	Module/ Topics	Hrs
1.	Numerical Computation and Estimation-2. [i. Time and Work, ii. Pipes and Cisterns, iii. Time and Distance, iv. Problems on trains, Boats and Streams, v. Races and Games of skill, vi. SI & CI]	6
2.	Geometry [i. Lines and Angles ii. Triangles iii. Quadrilaterals & Polygons iv. Circles]	4
3.	Mensuration [i. 2-Dimensional Mensuration (Triangles, Quadrilaterals and Circles), ii. 3-Dimentional Mensuration (Cubes, Cuboids, Cylinder, Cone, Sphere)]	3
4.	Data Sufficiency on Quantitative Reasoning	2
	Total	15

Part-2 **- 3 Hours per week**

Coding: -Medium Level problem solving techniques:
Permutations and Combination, Probability, Hash Tables, Heap, Greedy Method, Backtracking

Scheme of Evaluation

Internal Assessments by Assignments, Quizzes (multiple Choice questions). All the Students are expected to do at least 5 problems in each topic and they should submit the content written by them in each topic for final evaluation.

Type of Assessment	No.of Marks
At least 5 problems in each topic	15
Assignments	15
Content writing	10
Quizzes	10
Total	**50**

Late Work

Each homework is due in the beginning of the class meeting (that is, at 6:00pm) on the due date. If homework is submitted within seven days after this deadline, the grade will be reduced by 50%. Submission more than seven days after the deadline will not be accepted. If you have a serious reason for requesting an extension, such as illness or family emergency, you should discuss it with one of the instructors as soon as the problem arises, and definitely before the submission deadline.

References:-

The course does *not* have a required textbook. You may optionally use the following textbook and URLs to look up standard algorithms:

1. Data Structures and Algorithms made easy by Narasimha Karumanchi
2. Data Structure and Algorithmic Thinking with Python by Narasimha Karumanchi
3. Algorithm Design Techniques: Recursion, Backtracking, Greedy, Divide and Conquer and Dynamic Programming by Narasimha Karumanchi
4. Coding Interview Questions by Narasimha Karumanchi
5. Competitive Programming in Python- 128 Algorithms to develop your Coding Skills by Cristhop Durr & Jill-Jen Vie.
6. Guide to Competitive Programming: Learning and Improving Algorithms Through Contests (Undergraduate Topics in Computer Science) *by* Antti Laaksonen
7. https://www.geeksforgeeks.org/competitive-programming-a-complete-guide/
8. https://www.codechef.com/certification/data-structures-and-algorithms/prepare
9. https://codeforces.com/
10. https://leetcode.com/