BMS COLLEGE OF ENGINEERING BENGALURU
AUTONOMOUS COLLEGE UNDER VTU

Department of Electronics & communication Engineering

BMS College of Engineering, Bangalore

Scheme and Syllabus: III and IV Semester

Academic Year: 2015- 2016

BMS COLLEGE OF ENGINEERING BENGALURU
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BMS COLLEGE OF ENGINEERING, BENGALURU	
VISION	**MISSION**
PROMOTING PROSPERITY OF MANKIND BY AUGMENTING HUMAN RESOURCE CAPITAL THROUGH QUALITY TECHNICAL EDUCATION & TRAINING	ACCOMPLISH EXCELLENCE IN THE FIELD OF TECHNICAL EDUCATION THROUGH EDUCATION, RESEARCH AND SERVICE NEEDS OF SOCIETY

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AY	Academic Year
AAT	Alternate Assessment Tools
BOE	Board of Examiners
BOS	Board of Studies
CBCS	Choice Based Credit System
CGPA	Cumulative Grade Point Average
CIE	Continuous Internal Evaluation
CO	Course Outcome
DC	Department Core Course
GC	Group Core Course
HSS	Humanities and Social Science Course
IC	Institute Core Course
IE	Institute Elective Course
LTPS	Lecture-Tutorial-Practical-Self-Study
NFTE	Not Fit for Technical Education
PCC	Professional Core Course
PEO	Program Educational Objective
PO	Program Outcome
SEE	Semester End Examination
SGPA	Semester Grade Point Average
ST	Studio
EC	Electronics and Communication Engineering

BMS COLLEGE OF ENGINEERING BENGALURU

AUTONOMOUS COLLEGE UNDER VTU

ACADEMIC REGULATIONS

(Amended in June 2015; Applicable for all Autonomous batches)

1. SHORT TITLE AND COMMENCEMENT

1.1 The regulations listed under this head are common for all degree level undergraduate programmes (both B.E. and B.Arch.) offered.

1.2 The regulations are subject to amendments as may be made by the Academic Council of the college from time to time, keeping the recommendations of the Board of Studies in view. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme, as may be decided by the Academic Council.

2. DEFINITIONS

(a) "University" means Visvesvaraya Technological University (VTU)
(b) "College" means BMS College of Engineering (BMSCE)
(c) "Commission" means University Grants Commission (UGC)
(d) "Council" means All India Council for Technical Education (AICTE)
(e) "COA" means Council of Architecture
(f) "Statute" means VTU Autonomous College Statute, 2006
(g) "Academic Autonomy" means freedom granted by the University to the College in all aspects of conducting its academic programmes for promoting academic excellence
(h) "Autonomous College" means a college notified as an autonomous college as per the VTU Autonomous College Statute, 2006
(i) "Regular Students" means students who are admitted to B.E. or B.Arch. Programmes after PUC (10+2) or equivalent
(j) "Lateral Entry" means students who are admitted to the third semester Engineering (second year) programme after completing Diploma Course in the respective discipline
(k) "Branch" means specialization in a programme like B.E. degree programme in Civil Engineering or B.E. degree programme in Computer Science and Engineering or B.Arch. degree programme in Architecture etc.
(l) "Course" means a subject either theory or practical identified by its title and code number. *For example, Engineering Mathematics-I is a course offered in the first semester & its code is 14MA1ICMAT.*

3. NOMENCLATURE OF ACADEMIC PROGRAMMES

3.1 The nomenclature and the corresponding abbreviations shown below, shall continue to be used for the degree programmes under the University, as required by the Commission, Council and COA:

(i) Bachelor of Engineering (B.E.)
(ii) Bachelor of Architecture (B. Arch.)

Besides, the branch / programme of specialization, if any, shall be indicated in brackets after the abbreviation.

For example, engineering degree in Mechanical Engineering programme is abbreviated as B.E. (Mechanical Engineering).

3.2 Undergraduate degree programmes offered by the College:

SNo	Title of the UG programme	Abbreviation
1	Civil Engineering	CV
2	Mechanical Engineering	ME
3	Electrical and Electronics Engineering	EE
4	Electronics and Communication Engineering	EC
5	Industrial Engineering and Management	IM
6	Computer Science and Engineering	CS
7	Telecommunication Engineering	TE
8	Information Science and Engineering	IS
9	Electronics & Instrumentation Engineering*	EI
10	Medical Electronics	ML
11	Chemical Engineering	CH
12	Biotechnology	BT
13	Architecture	AT

**Earlier titled and offered as Instrumentation Technology*

4. DURATION OF THE ACADEMIC PROGRAMMES

As a flexible credit system is followed, it is to be noted that the programme duration shall be dictated by the period in which a student earns the prescribed credits for the award of degree. Hence, it is possible for an outstanding student to qualify for the award of degree in a shorter time than that of the duration specified for the concerned programme.

4.1. Normal Duration

4.1.1 The duration of an academic programme shall be four years for B.E. programme

4.1.2 The duration of an academic programme shall be three years for B.E. lateral entry programme

4.1.3 The duration of an academic programme shall be five years for B.Arch. Programme

4.2. Maximum Duration

4.2.1 The maximum period which a student can take to complete a full time academic programme shall be twice the normal duration of the programme, i.e., eight years for B.E., ten years for B.Arch. and six years for lateral entry (diploma students).

4.2.2 The maximum period for a programme shall also be dictated by the fact that a student has to demonstrate the prescribed minimum academic performance by registering for the prescribed minimum number of credits in every semester, for continuing with the programme. This period can be equal to or lesser than the maximum period indicated as in 4.2.1.

4.3 Admission of Students

4.3.1 The admission of students to various UG degree programmes listed under Section 3.1 & 3.2, shall be made by following the State Government and/or University Policies/Practices.

4.3.2 The candidates with a diploma or any other equivalent qualification approved by the Council and the Commission are eligible to join the degree programmes at the beginning of the second year (third semester), as per the prevailing practice in the University (Lateral Entry).

4.3.3 The students can migrate from one branch or specialization to another branch or specialization in the same College or at another Autonomous/ Affiliated College under the University at the beginning of the second year (third semester) following the AICTE/COA/VTU/State Government norms in vogue and as amended from time to time.

4.3.4 The eligibility criteria for admission of students to UG degree programmes shall be the same as those prescribed by the University from time to time.

4.3.5 The eligibility criteria for admission of students from a non-Autonomous College to an Autonomous College, from one Autonomous College to another Autonomous College and from University Scheme at an Autonomous College to its Autonomous scheme, shall be as fixed by the Academic Council. The eligibility criteria for admission of students from other Universities to an Autonomous College shall be fixed by the Academic Council by getting the individual cases examined through the concerned Board(s) of Studies, after which, the names of eligible candidates (qualifying for admission as per norms laid down by the University from time to time) are recommended to the University for its approval.

4.4. Semester Scheme

The semester scheme is being adopted since it provides several benefits to technical education programmes in contrast to the annual scheme of learning.

4.5 Academic Calendar

An academic year consists of two regular semesters and a fast track semester; the details of which are shown in Table 1.

Table 1: A TYPICAL SCHEDULE OF ACADEMIC YEAR

SNo	Activity	Description	
1	Number of semesters in an academic year	Two regular semesters (Odd & Even) and a Fast Track Semester	
2	Duration of Regular Semester	19 weeks	
3	Duration of Fast Track Semester	08 weeks	
4	Academic activities (duration in weeks)	Regular Semester(s)	Fast Track Semester
	Course Registration	0.5	0.1
	Course Work	15.5	7.0
	Examination preparation	1.0	0.2
	Examination (SEE)	1.0	0.2
	Declaration of Results	1.0	0.5
5	Evaluation	Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), both have equal weightage in the student's performance in Course/Laboratory Work and other activities	
6	Other Items	The total number of working days in an academic year shall be ~ 180	
		Academic schedules prescribed by the College shall be strictly adhered to by all the concerned	
		Students failing in any Course(s) shall register for the same again (re-register) and shall secure CIE and SEE afresh in each course(s). This shall continue until a pass grade is obtained in the said course(s).	
7	Fast Track Semester	Fast Track Semester (*refer Regulation-12.8*) conducted for the benefit of the students to clear their failed courses, if any.	

5. PROCTOR SYSTEM

5.1 Introduction

The faculty advisory system (Proctoring system) is to help the students to complete their studies successfully & comfortably. A faculty is called as proctor and the student as proctee

5.2 Objective(s):

5.2.1 To advice the students in their academic requirements
5.2.2 To guide/mentor the students appropriately from time to time
5.2.3 To provide supportive care to the students from time to time

5.3. Role & Responsibilities:

5.3.1 The proctor shall pay complete attention in respect of the student who fails to satisfy minimum attendance (85%) in all courses & internal marks (50%) in each of the laboratories, drawings and workshops etc as per the regulations.

5.3.2 The proctor shall get their copy of proctor diary updated and ensure that student proctor diary is also completed in all respects from time to time.

5.3.3 The proctor shall arrange for a meeting with the students at least twice in a month and submit the proceedings to the concerned HOD.

5.3.4 The proctor shall invite the parent for discussion at least once in every semester to update the academic progress of their ward.

5.3.5 The Proctor should arrange to send the progress reports to the parent furnishing the details of attendance, class marks, examination results, etc. These reports shall be sent twice in a semester (preferably after the conduction of Test1 & Test2) to the parents/guardians of all the concerned students.

5.3.6 Proctor shall ensure that the students should not partake in any sort of ragging activity in & outside of the campus/hostel and they shall not indulge in any anti-social activities and acts unbecoming of a student.

5.4 **Expected Outcome:**

Reduce the failure rate, motivate the students & improve the overall performance and quality of the student.

6. CREDIT SYSTEM

6.1 General

6.1.1 The institution follows a Choice Based Credit System (CBCS) from the academic year 2008-09 onwards. The students have an option of choosing from a wide range of electives (department, cluster and institutional) and complete the programme at their own pace. Value added courses are also offered as a part of extended learning in inter-disciplinary and multi-disciplinary domains. Thus the CBCS facilities continuous learning and assessment.

Credit System has many advantages over the conventional system of organizing academic programmes; in particular the CBCS for the various programmes will provide a great opportunity to the students in their preparation to meet the challenging opportunities ahead.

6.1.2 In the Credit System, the course work of students is unitized and one credit is assigned to each unit after a student completes the teaching-learning process as prescribed for that unit (credit) and is successful in its assessment.

6.1.3 **Credit Definition**

One unit of course work is assigned one credit in the regular semester (odd/even) for:

a) Theory Course conducted for one hour/week/semester
b) Tutorials and Practical classes (Laboratory Courses) conducted for Two hours/Week/Semester
c) Self-Study in a Course, for four hours/week/semester

However, in case of fast track semester, the Course load is multiplied by two. These guidelines form the basis to fix semester course load & weekly contact hours in the regular/ fast track semesters.

Note: Other student activities like practical training (except in B.Arch. Programme), study tours, industrial visits, guest lectures shall not carry any credits.

6.1.4 **Course Registration**

A student shall register for the courses to earn credits for meeting the requirements of the degree programme. Such courses together with their grades and the credits earned will be included in the Grade Card issued by the College at the end of each semester and it forms the basis for determining the student's academic performance in that semester.

6.1.5 **Audit/Value Added Courses**

In addition, a student can register for courses such as value added courses for audit only with a view to supplement his/her knowledge and/or skills. But, these shall not be taken into account in determining the students' academic performance in the semester.

6.2 Credit Structure

6.2.1 A typical Credit Structure for course work (hrs/wk/sem) in B.E. Programme is shown in Table 2:

Table- 2

Course	Credits					Hours					Total Contact Hours
	L	T	P	S	Tot	L	T	P	S	Tot	
ABC	3	1	0	1	5	3	2	0	4	9	5
PQR	2	0	1	1	4	2	0	2	4	8	4
XYZ	3	1	0	2	6	3	2	0	8	13	5

7 Course Load in regular semester(s):

7.1 The course load is fixed at 25 credits per semester from the academic year 2015-16.

7.2 In the first two semesters, a prescribed course load per semester is mandated. Withdrawal/dropping of courses in the first year (first two semesters) is not allowed.

7.3 In higher semesters, the applicable course load per semester may vary from a minimum of 20 credits to a maximum of 30 credits. The variation in credits depends on CGPA in the previous semesters. This flexibility enables students (from 3rd semester onwards) to cope-up with the course work and helps in improving their academic performance and optimizes the learning outcome.

7.4 As mentioned in the Rule 7.3, the students can register for more number of credits i.e. > 25 and ≤ 30 (from 3rd semester onwards). This provision is provided based on the CGPA, proctors advice and is subject to satisfying the following conditions:

a) The student has secured a CGPA ≥ 8.5
b) The student doesn't have more than two backlogs from the previous semesters
c) The student shall ensure that there is no overlapping in time-table for the period and obtain concurrence from the Proctor.
d) The student shall submit a copy of documentary evidence in respect of the above (a,b,c) while seeking approval from the concerned HOD.

7.6 The total number of credits required to be earned by a student to qualify for the award of the degree in respect of Engineering (both regular and lateral entry) & Architecture is as shown in the following table:

Programme	Normal Duration		Total number of credits to be earned
	Years	Semester	
B.E.	4	8	200
B.E. (Lateral Entry)	3	6	150
B.Arch.	5	10	250

8. Course load in Fast Track Semester:

The Fast Track semester is provided for helping students who have failed in their examinations. The Fast Track semester is provided to help the student to avoid losing an academic year. The department/college may offer some courses based on the availability of resources in hand.

It is the discretion of the department/College whether to offer the fast track semester or not. Fast Track semester is a special semester and the student cannot demand it as a matter of right.

The student has to pay a special fee prescribed by the College to register for a course in the Fast Track semester.

8.1 Course Load:

A student is permitted to register for a maximum of **16 credits and 40 contact hours** or less per week. All courses are not offered. A student has to opt from those courses offered by the department in a given Fast Track Semester.

8.1.1. Course load for Architecture Students

With regard to B.Arch. programme, during the Fast Track semester, a student is permitted to register for one Architectural Design course (I to VII semester) only and shall not be permitted to register for any other course. However, in case students don't register for Architectural Design course, they can register for other courses subject to a maximum of 16 credits and 40 contact hours per week.

Note: The "Architectural Design Project" course will not to be offered during Fast Track Semester.

9 Curriculum Framework

9.1 Contact Hours: The maximum number of contact hours for the students is to be set at 35 hrs/week. This will be of help to students in getting enough time and opportunity to develop their creative talents and abilities, benefitting from Add-On courses and also those taken for audit, in addition to the ones prescribed for credit under a Programme and preparing them for challenging and exciting careers ahead.

9.2 Curriculum framework is important in setting the right direction for a degree programme, as it takes into account the type and quantum of knowledge necessary to be acquired by a student to qualify for award of a particular degree in his/her chosen branch or subject area.

9.3 Besides, this also helps in assigning the credits for each course, sequencing the courses semester-wise and finally arriving at the total number of courses to be studied and the total number of credits to be earned by a student to fulfill the requirements for a particular conferment.

9.4 B.E. Degree Programme

Table-4 shows a typical Curriculum framework for B.E. degree programme:

Table-4

SNo	Subject Area	Average No. of Credits
1	Basic Science Core courses	30
2	Engineering Science	30
3	Humanities & Social Science courses	10
4	Professional Core courses	80
5	Professional Elective courses	30
6	Major Project / Seminar, etc.	20
	Total	**200**

9.5 B.Arch. Degree Programme

Table-5 shows a typical Curriculum framework for B.Arch. degree programme:

Table-5

SNo	Subject Area	Average No. of Credits
1	Humanities and Social Science courses	04
2	Professional Core courses	176
3	Professional Elective courses	04
4	Departmental/Programme Major project	18
5	Professional Training	48
	Total	**250**

10 Mandatory Courses for B.E. programme

The UG degree programmes also require the inclusion of certain courses like proficiency in a language, Constitution of India, bridge courses and additional courses suggested by respective BOS for the completion of programme as mandatory courses. Mandatory courses will not carry any credits; but, a pass in each such course after attaining required CIE or SEE requirements during the programme shall be a necessary requirement for the student to qualify for the award of Degree.

10.1 Mandatory Courses for the students admitted under lateral entry

10.1.1 The student shall compulsorily pass two bridge courses in Mathematics (one in 3rd and one in 4th semester);

10.1.2 The student must clear the bridge courses before advancing to the 7th semester of the programme.

10.1.3 The student shall pass the following non-credit mandatory/HSS courses for the award of the degree.

Table-6: Mandatory and HSS Courses for lateral entry

Mandatory Courses	HSS Courses
Functional English Kannada Language	Constitution of India and Professional Ethics Environmental Studies Personality Development and Communication

10.2 Mandatory Courses for B. Arch. programme

The B.Arch. programme requires the inclusion of courses like Kannada language, Study tour/vacation assignment and Constitution Law suggested by respective BOS for the completion of B.Arch. programme as mandatory courses. These courses will not carry any credits; but, a pass in each such course after attaining required CIE or SEE requirements during the programme shall be a necessary requirement for the student to qualify for the award of Degree.

11 ASSESSMENT

The College has effective examination and assessment system for each activity.

11.1 Achievement Testing

11.1.1 The assessment of student's performance during and/or at the conclusion of a programme has to be done using examinations. In general, an examination may have different objectives, like achievement testing, prediction testing, endurance testing, testing of creativity and testing for ranking.

11.1.2 Typically achievement testing is done in two parts as follows:

a) **Sessional:** Involving **Continuous Internal Evaluation (CIE)**, to be conducted by the subject teacher all through the semester; and, to include mid-term tests, weekly/fortnightly class tests, homework assignments, problem solving, group discussions, quiz, seminar, mini- project and other means.

b) **Terminal:** Covering **Semester End Examination (SEE)**, to be conducted by the subject teacher jointly with an external examiner at the end of a semester, on dates to be fixed at the College level; and to include a written examination for theory courses and practical/design examination with built-in oral part for laboratory/design courses.

c) Both CIE and SEE have equal (50:50) weightage. Student's performance in a course shall be judged by taking into account the results of CIE and SEE individually and also together.

11.2 Question Papers

11.2.1 **Achievement Testing:** For an effective achievement testing of the students in a course, a good question paper needs to be used as the principle tool. This makes it necessary for the question papers used at CIE and SEE to:

- Cover all sections of the course syllabus uniformly;
- Be unambiguous and free from any defects/errors;
- Emphasize knowledge testing, problem solving & quantitative methods;
- Contain adequate data / other information on the problems assigned;
- Have clear and complete instructions to the candidates.

11.2.2 **Question Paper Planning:** Question Paper to cover the entire syllabus, with a provision for the students to answer questions from the full syllabus. As students need to be given some choice in the questions included in the Paper, it is preferred for the Question Papers at SEE, in particular, to have built in choice. This factor shall be taken note of by the Board of Examiners (BOE), while planning for the Question Papers.

11.2.3 Besides, it is also necessary for the course syllabi to be well drafted, be defect-free and be properly unitized (or modularized) to enable the setting of good question papers covering the whole syllabus. These aspects have to be taken into account, in particular, by the Board of Studies (BOS).

11.2.4 Typical Question Paper: The questions to be included in the Question Papers at CIE and SEE can be of two types as follows and the subject teachers as well as the external examiners shall have to be well trained to set them:

(i) Multiple Choice questions, having each question to be answered by tick marking the correct answer from the choices (commonly four) given against it; such a question paper to be useful in the testing of knowledge, skills, comprehension, application, analysis, synthesis, evaluation and understanding of the students; however, Question Papers for CIE and SEE to include no more than 15-20% of the questions of this type.

(ii) Comprehensive questions that have to be answered in detail. Such a question paper to be useful in the testing of overall achievement and maturity of the students in a subject, through long questions relating to theoretical / practical knowledge, derivations, problem solving, application and quantitative evaluation.

11.3 Examinations/Assessment

11.3.1 **Continuous Internal Evaluation (CIE):** The CIE shall be conducted exclusively by the faculty handling the Course. The Course teacher/instructor to spell out the components (test, quiz, assignment etc.) of CIE and its assessment (type, pattern, rubrics etc.) to students well in advance, maintain transparency in its operation, announce the evaluation results in time; also the faculty is expected to solve questions from the test papers during the class/tutorials for the benefit of students.

11.3.2 Types of Courses:

There are three types of courses – Regular/normal, integrated and Comprehensive

1. Regular/normal Courses are those courses which have either a theory or a practical component
2. Integrated Courses are those which have both theory and practical components
3. Comprehensive Courses are those courses which have all the three components namely theory, practical and self-study

11.3.3 Alternative Assessment:

The faculty members have been provided with freedom to use innovative methods while delivering the course and design own method of internal evaluation (CIE) i.e., assessing the outcomes which are indicators of students learning. This is known as application of **Alternative Assessment Tool (AAT).** The AATs enhance autonomy of individual faculty and enables creation of innovative pedagogical practices. If properly applied, the AATs convert the classroom into an effective learning space. The various AATs are seminar, assignments, term paper, open ended experiments, mini-projects, two minute videos, MOOCs etc.

The AATs have been given a maximum weightage of 40% (approved in the 9th ACM).

It is however mandated for a faculty to obtain prior permission from the concerned HOD for implementing AAT; and mandated to announce the same in the respective class before the commencement of a course.

11.3.4 CIE assessment patterns for various courses with 20% weightage for AAT.

11.3.4.1 Assessment pattern for Regular/Normal courses:

The weightages of various components of CIE for **regular/normal courses** considering weightage of **20% to Quiz/AAT** i.e. 10 out of 50 marks are shown in table-7.

Table-7

Component	Test-1	Test-2	Quiz-1 or AAT	Quiz-2 or AAT	Total Marks
Max. Marks	40	40	10	10	100
Reduced-CIE	20	20	5	5	50

11.3.4.2 Assessment pattern for Integrated Courses:

The weightages of various components of CIE for integrated courses considering weightage of **20% to Quiz/AAT** i.e. 10 out of 50 marks are shown in table-8.

Table-8

Component	Theory (50%)			Practical (50%)			Total Marks
	Test-1	Test-2	Quiz/ AAT	Records& Performance	Lab Test	Viva-voce/AAT	
Max. Marks	20	20	10	20	20	10	100
Reduced-CIE	10	10	05	10	10	5	50

11.3.4.3 Assessment pattern for Comprehensive Courses:

The weightages of various components of CIE for comprehensive courses considering weightage of **20% to Quiz/AAT** i.e. 10 out of 50 marks are shown in table-9.

Table-9

Component	Theory (50%)			Practical (30%)		Self-Study (20%) /AAT	Total Marks
	Test-1	Test-2	Quiz	Lab Performance/ Record	Lab Test		
Maximum Marks	20	20	10	20	10	20	100
Reduced CIE marks	10	10	5	10	5	10	50

11.3.5 CIE assessment pattern using AAT with more than 20% weightage, but limited to, 40%.

A faculty who wishes to design AAT with more than 20% weightage, shall create a new pattern for assessment indicating weightages for all the three components. The assessment pattern shown above need not be used. Hence, it is mandated that a faculty shall submit a detailed assessment pattern and obtain prior approval (preferably one week before the commencement of classes), from the concerned HOD/BOS Chairperson.

11.3.6 **The CIE for certain courses in B.Arch.** can also contain assessment through Reviews/Assignments/Portfolios submission that will be predefined by the course coordinator.

Note: Students must secure a minimum of 40% in CIE and should have 85% attendance.

In case of integrated and comprehensive courses, a student must secure a minimum of 40% marks and 85% attendance in both theory and practical components. In addition, the overall CIE marks including theory, practical and self-study components shall not be less than 40%.

11.4. Semester End Examination (SEE): The SEE shall be conducted jointly by the subject teacher and an external examiner appointed for this purpose by the College. Here, the external examiner to mainly associate with the work of Question Paper setting, because of the difficulties in having him/her for conducting the evaluation of student's answer scripts due to the tight time schedule for the various tasks connected with SEE.

11.4.1 SEE Answer Scripts: The answer scripts of SEE are evaluated first by the course instructor/teacher; before declaring the results, to include a second evaluation or an external review of SEE conducted. A committee of the College may oversee and ensure the quality and standard of evaluation and of the grades awarded in all the cases;

11.4.2 External Review of SEE: An external review shall be conducted under the aegis of the Board of Examiners (BOE) of the College by appointing a panel of subject experts from outside the College for this purpose and aiming at totality in the review of SEE operation and covering such steps as, question paper review, checking random samples of answer scripts, analysis of results/grades awarded, etc. This step is necessary for gaining the confidence of the University and also of the society at large, on the fairness and transparency in the system.

11.5 Passing Standards: High standards are maintained in all aspects of the examination. The absolute grading method is followed. The minimum standard of passing in respect of CIE and SEE for each course is shown in Table-10.

Table-10: Passing Standards using **Absolute Grading**

Evaluation Method	Passing Standard
Sessional (CIE)	Score: ≥40%
Terminal (SEE)	Score: ≥40%

11.6 Project work Evaluation: The evaluation of **CIE** of the project work shall be based on the progress of the student in the work assigned by the project supervisor/guide, periodically evaluated by him/her together with a Departmental Committee constituted for this purpose.

A seminar presentation, submission of project report and final oral examination conducted by a common Project Evaluation Committee at the College level shall form the **SEE** of the project work.

11.7 There shall be **NO RE-EXAMINATION** for any Course in the credit system to take care of such students who have:

a) Absented themselves from attending CIE or SEE; without valid reasons; or,
b) Failed (Grade F, as covered in Section 9) to meet the minimum passing standards prescribed for CIE and/or SEE; or,
c) Been detained for want of attendance; or,
d) Withdrawn (Grade W, as covered in Section 9.) from a Course;

Such students listed above (a – d), shall be required to re-register for the Course(s) and go through CIE and SEE again and obtain a Grade equal to or better than E (refer Section 9) in each case. While such students shall have to re-register for the same Course(s) if hard core (core courses), they can re-register for alternative Course(s) from among the soft core (elective courses), as the case may be. The re-registration shall be possible when the particular course is offered in regular semesters.

11.8 Successive Failures: A student who has not been able to obtain eligibility for third semester even after **three academic years** will be declared as Not Fit for Technical Education [NFTE]. However, such a student can re-join B.E./B.Arch. Programme in the College as a fresh student to the First Year.

12. ATTENDANCE REQUIREMENT

12.1 All students shall maintain a minimum attendance of 85% in each course registered. In case of shortfall, the concerned Head of the Department shall consider and may condone deficiency up to a limit of 10% in special cases. The relevant documents pertaining to condonation of attendance shall be maintained by the respective departmental head and produced as and when required by the head of the institution. Any student failing to meet the above standard of attendance in any course(s) registered, shall not be allowed to appear for SEE of such course(s).

12.2 In the event of condonation, the students whose attendance is condoned are not eligible for make-up examination in that course during the semester.

12.3 Attendance at CIE and SEE**:** Attendance at all examinations, both CIE and SEE of each course registered shall be compulsory for the students and there shall not be any provision for re-examination/consideration.

12.4 Any student against whom any disciplinary action by the College is pending shall not be permitted to attend any SEE in that Semester.

12.5 Each Semester is considered as a unit and the candidate has to put in a minimum attendance of 85% in each course with a provision of condonation of 10% attendance for reasons such as medical emergencies and legitimate grounds.

12.6 The basis for the calculation of the attendance shall be the period prescribed by the College by its calendar of events. For the first semester students, the same is reckoned from the date of admission to the course.

12.7 The students shall take note of his/her attendance status periodically from the respective faculty and strive to make up the shortage. However, the departments shall periodically announce the attendance status of the students. Non-receipt of such information from the college will not be considered as valid reason for exemption from the attendance requirements.

12.8 If a student does not fulfill the attendance requirements in any course, he/she is not permitted to attend the Semester End Examination (SEE) in that course and is deemed to have been awarded "F" grade in that course.

12.9 In respect of Integrated Courses 85% of attendance shall be maintained in theory as well as practical component of the course. Failing to maintain the 85% attendance in any one component, the student will not be permitted to take up SEE in that course.

13. GRADING

General

13.1 As in recent years, the grading system has replaced the evaluation of student's performance in a Course based on absolute marks. This is to ensure uniformity in the grading practice at different autonomous colleges to facilitate the migration of students or transfer of credits among Autonomous Colleges under the University.

13.2 Letter Grades: A letter grade is basically a qualitative measure (an alphabet/letter) giving the performance of a student, such as, Outstanding (S), Excellent (A), Very Good (B), Good (C), Average (D), Poor (E) and Unsatisfactory/Fail (F), based on the raw score (marks, as in conventional practice) obtained by the student. This is usually arrived at after the student's performance in a Course, which includes both CIE and SEE, is assessed and raw score (marks) for the total are awarded to begin with, followed by grouping of all the students in a Course under different grading levels, as above.

13.3 Absolute Grading: The College has adopted the absolute grading system.

14.2 Grade Points

14.2.1 Depending on the letter grades assigned, a student earns certain grade points. As the grading system can have different grade points, like 5, 8 and 10, more number of points in the scale, will be necessary to provide a better resolution in the performance assessment.

The Colleges follow the 10-point grading system, as given in the Table-11:

Table-11: Grade Points Scale (Absolute Grading)

Level	Out-standing	Excellent	Very Good	Good	Average	Poor	Fail
Grade	S	A	B	C	D	E	F
Grade Points	10	09	08	07	05	04	00
Score (Marks) Range (%)	≥ 90	≥ 75 - <90	> =60 - < 75	≥50 - < 60	≥ 45 - < 50	≥40 - <45	< 40

14.2.2 The grade points given in above table help in the evaluation of credit points earned by the student in a Course as the credit points are equal to the number of credits assigned to the Course multiplied by the grade points awarded to the student in that Course. This shall be used in arriving at the credit index of the student for that semester, as it is the sum total of all the credit points earned by the student for all the Courses registered in that semester.

14.2.3 Earning of Credit: A student shall be considered to have completed a course successfully and earned the credits if he/she secures an acceptable letter grade in the range S to E. Letter grade 'F' in any Course implies failure of the student in that Course and no *credits* earned.

14.2.4 Transitional Grades: The transitional grades, such as, 'I', 'W' and 'X' shall be awarded to a student in the following cases. These transitional grades shall be converted into any one of the letter grades (S to F) after the student completes his/her Course requirements, including examination.

14.2.4.1 **Grade 'I':** Awarded to a student having satisfactory attendance at classes and meeting the passing standard at CIE in a Course, but remained absent from SEE for valid and convincing reasons acceptable to the College, like:

(i) Accident or severe illness leading to hospitalization, which disabled the student from attending Semester End Examination (SEE);

(ii) A calamity in the family at the time of SEE, which required the student to be away from the College;

(iii) In the event of (i) and (ii) above, it is the responsibility of the student/parent/guardian to inform the college authorities (proctor/HOD) immediately. The information may be in the form of either written communication, personal communication by parent/guardian/peer or an e-mail or mobile message. The candidate needs to submit all the relevant evidences (hospital reports, police reports, certificates from competent authorities, etc.,) prior to attending the college. Intimation is mandatory. Any intimation after the conduct of examination will not be entertained.

14.2.4.2 **Grade 'X':** Awarded to a student having attendance ≥ 85% and CIE rating (≥60%) in a course, but SEE performance observed to be poor, which could result in an overall 'F' Grade in the Course. No 'F' Grade is awarded in this case but student's performance record is maintained separately. The student will be provided an opportunity in the make-up examination; however, the grades ('D' to 'S') will be reduced to the next lower grade and grade 'E' will remain unchanged.

14.2.5 **Grade 'W':** Awarded to a student having satisfactory attendance at classes, but withdrawing from that Course before the prescribed date in a semester under faculty advice; the student shall re-register for the said course in the regular semesters only. All the 'W' grades awarded to the students shall be eligible for conversion to the appropriate letter grades only after the concerned students re- register for these Courses in a main (Odd/Even) semesters only and fulfill the passing standards.

14.2.6 **Grade Card:** Each student shall be issued a Grade Card (or transcript) at the end of each semester. This will have a list of all courses registered by a student in the semester along with the credits. In addition to the letter grades with grade points, the grade card will also contain transitional grades 'I' and 'X' which do not carry any grade points. Hence, only the courses registered for credit and having grade points shall be included in the computation of student's performance i.e., SGPA and CGPA.

However, the Courses taken for audit will not form part of this computation. The results of mandatory courses, which are of the non-credit type, shall also be reflected in the Grade Card as 'PP' (for Passed) or 'NP' (for Not Passed). It may be noted that each UG student shall have to obtain the grade 'PP' in each mandatory course to qualify for award of the Degree by the University.

14.2.7 **Make-up Examination:** The Make-up Examination facility shall be available to students who may have missed to attend the SEE of one or more Courses in a semester for valid reasons and given the 'I' grade; Students having the 'X' grade shall also be eligible to take advantage of this facility. The standard of the Make-up Examination shall be the same as that of regular SEE for the Courses. The Make-up Examination shall be held as per dates notified in the Academic Calendar. However, it will be possible for the Autonomous institution to modify the Academic Calendar with the permission of the Academic Council.

14.2.8 In the event a student fails in a Laboratory course and/or in CIE of a course in final year, the student shall be given 'I' grade. In such a case, the concerned Chairperson of BOE may grant the student extra time not exceeding 12 weeks for completing the course with due concurrence of the faculty and Head of the Department. If no such extra time is sought / granted, the concerned student shall have to re-register for the course(s) in the succeeding regular semester and fulfill the academic requirements for the award of the degree.

14.2.9 All the transitional grades ('I' and 'X') awarded to a student shall have to be converted to an appropriate letter grade after the make-up examination. Any outstanding 'I' and 'X' grades two days after the last scheduled Make-up Examinations shall be automatically converted to 'F' grade.

14.3 Grade Point Averages

14.3.1 **SGPA and CGPA:** The credit index can be used further for calculating the Semester Grade Point Average (SGPA) and the Cumulative Grade Point Average (CGPA), both of which are important performance indices of the student. While SGPA is equal to the credit index for a semester divided by the total number of credits registered by the student in that semester, CGPA gives the sum total of credit indices of all the previous semesters divided by the total number of credits registered in all these semesters. The SGPA and CGPA will be computed as shown below:

Semester Grade Point Average (SGPA)

$$\frac{\Sigma\,[(\text{Course credits}) \times (\text{Grade points})]\ \text{(for all Courses in that semester excluding transitional grades)}}{\Sigma\,[(\text{Course credits})]\ \text{(for all courses in that semester excluding transitional grades)}}$$

Cumulative Grade Point Average (CGPA)

$$\frac{\Sigma\,[(\text{Course credits}) \times (\text{Grade points})]\ \text{(for all Courses excluding those with F \& transitional grades until that semester)}}{\Sigma\,[(\text{Course credits})]\ \text{(for all Courses excluding those with F \& transitional grades until that semester)}}$$

Both SGPA and CGPA facilitate the declaration of academic performance of a student, at the end of a semester and at the end of successive semesters respectively. Both SGPA and CGPA shall be normally calculated up to the second decimal position, so that the CGPA, in particular, can be made use of in ranking the students in a class. If two students get the same CGPA, the tie should be resolved by considering the number of times a student has obtained higher SGPA; but, if it is not resolved even at this stage, the number of times a student has obtained higher grades like S, A, B etc., shall be taken into account in ranking the students in a class.

14.3.2 **An illustrative Example:** An illustrative example given in Table-11 below indicates the use of the above two equations in calculating SGPA& CGPA:

Table-12: Typical example - Calculation of SGPA/CGPA

Semester (Odd:I) (Even:II)	Course No.	Credits	Grade	Grade Points	Credit Points	SGPA	CGPA
I	AA 101	5:0:0	B	8	40		
I	AA 102	3:2:0	W	-	--		
I	AA 103	3:0:0	A	9	27		
I	AA 104	0:1:1	F	0	00		
I	AA 105	4:1:0	D	5	25		
I	AA 106	5:0:0	E	4	20		
Total		20 (18*)			112	5.60 (112/20)	5.60 (112/20)
II	BB 107	3:1:1	C	7	35		
II	BB 108	4:0:0	B	8	32		
II	BB 109	3:0:0	D	5	15		
II	BB 110	4:1:0	E	4	20		
II	BB 111	2:1:1	A	9	36		
II	BB 112	2:0:0	F	0	00		
II	BB 113	0:2:0	B	8	16		
Total		25 (23*)			154	6.16 (154/25)	6.48 (266/41)
Fast Track	XX 102	3:2:0	D	5	25		
Fast Track	XX 104	0:1:1	C	7	14		
Fast Track	XX 112	2:0:0	D	5	10		
Total		9			49	5.44 (49/9)	6.30 (315/50)

*Total No. of credits excluding those with 'F' and transitional grades; this is particularly important to keep track of the number of credits earned by a student up to any semester.

14.3.3 **Vertical Progression:** Minimum standards for SGPA and CGPA together with the minimum number of credits are laid down for the vertical progression of students. This facilitates the mobility of students from one College to another and also avoids confusion among the students. The vertical progression of students is applied between two academic years only.

The following are the prescribed standards for vertical progression:

a) Minimum Standard for SGPA =5.0
b) Minimum Standard for CGPA =5.0 (at the end of each academic year)
c) Maximum Number of 'F' Grades that can be carried at the end of any academic year is four only
d) The maximum number of withdrawals at any given time shall not exceed two courses subjected to maintaining the minimum registration requirements

However, failure to secure a minimum CGPA = 5.0 at the end of any semester for the first time, shall **attract a warning** before allowing the student to continue in the next semester.

14.3.4 Award of Class: The class will be awarded after students earn a total of 200 credits. The Table-13 shows the conversion of CGPA into percentage of marks and the award of class thereon.

Table-13

Range of Grade Point Average (SGPA or CGPA)	Percentage of Marks	Class
≥ 5.75 and < 6.75	≥ 50 and < 60	Second Class
≥ 6.75 and < 7.75	≥ 60 and < 70	First Class
≥ 7.75	≥ 70	First Class with Distinction

For a given SGPA or CGPA, the percentage of marks can be computed using the following formula: % MARKS SCORED = [CGPA - 0.75] x 10

Table-14

CGPA	% Marks		CGPA	% Marks
5.25	45.0		7.75	70.0
5.50	47.5		8.00	72.5
5.75	50.0		8.25	75.0
6.00	52.5		8.50	77.5
6.25	55.0		8.75	80.0
6.50	57.5		9.00	82.5
6.75	60.0		9.25	85.0
7.00	62.5		9.50	87.5
7.25	65.0		9.75	90.0
7.50	67.5		10.00	≥ 92.5

15. Other Academic Matters

Time Schedules

15.1 **Academic Schedules:** An Academic Calendar is published before the commencement of every academic year to assist the students and faculty. The calendar includes, dates for registration of courses, dropping of courses and withdrawal from courses. This enables the students to be well prepared, minimize their chances of failure in CIE and / or SEE and take full advantage of the flexibility provided by the credit system.

15.2 **Registration of Courses:** Each student shall have to register for course work at the beginning of a semester. The student has to compulsorily register for all the stipulated credits in the first year of the programme. In the subsequent years (higher semesters i.e., third semester onwards) the registrations shall be within the limits of minimum (≥20) and maximum (≤30) credits. A period of 2-3 days is assigned for this event to facilitate the students to seek faculty advice and discuss with the proctor/faculty prior to registering for courses.

15.3 **Dropping of Courses:** A specific period in the middle of a semester is fixed for this purpose and to help review the student's performance in CIE by the faculty advisors (proctors). The students having poor performance are facilitated to drop the identified course(s) (up to the minimum credits specified for the semester) in the higher semesters only (i.e., third semester onwards) without being mentioned in the Grade Card. Such Courses to be re-registered by these students in the regular semesters at a later time.

15.4 **Withdrawal from Courses:** A specific period is identified towards the end of a semester to help review the students' performance in CIE by the Proctor who shall advise the students having poor performance to withdraw from identified course(s) (up to the minimum credits specified for the semester) with mention in the Grade Card (Grade 'W'). Such Courses to be re-registered by these students in the main/regular semesters at a later time.

When to withdraw?: A student is allowed to withdraw from a Course(s) after one week from the last date of the second internal test (CIE) or as mentioned in the Academic Calendar.
Separate circular/notification shall not be issued in this regard. It is the responsibility of the student to withdraw from the courses with in the stipulated time failing which student will have to continue with the course and fulfill the academic requirements.

15.5 Temporary withdrawal from programme:

15.5.1 A student may withdraw temporarily from the programme on grounds like, prolonged illness, grave calamity in the family or any other serious happening. The withdrawal shall be for periods which are integral multiples of a semester, provided that:

- the student applies to the College within 6 weeks of the commencement of the semester or from the date he/she last attended the classes, whichever is later, stating fully the reasons for such a withdrawal, together with supporting documents and endorsement of his/her parent/guardian.

- The College is satisfied of the genuineness of the case and that, even by taking into account the expected period of withdrawal, the student has the possibility to complete the programme requirements within the time limits specified by the University.
- The student does not have any dues or demands at the College/University including tuition and other fees as well as library material.

15.5.2 A student availing of temporary withdrawal from the College under the above provision shall be required to pay such fees and/or charges as may be fixed by the College until such time as his/her name appears on the Students' Roll List. **However, it may be noted that the fees/charges once paid shall not be refunded**.

15.5.3 Normally, a student will be entitled to avail **the temporary withdrawal facility only once during his/her studentship of the programme**. However, any other concession for the concerned student shall have to be approved by the Academic Council of the College. Hence, the students shall be advised by the Principal to use this provision only in exceptional cases.

15.6 Termination from the Programme

A student shall be required to withdraw from the programme and leave the College on the following grounds:

15.6.1 Failure (getting 'F' Grade) and not passing a Course to earn credits for the same, in-spite of **five attempts**.

15.6.2 Failure to secure a CGPA ≥ 5.00 on **three** consecutive occasions to lead the student being asked to discontinue the programme and leave the College (However, failure to secure a CGPA ≥ 5.00 at the end of any semester for the first time, to attract warning before approval of the student to continue in the following semester).

15.6.3 Absence from classes for more than **one regular semester** at a time **without leave of absence** being granted by competent authorities.

15.6.4 Failure to meet the **standards of discipline** as prescribed by the College from time to time;

15.7 Student's Feedback

15.7.1 The college obtains feedback from students on their course work and various academic activities conducted. The feedback is obtained on-line from the students at regular intervals maintaining confidentiality.

15.7.2 The feedback received from the students is reviewed/discussed by a committee constituted for the purpose and necessary corrective measures are taken.

15.8 Graduation Ceremony

15.8.1 The College conducts annual Graduation Day ceremony for the award of Degrees to students completing the prescribed academic requirements. The Graduation Day is conducted after the University Convocation.

15.8.2 The College awards Ranks and Medals to the meritorious students during the Graduation Day Ceremony to encourage the students to strive for excellence.

16. Interpretation

Any question as to the interpretation of these rules and regulations shall be decided by the College, whose decision shall be final and binding on the student in the matter. The College shall also have the power to issue clarifications to remove any doubt, difficulty or anomaly, which may arise in regard to the implementation of these regulations.

:: NOTE ::

These rules and regulations may be altered/changed from time to time by the academic council. Failure to read and understand is not an excuse

Department Vision

To emerge as a Centre of Academic Excellence in Electronics, Communication and related domains through Knowledge generation, acquisition and dissemination meeting the global needs and standards

Department Mission

Imparting quality education through state of the art curriculum, conducive learning environment and Research with scope for continuous improvement leading to overall professional Success

Program Educational Objectives

The Program Educational Objectives (PEOs) describe the professional accomplishments of our graduates about three-five years after having completed the under-graduate program in Electronics and communication Engineering.

PEO-1. Graduates will professionally progress in Electronics, Communication and related areas with an inclination towards continuous learning.

PEO-2. Graduates will work in diversified teams of multidisciplinary environment.

PEO-3. Graduates will exhibit good inter-personal skills, adapt themselves for changes in contemporary technology.

Program Outcomes

Program Outcomes (POs), are attributes acquired by the student at the time of graduation. The POs given in the Table below, ensure that the POs are aligned to the Graduate Attributes (GAs) specified by National Board of Accreditation (NBA). These attributes are measured at the time of Graduation, and hence computed every year for the outgoing Batch. The POs are addressed and attained through the Course Outcomes (COs) of various courses of the curriculum.

PO-1	Ability to apply the knowledge of mathematics, science, electronics and communication to conceptualize solutions to complex engineering problems.
PO-2	Ability to Identify, formulate and analyse in Engineering domains using first principles of basic sciences and engineering sciences.
PO-3	Ability to design and realize solutions for complex engineering problems with applicable considerations.
PO-4	Ability to support investigations of Research based knowledge including literature survey, design of experiments, data analysis and data interpretation leading to valid conclusions.
PO-5	Ability to choose modern Engineering tools and resources for Electronics & communication engineering problems and their applications
PO-6	Ability to identify and assess societal, safety and legal issues using contextual knowledge and develop potential to assume consequent responsibilities during engineering practice.
PO-7	Ability to recognize the impact of electronics and communication engineering domain in societal and environmental contexts and demonstrate knowledge of and need for sustainable development.
PO-8	Ability to apply ethical principles and practice professional ethics.
PO-9	Ability to function effectively either as an individual or as a member/leader within diversified and multidisciplinary teams.
PO-10	Ability to communicate on engineering activities understandably, among stake holders and society at large through effective reports, design documentation and effective presentations.
PO-11	Ability to identify and engage in self-learning in the context of technological changes.
PO-12	Ability to demonstrate the knowledge of and apply project management principles to manage projects in multidisciplinary environments in team or as an individual.

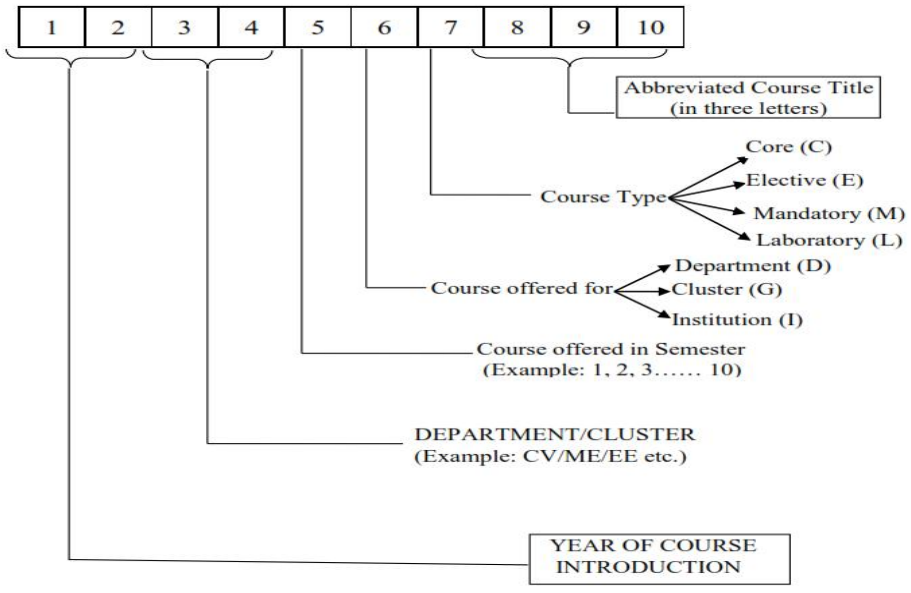
III Semester Scheme

Sl. No.	Course Code	Course Title	Credits				
			L	T	P	S	Total
1	15MA3GCAEM	Advanced Engineering Mathematics	3	1	0	0	4
2	15ES3GCLCA	Linear Circuit Analysis	3	1	0	0	4
3	15ES3GCAMC	Analog Microelectronics	3	0	1	2	6
4	15ES3GCDEC	Digital Electronics	3	0	1	2	6
5	15ES3GCFAW	Fields and Waves	3	1	0	0	4
6	15EC3DLSL1	Simulation Laboratory-1	0	0	1	0	1
Total			**15**	**3**	**3**	**4**	**25**

IV Semester Scheme

Sl. No.	Course Code	Course Title	Credits				
			L	T	P	S	Total
1	15MA4GCDMP	Discrete Mathematics and Probability	3	1	0	0	4
2	15EC4DCHDL	Verilog HDL Programming	3	0	1	0	4
3	15ES4GCAIC	Analog Integrated Circuits	3	0	1	2	6
4	15ES4GCMCS	Microcontrollers	3	0	1	2	6
5	15ES4GCSAS	Signals and Systems	3	1	0	0	4
6	15EC4DCTEW	Technical Writing	0	1	0	0	1
Total			**15**	**3**	**3**	**4**	**25**

NOMENCLATURE FOR THE COURSE CODE



Course Title	ADVANCED ENGINEERING MATHEMATICS (Common to EC, TE, EE, IT, ML)				
Course Code	**15MA3GCAEM**	**Credits**	4	**L-T-P-S**	3:1:0:0
CIE	100 marks (50% weightage)	**SEE**	100 marks (50% weightage)		

Pre-requisites

Trigonometric formulas, methods of differentiation, methods of integration, partial derivatives, matrices, Fourier Series, Fourier Transforms

UNIT I **[9 hours]**

MATRICES

Introduction: Elementary row transformations, Echelon form of a matrix, rank of a matrix by elementary row transformations. Consistency of system of linear equations and solution. Solution of a system of non-homogenous linear algebraic equations: Gauss elimination method, LU decomposition method, Gauss-Seidel method. Eigenvalues and eigenvectors of matrices. Reduction of a matrix to diagonal form.

(7L+2T)

Suggested Reading: Inverse of a matrix using Gauss-Jordan method. Largest eigenvalue and corresponding eigenvector using Rayleigh power method.

UNIT II **[10 hours]**

NUMERICAL METHODS

Solution of algebraic and transcendental equations: Newton-Raphson method.

Finite Differences and interpolation: Forward differences, backward differences. Newton-Gregory forward interpolation formula, Newton-Gregory backward interpolation formula, Lagrange's interpolation formula, Lagrange's inverse interpolation. Numerical integration: Simpson's $1/3^{rd}$, $3/8^{th}$ rule, Weddle's rule. Numerical solution of ordinary differential equations: Euler's modified method, Runge-Kutta method of fourth order**.**

(8L+2T)

Suggested Reading: Milne's method to solve ordinary differential equations. Solution of simultaneous differential equations by Runge-Kutta fourth order method.

UNIT III **[10 hours]**

PARTIAL DIFFERENTIAL EQUATIONS

Formation of Partial differential equations-elimination of arbitrary constants, elimination of arbitrary functions. Equations of first order- Solution of the linear equation $P\,p + Q\,q = R$ **(**Lagrange's partial differential equation).

Applications: One-dimensional heat equation and wave equation (without proof), Transmission line-telegraph equations, various possible solutions of these by the method of separation of variables.

(7L+3T)

Suggested Reading: Direct integration method, method of separation of variables, D'Alembert's solution of wave equation.

UNIT IV **[9 hours]**

COMPLEX ANALYSIS 1

Function of a complex variable, limits, continuity and differentiability of a complex valued function. Analytic functions, properties of analytic functions, Cauchy-Riemann equations in Cartesian and polar form, construction of analytic functions by Milne-Thomson method.

Conformal mapping-Transformations: $w = z^2$ and $w = z + \frac{a^2}{z}$ $(z \neq 0)$.Bilinear transformations.

(7L+2T)

Suggested Reading: Standard transformations $w = c + z$, $w = cz$, $w = 1/z$, properties of bilinear transformations.

UNIT V				**[10 hours]**

COMPLEX ANALYSIS 2

Complex integration: Line integral, Problems on line integral, Cauchy's theorem, Cauchy's integral formula.

Complex series: Taylor's series, Maclaurin's series and Laurent's series (without proof).

Zeros, Poles and Residues: Residue theorem (without proof). Evaluation of real definite integrals using residues.

(7L+3T)

Suggested Reading: Power series, radius of convergence. Removable and essential singularities, improper real integrals with singular points on real axis.

Applications: Use of harmonic function to a heat transfer problem. Analysing AC circuits, Current in a field- effect transistor.

Mathematics Lab

- Solution of system of algebraic equations using Gauss Seidel method.
- LU decomposition of matrices.
- Eigenvalues and eigenvectors of matrices.
- Largest eigenvalue, smallest eigenvalue and corresponding eigenvectors of a matrix.
- Solution of algebraic and transcendental equations using Newton- Raphson method.
- Numerical integration.
- Numerical solution of ordinary differential equations

Text Books:

1.	Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
2.	Advanced Engineering Mathematics, 5th edition, 2011, by Dennis G. Zill and Cullen, Jonesand Bartlett India Pvt. Ltd.

Reference Books:

1.	Higher Engineering Mathematics, B.V. Ramana, 2007, Tata Mc. Graw Hill.
2.	Advanced Engineering Mathematics, Erwin Kreyszig, 10th edition Vol.1 and Vol.2, 2014, Wiley-India.
3.	Numerical Methods for Scientific and Engineering Computation. M.K. Jain, S.R.K Iyengar, R.K. Jain, 6th edition, 2010, New Age International (P) Limited Publishers

E books

1.	Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
2.	Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3.	http://ocw.mit.edu/courses/mathematics/ (online course material)

MOOCs	
1.	http://nptel.ac.in/courses.php?disciplineId=111
2.	https://www.khanacademy.org/
3.	https://www.class-central.com/subject/math (MOOCS**)**
4.	E-learning: www.vtu.ac.in

CO-1: Obtain numerical solution a system of algebraic equations, algebraic and transcendental equations and ordinary differential equations.
CO-2: Formulate boundary value problems involving one dimensional heat and wave equation.
CO-3: Solve partial differential equations with appropriate boundary conditions using the method of separation of variables**.**
CO-4: Construct analytic functions and simple conformal mappings.
CO-5: Evaluate real and complex integrals using the calculus of residues.

Assessment

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question each from Units 1, 2, 4 and two questions from Unit 3 and Unit 5.

Questions for CIE (50%) and SEE(50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

- Remembering and understanding the course contents (weightage: 40%)
- Applying the knowledge acquired from the course (weightage: 35%)
- Designing and analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 10%)

Course Title	DIGITAL ELECTRONICS (Common to EC, TE, EE, IT, ML)				
Course Code	**15ES3GCDEC**	**Credits**	**6**	**L-T-P-S**	**3:0:1:2**
CIE	100 marks (50% weightage)	**SEE**	100 marks (50% weightage)		

Pre-requisites Elements of Electronics Engineering				
UNIT I				**[8 hours]**
Introduction: Review of Boolean algebra, logic gates. **Simplification of Boolean functions :** Three Variable K – Maps, Four Variable K – Maps, The Tabulation Method, Determination of Prime Implicants, Selection of prime implicants **Combinational Logic Circuits:** Introduction, Carry Look Ahead Adder, Parallel Adder, Decimal Adder Code conversion, , Magnitude Comparator, Decoders, Multiplexers, Read Only memories (ROM), Programmable Logic Arrays(PLAs).				
UNIT II				**[7 hours]**
Flip-Flops: The Basic Flip-flop circuit, Clocked Flip-flops, Triggering of Flip-flops: Master Slave Flip-Flops, Edge Triggered Flip Flops, Characteristic Equations.				
UNIT III				**[8 hours]**
Sequential Logic Circuits: Shift Registers, Ripple Counters, Design of Synchronous Counters				
UNIT IV				**[8 hours]**
Sequential systems: Analysis of Clocked Sequential circuits, State Reduction and Assignment, Design Procedure, Design with State Equations				
UNIT V				**[8 hours]**
Logic Families: Characteristic of Digital ICs, Transistor – Transistor Logic, Complementary MOS (CMOS) Logic, Comparison of TTL and CMOS families				
This course shall include assessments based on the QEEE Phase IV lecture on 'Nitty Gritty of Logic Gates to Processor Design' by Prof. Ashok Jhunjhunwala, IIT Madras (based on the topics Logic Gates to Execution Unit Design, ALU design)				
Text Books:				
1	Digital Logic and Computer Design- M. Morris Mano, Prentice Hall – Pearson Educatio			
2	Fundamental of Logic Design- Charles Roth Jr., Thomas Learning			
Reference Books:				
1	Digital Principles and Design- Donald Givone, Tata Mc Graw Hill			
2	Digital Logic Applications and principles- John Yarbrough, Pearson Education			
E Books				
1.	http://www.free-engineering-books.com/2014/11/digital-fundamentals-by-thomas-l-floyd.html			
2.	https://books.google.co.in/books/about/Fundamentals_of_Digital_Circuits.html?id=BO			

	VkrtiLUcEC
MOOCs	
1.	http://freevideolectures.com/blog/2010/11/130-nptel-iit-online-courses/
2.	http://freevideolectures.com/Course/2319/Digital-Systems-Design#
3.	www. Pyroelectrom.com/edu
4.	Nptel.ac.in/courses/117106086
5.	http://nptel.ac.in/courses/117105080
6.	**Digital Circuits and Systems** Youtube - S. Srinivasan, IIT Madras
7.	**Digital Integrated Circuits** Youtube - AmitavaDasgupta, IIT Madras

Course Outcomes

At the end of the course, the student will have the

CO1: Ability to **understand, define and explain** the fundamental concepts of Digital circuits	PO1
CO2: Ability to **apply** the knowledge of digital circuit concepts (Boolean Algebra, K-Maps and Quine-McClusky method) to optimize a digital circuit for the given parameter (number of gates, time delay, power consumption, cost)	PO2
CO3: Ability to **analyze** digital circuits and arrive at suitable conclusions	PO3
CO4: Ability to **design** a digital circuit for given specifications	PO4
CO5: Ability to **conduct experiments** using digital ICs for a given application/problem statement	PO6
CO6: Ability to engage in **self-study** to formulate, design, implement, analyze and demonstrate an application of digital electronic circuits through an **open ended experiment**	PO3, PO4, PO6, PO9, PO10, PO12
CO7: Ability to engage in **self-study** to deliver a **seminar** on topics related to the course accompanied by a seminar report (www.deity.gov.in, Comparative study of components, preparing the specifications of components, verifying the data sheets, applications of digital ICs, the characteristics/specifications of different digital ICs, etc)	PO10, PO12

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	40%
	Quiz (Best Two of Three)	10%
Laboratory Component	Laboratory component	30%
Self-Study Component	Seminar (Oral presentation with report)	10%
	Conduction and demonstration of an Open-Ended Experiment	10%

Semester End Examination (This is a written examination for THREE hours)	**Marks 100 (Weightage 50%)**

Course Title	ANALOG MICROELECTRONICS (Common to EC, TE, EE, IT, ML)				
Course Code	**15ES3GCAMC**	**Credits**	**6**	**L-T-P-S**	**3:0:1:2**
CIE	100 marks (50% weightage)	**SEE**	100 marks (50% weightage)		

Pre-requisites
Elements of Electronics Engineering

UNIT I **[7 hours]**

Diodes: - Introduction
Limiting and clamping circuits --- Limiter circuits, The Clamped capacitor or DC restorer .
Bipolar Junction Transistor (BJTs):- Introduction,
Single stage BJT amplifiers --- The basic structure , characterizing BJT Amplifiers, The common emitter amplifier
Frequency Response of the CE amplifier---The 3 frequency bands, The high frequency response , The low frequency response.

UNIT II **[8 hours]**

MOSFETS:-
Introduction ,
Device structure and physical operation ---- Device structure, operation with no gate voltage, creating a channel for current flow, Applying a small VDs, Operation as VDs is increased, Derivation of the id – V_{DS} relationship, The P- Channel MOSFET, Complementary MOS or CMOS, operating the MOS transistor in the subthreshold region .
Current voltage Characteristics---Circuit symbol, id – V_{DS} characteristics, characteristics of the P-Channel MOSFET
MOSFET Circuits at DC
The MOSFET as an amplifier and as a switch --- Large – signal operation , Graphical derivation of the transfer characteristic, operation as a switch, operation as a linear amplifier.
Biasing in MOS amplifier circuits---Biasing by fixing V_{GS}, Biasing by fixing V_G and connecting a resistor in the source , Biasing using a drain to gate feedback resistor, biasing using a current source

UNIT III **[7 hours]**

Small – signal operation and models of MOSFETs---The DC bias point, the signal current in the drain terminal ,the voltage gain, separating dc analysis and the signal analysis, small signal equivalent circuit models, the transconductance g_m, the T equivalent circuit model.
Single stage MOS amplifiers---The basic structure, characterizing amplifiers, The CS amplifier, The CS amplifier with a source resistance.
IC Biasing :– **Current sources, current mirror and current steering circuits**---
The basic MOSFET current source, MOS current steering circuits
Current mirror circuit with improved performance --- The Wilson current mirror

UNIT IV				**[7 hours]**
Feedback:- Introduction ,the general feedback structure, S**ome properties of negative feedback**---Gain density, bandwidth extension, noise reduction, reduction in non linear distortion, **The four basic feedback topologies---** Voltage amplifiers, current amplifiers, transconductance amplifiers , practical feedback circuits for current series and voltage series feedback				
UNIT V				**[7 hours]**
Power Amplifiers:- Introduction, The classification of output stages . C**lass A output stage** – transfer characteristic, signal w/Fs, power dissipation, power conversion efficiency, transformer coupled power amplifiers, class B transformer coupled amplifier **Class B output stage** – Circuit operation , transfer characteristic, power conversion efficiency, power dissipation, reducing crossover distortion, single supply operation **Class AB output stage** – Circuit operation, output resistance **Power BJTs** – Junction te**mperatur**e, thermal resistance, power dissipation versus temperature, transistor case and heat sink				
This course shall include an assessment based on the **QEEE Phase IV** on 'Fundamentals of Small Signal Analysis' taught by Prof.Shanthi Pavan, IIT Madras				
Text Books:				
1.	Microelectronic Circuits-Theory and applications by Adel S. Sedra and Kenneth C.Smith, Fifth Edition , (Oxford International Student Edition)			
2.	Electronic Devices and Circuit Theory-Robert L.Boylestad and Louis Nashelsky (Pearson Education)			
Reference Books:				
1.	Electronic Devices and Circuits- Millman and Halkias, TMH			
2.	Electronic Devices and Circuits- David A Bell - PHI 4th edition			
On-line Reference				
1.	www.pyroelectro.com/edu/analog			
2.	http://freevideolectures.com/Course/3020/Circuits-for-Analog-System-Design			
MOOCs				
1.	https://www.mooc-list.com/course/electronic-systems-and-digital-electronics-uninettuno?static=true			
2.	http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-spring-2009/			
3.	Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings			
Course Outcomes **At the end of the course, the student will have the**				
CO1: Ability to **define, understand and explain** the structure, V-I characteristics, working and applications of analog electronic devices like diodes, Bipolar Junction Transistors(BJTs) and MOSFETs				PO1
CO2: Ability to **apply** the knowledge of KVL and KCL to obtain				PO2

voltage /current/waveform at different points in analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers	
CO3: Ability to **analyze** analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers etc. to obtain voltage /current/waveform at different points for given specifications	PO3
CO4: Ability to **design** analog electronic circuits such as diode clippers, clampers, amplifiers using BJTs and MOSFETs, current sources, current mirrors, power amplifiers, feedback amplifiers for given specifications.	PO4
CO5: Ability to **conduct experiments** using analog electronic components and electronic instruments to function as switch, regulator, clippers, clampers, small signal amplifiers, oscillators, power amplifiers	PO1, PO2 PO3, PO4 PO6, PO9
CO6: Ability to engage in **self-study/independent study** to formulate, design, implement, analyze and demonstrate an application using analog electronic components through an **open ended experiment**	PO3, PO4, PO6, PO9, PO10, PO12,
CO7: Ability to engage in **self-study/independent study** to submit a seminar report and make an effective presentation on topics related to the course (e-waste management, www.deity.gov.in, Comparative study of components, preparing the specifications of components, verifying the data sheets, applications of analog electronics)	PO7, PO8, PO10, PO12

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	40%
	Quiz (Best Two of Three)	10%
	QEEE Quiz	10%
Laboratory Component	Laboratory component	20%
Self-Study Component	Seminar (Oral presentation with report)	10%
	Conduction and demonstration of an Open-Ended Experiment	10%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	LINEAR CIRCUIT ANALYSIS (Common to EC, TE, EE, IT, ML)				
Course Code	**15ES3DCLCA**	**Credits**	**4**	**L-T-P-S**	**3:1:0:0**
CIE	100 marks (50% weightage)	**SEE**	100 marks (50% weightage)		

Pre-requisites
Elements of Electronics Engineering

UNIT I **[5+4 hours]**

Basic Concepts:

Practical sources, Source transformations, Network reduction using Star Delta transformation, Loop and node analysis with linearly dependent and independent sources for DC and AC networks, Concepts of super node and super mesh.

UNIT II **[8+6 hours]**

Network Topology:

Graph of a network, Concept of tree and co-tree, incidence matrix, tie-set, tie-set & cut- set schedules, Formulation of equilibrium equations, Principle of duality.

Resonant Circuits: Series and parallel resonance, frequency response of series and Parallel circuits, Q factor, Bandwidth

UNIT III **[7+6 hours]**

Network Theorems :

Superposition, Reciprocity, Millman's, Thevinin's and Norton's theorems; Maximum Power transfer theorem

UNIT IV **[10+6 hours]**

Transient behavior and initial conditions:

Behavior of circuit elements under switching condition and their representation, evaluation of initial and final conditions in RL, RC and RLC circuits

Review of Laplace transforms, Laplace Transformation & Applications, , waveform Synthesis, initial and final value theorems, step, ramp and impulse responses, convolution theorem, solution of simple R-L, R-C, R-L-C networks for AC and DC excitations using Laplace transforms.

UNIT V **[6+2 hours]**

Two port network parameters and State Variable analysis:

Definition of z, y, h and transmission parameters, modeling with these parameters, relationship between parameters sets. Writing state equations and solution using Laplace transforms.

Text Books:	
1.	"Network Analysis", M. E. Van Valkenburg, PHI / Pearson Education, 3rd Edition. Reprint 2002.
2.	"Networks and systems", Roy Choudhury, 2nd edition, 2006 re-print, New Age International Publications
3.	Theory and Problems of Electric Circuits (Schaum Series), 2nd Edition McGraw Hill
Reference Books:	
1.	"Engineering Circuit Analysis", Hayt, Kemmerly and Durbin,TMH 6th 2002
2.	"Network analysis and Synthesis", Franklin F. Kuo, Wiley Edition
3.	"Analysis of Linear Systems", David K. Cheng, Narosa Publishing House, 11th reprint, 2002
4.	"Circuits", Bruce Carlson, Thomson Learning, 2000. Reprint 2002
E-Books	
1.	Nptel.ac.in/courses/108105065- Networks signals and systems by Prof T.K. Basu, IIT Kharagpur
2.	Nptel.ac.in/courses/108102042- Circuit Theory by Prof Dutta Roy S.C, IIT Delhi
3.	www.electrodiction.com/circuit-theory
MOOCs	
1.	http://elearning.vtu.ac.in/06ES34.html
2.	https://www.coursera.org/course/circuits

Course Outcomes

At the end of the course, the student will have the

CO1: Ability to **understand, define and explain** the concepts of loop and node analysis, network topology and resonant circuits	PO1
CO2: Ability to **apply** the knowledge of Network theorems, Laplace transformation and state -space analysis to two port networks to obtain desired parameters	PO2
CO3: Ability to **analyze** two port networks	PO3
CO4: Ability to listen and comprehend audio/video lectures related to the course	PO10

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	70 %
	Quiz (Average of two)	10%
	Quiz based on NPTEL web link to be provided (Average of two)	10%
	Lab component (AAT)	10%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	FIELDS AND WAVES (Common to TE and EC)				
Course Code	15ES3GCFAW	Credits	4	L-T-P-S	3:1:0:0
CIE	100 marks (50% weightage)	SEE	100 marks (50% weightage)		

Pre-requisites

Engineering Physics
Engineering Mathematics

UNIT I				[8 +4 hours]

Introduction to electrostatics: Introduction to line integral, surface integral, volume integral of vectors, Coulomb's Law(vector form), Electric Field Intensity (vector form), Electric Flux Density (EFD), Gauss' Law and Divergence Theorem

Energy and Potential: Energy spent in moving charge, Definition of Potential Difference (PD), PD due to Point Charge ,Energy Density

Current and current density: Current and Current Density, Continuity of Current, Conductor, Dielectric materials, Properties, and Boundary Conditions, capacitance-parallel plate ,co-axial, spherical.

UNIT II				[6+4 hours]

Introduction to Magnetostatics: Biot-Savart Law, Ampere's circuital law, curl, Magnetic Flux, Flux Density, Scalar and Vector Magnetic Potentials, Force on a moving charge, Force on different current element, Magnetic Boundary Condition.

UNIT III				[7+6 hours]

Time varying fields and Maxwell's equations: Faraday's Law, Displacement Current, Maxwell's Equations in Point and Integral Form, retarded potentials,

UNIT IV				[7+6 hours]

Uniform plane waves: Wave equations, solution of wave equation, wave propagation through good dielectric, good conductor, skin effect, Poynting Theorem, wave polarization.

UNIT V				[8 + 4 hours]

Plane wave reflection and dispersion: Reflection of uniform plane waves at normal incidence SWR ,Wave reflection from multiple interfaces, plane wave propagation in general directions, plane wave reflection at oblique incidence angles, total reflection and total transmission of obliquely incident waves, wave propagation in dispersive media, pulse broadening in dispersive media

This course shall include an assessment based on the **QEEE Phase IV** on 'Electromagnetic Waves' taught by Prof. Deepa Venkatesh, IIT Madras

Text Books:

1. **Engineering Electromagnetics,** W H Hayt ,J A Buck,M Jaleel Akhtar Tata McGraw-Hill, 8e Edition, 2014.
2. **Electromagnetics,** Schaum's Outline series Joseph A Ediminister Tata McGraw-Hill, revised second Edition, 2014.

Reference Books:

1. Electromagnetics with Applications, John Krauss and Daniel A Fleisch, McGraw-Hill, 5th Edition, 1999.

2.	"Field and wave electromagnetic, David K Chary, Pearson Education Asia, Second Edition – 1989, Indian Reprint - 2001
On-line Reference	
1.	http://nptel.ac.in/courses/108106073/
2.	http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/
3.	Transmission%20Lines%20and%20EM%20Waves/Course%20Objective.htm
MOOCs	
1.	http://emt-iiith.vlabs.ac.in/
2.	http://emt-iiith.vlabs.ac.in/Experiment.php?code=C001 to C010
3.	http://nptel.ac.in/courses/108106073/ 1 to 108106073/42

Course Outcomes

At the end of the course, the student will have the

CO1: Ability to **define, understand**, and **explain** concepts on electrostatics and magnetostatics, Time varying fields and Maxwell's equations, wave propagation in different media, concepts on reflection and dispersion of plane waves	PO1
CO2: Ability to **apply** various properties/ laws/theorems/ Maxwell's equations of electrostatics, magnetostatics to solve/derive **examples** in different media of time varying fields and uniform plane waves.	PO2
CO3: Ability to **analyze** the given specifications of static and time varying Electric, Magnetic fields, uniform plane waves in various configurations/ distributions	PO3
CO4: Ability to listen and comprehend audio/video lectures related to electromagnetic fields and waves domain	PO10

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	60%
	Quiz (Best Two of Three)	20%
	QEEE Quiz	10%
Laboratory Component	Quiz based on the Laboratory component (as AAT based on videos from vlab.co.in)	10%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	SIMULATION LABORATORY – I (TE only)				
Course Code	15TE3DLSL1	Credits	1	L-T-P-S	0:0:1:0
CIE	100 marks (50% weightage)	SEE	100 marks (50% weightage)		

Part A

1. **Introduction:** The MATLAB Environment, Data addressing, Language fundamentals, Operators, Functions & System objects, Data input & output, Matlab functions
2. **Numerical Computation** Matrix arithmetic. Equations & Expressions- Solve simultaneous and differential equations and visualize the same.
3. **Data Analysis & visualization** Graphical visualization, Plotting tools, Plotting multi graphs, multi curves, pie charts, bar graphs. Labeling and annotation Introduction to functions, function I/O, definitions of functions, scope, advantages, scripts, File I/O, MAT files, excel files, text files, binary files.
4. **Signal generation and system analysis-** Using MATLAB commands, Solution of mesh current and node voltage equations using matrix operations. Obtain the time response of first and second order systems and the domain specifications. Realize a logical expression using Boolean algebra.

PART – B (Simulink)

1. Create mathematical models of systems, Interact with MATLAB workspace and obtain the plots .
2. Use of Simulink tool box, steps involved in creating system models using the simulink Library, solver selection, creating model hierarchy.
3. Obtain the transient response of first order and second order systems. Transfer of variables between Simulink and MATLAB workspace and obtain their plots .
4. Modeling Mechanical /Electrical systems-such as Full wave rectifier design, Op Amp configuration , Digital system etc. (not limited)

Course Outcomes

At the end of the course, the student will have the

1. Familiarize the MATLAB environment, enter commands, Create access, modify, perform calculations, and visualize matrix data and customize plots.	
2. Import data from files ,write and debug scripts and	

create functions.	
3. Graphical Visualization and interpretation of data	
4. Solve simultaneous and differential equations and visualize the same. Realize a logical expressions.	
5. Familiarize the SIMULINK environment, Create and simulate a model of a physical system.	

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Laboratory Component	Part A	40%
	Part B	40%
	Open Ended Experiment from either Part-A or Part-B	20%
Semester End Examination (This is a laboratory examination for THREE hours, and shall include ONE experiment EACH from Part A and Part B)		**Marks 100 (Weightage 50%)**

Course Title	**DISCRETE MATHEMATICS AND PROBABILITY** (Common to EC, TE, EE, IT, ML)				
Course Code	**15MA4GCDMP**	**Credits**	**4**	**L-T-P-S**	**3:1:0:0**
CIE	100 marks (50% weightage)	**SEE**	100 marks (50% weightage)		

Pre-requisites
Basic concepts of set theory, relations and functions. Matrices. Basic concepts of probability, addition theorem, conditional probability, Bayes' theorem, discrete random variable, Binomial distribution

UNIT I				**[12 hours]**

SET THEORY AND RELATIONS
Introduction to sets and subsets, operations on sets, laws of set theory. Duality, Principle of duality for the equality of sets. Countable and uncountable sets. Addition Principle. Introduction to Relations. Definition, Types of functions, operations on relations, matrix representation of relations, composition of relations, properties of relations, equivalence relations, partial orders, Hasse diagram. Posets- extremal elements on posets.

(9L+3T)

Suggested Reading: Some particular functions- Floor and ceiling functions, Projection, Unary and Binary operations.

UNIT II				**[10 hours]**

ALGEBRAIC STRUCTURES- Groups, properties of groups. Some particular groups- The Klein 4-group, additive group of integers modulo *n*, multiplicative group of integers mod *p*, permutation groups. Subgroups, Cyclic groups, Coset decomposition of a group, homomorphism, isomorphism.

(7L+3T)

Suggested Reading: Lagrange's theorem and its consequences.

UNIT III				**[9 hours]**

GRAPH THEORY Basic concepts: Types of graphs, order and size of a graph, in-degree and out-degree, connected and disconnected graphs, Eulerian graph, Hamiltonain graphs, subgraphs, dual graphs, isomorphic graphs. Matrix representation of graphs: adjacency matrix, incidence matrix. Trees: spanning tree, breadth first search. Minimal spanning tree: Kruskal's algorithm, Prim's algorithm, shortest path-Dijkstra's algorithm.

(7L+2T)

Suggested Reading: Konigsberg bridge problem, Utility problem.

UNIT IV				**[8 hours]**

PROBABILITY

Theoretical distributions: Poisson distribution, Normal distribution: Error function, Central limit theorem.

Two dimensional random variables: Discrete random variable, Mathematical expectation, Covariance and Correlation.

(6L+2T)

Suggested Reading: Exponential distribution, Uniform distribution. Continuous two dimensional random variables.

UNIT V				**[9 hours]**

MARKOV CHAIN AND QUEUING THEORY

Markov Chain, Probability vectors, stochastic matrices, fixed point vector, regular stochastic matrices. Higher transition probabilities, stationary distribution of regular Markov chains. Queuing models: Concept of Queue, M/M/1 queuing systems.

(7L+2T)

Suggested Reading: Power supply model, Economic cost profit model.

Mathematics Lab

- Probability distributions
- Minimal spanning tree- Kruskal's algorithm, Prim's algorithm.
- Shortest Path- Dijkstra's algorithm

Text Books:

1.	Discrete Mathematical Structures, Dr. DSC, 4th edition, 2011-12, Prism Engineering Education Series.
2.	Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2013, Khanna Publishers.
3.	Discrete Mathematics, Seymour Lipschutz. M. Lipson, 2005, Tata Mc Graw Hill.

Reference Books:

1.	Higher Engineering Mathematics, B.V. Ramana, 2007, Tata Mc. Graw Hill.
2.	Discrete Mathematics, J K Sharma, 3rd edition, 2013, Macmillan India Ltd.
3.	Queuing Theory and Telecommunications, Networks and applications, Giovanni

	Giambene, 2005, Springer
4.	Data Networks, Dimitri Bertsekas, Robert Gallager, 2nd edition, 1992, Prentice India
5.	Schaum's Outline of Probability and Statistics, John J Schiller, Murray R Speigel, 4th edition, 2013, Schaum's Outlines
E books	
1.	Discrete Mathematics for Computer Science, Gary Haggard, John Schlipf, Sue Whitesides, Thomson Brooks/Cole, 2006
2.	(1) http://www.khanacademy.org/math/probability/random-variablestopic/random_variables_prob_dist/v/random-variables
3.	http://ocw.mit.edu/courses/mathematics/ (online course material)
MOOCs	
1.	www.nptelvideos.in/2012/11/discrete-mathematical-structures.html
2.	www.cs.berkeley.edu/~daw/teaching/cs70-s05
3.	https://www.khanacademy.org/

Course Outcomes

At the end of the course, the student will have the

CO-1: Understand the notation of set theory, relations and functions.
CO-2: Construct a Hasse diagram for partial orderings, Use many terms associated with graphs and prove whether two graphs are isomorphic.
CO-3: Obtain the probability of an event using discrete and continuous distributions, including the n-step transition probability.
CO-4: Analyse and classify simple states (recurrent/transient)
CO-5: Understand, derive and apply the properties of the M/M/m queuing model (properties like stationary probability, average waiting and system time, expected number of customers in the queue)

Assessment

1. Each unit consists of one full question.
2. Each full question consists of three or four subdivisions.
3. Five full questions to be answered.
4. To set one question each from Units 1, 4, 5 and two questions from Unit 2 and Unit 3.

Questions for CIE (50%) and SEE(50%) will be designed to evaluate the various educational components (Blooms taxonomy) such as:

- Remembering and understanding the course contents (weightage: 40%)
- Applying the knowledge acquired from the course (weightage: 35%)
- Designing and analyzing various engineering problems (weightage: 15%)
- Understanding of various system models (weightage: 10%)

Course Title	Verilog HDL Programming (Only EC)				
Course Code	15EC4DCHDL	Credits	4	L-T-P-S	3:0:1:0
CIE	100 marks (50% weightage)	SEE	100 marks (50% weightage)		

Pre-requisites: Digital Electronics

UNIT I **[8 hours]**

Overview of Digital Design with Verilog HDL:
Evolution of computer aided digital design, Emergence of HDLs, Typical design flow, importance of HDLs, Verilog HDL and Design. Methodologies, modules, instances, components of simulation, example, basic concepts.
Modules and ports: Modules, ports, Rules, Hierarchical Names.
Gate Level modeling and Data flow modeling: Gate Types, Gate Delays, Examples, Continuous assignment, Delays, Expressions, Operators, Operands, Operator Types and Examples.

UNIT II **[8 hours]**

Structured procedures, Procedural assignments, Timing controls, conditional statement, Multi way branching, Loops, Sequential and parallel blocks, generate blocks, Examples.
Tasks and Functions: Difference between Tasks and Functions, Tasks, Functions, Automatic Functions, Constant Function, Signed Functions.

UNIT III **[8 hours]**

Logic synthesis, Verilog HDL Synthesis, Interpretation of Verilog Constructs, Synthesis Design flow, examples, verification of the gate level netlist, modeling tips for logic synthesis.
Timing and delays: Types of delay models, modeling, timing checks and delay back annotation.

UNIT IV **[7 hours]**

Introduction, basic concepts, Digital design with FPGAs, FPGA based system design.
FPGA Fabrics: FPGA architectures, SRAM based FPGAs, Chip I/O and Circuit design of FPGA fabrics, Architecture of FPGA fabrics, SPARTAN III and above.

UNIT V **[8 hours]**

Moore and Mealy machines, definition of state machines, state machine as sequence controller, Design of state machines, state table, state assignment, transition excitation table, logic realization, Design example- Serial adder.

Text Book:

1. Samir Palnitkar, "VERILOG HDL,A Guide to digital design and synthesis", 2nd edition, Pearson education, 2003.
2. Wayne Wolf, "FPGA based system design", Reprint 2005, Pearson Education

Reference Books:

1. Stephen Brown andZvonkoVranesic, "Fundamentals of Digital logic with VERILOG design", TMH.

E Books	
1.	http://www.eng.auburn.edu/~strouce/class/elec4200/Overview%20of%20Verilog.pdf
2.	**Verilog HDL: A Guide to Digital Design and Synthesis, Volume 1** By Samir Palnitkar at **https://books.google.co.in/books**
MOOCs	
1.	http://www.xilinx.com/training/languages/basic-hdl-coding-techniques-video.htm
2.	http://www.nitroindia.org/training.html?gclid=CMzC_9S-4cYCFafLtAodkCEOSA
3.	http://www.eetimes.com/lecture-calendar.asp?cid=902#lecture_track_cgid_3

Course Outcomes

At the end of the course, the student will have the

1. Demonstrate the basic knowledge of HDL.	PO1
2. Demonstrate the ability to apply HDL in modelling combinational and sequential circuits and to write a VERILOG test bench to test VERILOG modules.	
3. Use EDA tools in digital circuit modelling, simulation, functional verification.	
4. Target and synthesize a VERILOG design to FPGA board.	
5. Design state machines to control complex systems	

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	40%
	Quiz	10%
Laboratory Component	Laboratory component	40%
	Open-Ended Experiment	10%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	**ANALOG INTEGRATED CIRCUITS** (Common to EC, TE, EE, IT, ML)				
Course Code	**15ES4GCAIC**	**Credits**	**6**	**L-T-P-S**	**3:0:1:2**

CIE	100 marks (50% weightage)	SEE	100 marks (50% weightage)

Pre-requisites Elements of Electronics Engineering Analog Microelectronics				
UNIT I				**[8 hours]**
Operational Amplifier Characteristics: Introduction, DC Characteristics, AC Characteristics, Analysis of data sheets of an OP-AMP **Operational Amplifier Applications:** Review of basic Opamp applications, Instrumental Amplifier, V to I and I to V converter, Op-amp circuits using Diodes – Half wave rectifier, Full wave rectifier, Sample and hold circuit, Multiplier and Divider.				
UNIT II				**[7 hours]**
Comparators and Waveform Generators: Introduction, comparator, Regenerative comparator (Schmitt Trigger), Square wave generator (Astable Multivibrator), Monostable Multivibrator, Triangular wave generator. (RC and wein bridge oscillators only)				
UNIT III				**[7 hours]**
Voltage Regulators: Introduction, Series op-amp regulator, IC Voltage regulators, 723 General purpose Regulator, Switching Regulator. **Active Filters:** Introduction, RC Active Filters, First order low pass filter, second order active filter, Highe order low pass filter, High pass active filter, All pass filter-phase shift lead and lag circuit				
UNIT IV				**[7 hours]**
Timers : Introduction to 555 timer, Description of Functional diagram, monostable operation, astable operation. **Phase locked loops** : Introduction, Basic principles, phase detector/comparator, voltage controlled oscillator (VCO)				
UNIT V				**[7 hours]**
D-A and A-D Converters: Introduction, Basic DAC Techniques- Weighted Resistor DAC, R-2R Ladder DAC. A-D Converters: Direct type ADCs- The parallel Comparator (Flash) A/D converter, Successive Approximation Converter, DAC/ADC Specification, Sigma – delta ADC				

Text Book:	
1.	Linear Integrated Circuits-D.Roy Choudhury & Shail B.Jain (New age Publication)
2.	Op-Amps and Linear Integrated Circuits- Ramakanth A.Gayakwad,4th ed,PHI
Reference Books:	
1.	Linear Integrated Circuits-S.Salivahanan & V.S.Kanchana Bhaaskaran (Tata McGraw-Hill Publication)
2.	Opamps and Linear ICs-David A.Bell (Prentice-Hall Publications)
E Books	
1.	http://freevideolectures.com/Course/2321/Electronics-for-Analog-Signal-Processing-I

2.	http://freevideolectures.com/Course/2322/Electronics-for-Analog-Signal-Processing-I
MOOCs	
1.	http://ocw.tudelft.nl/courses/microelectronics/analog-integrated-circuit-design/course-home/
2.	Introductory Analog Electronics Laboratory (Spring 2007) by MIT Open Courseware | Reviews and Ratings
3.	http://www.pannam.com/blog/free-resources-to-learn-electrical-engineering/

Course Outcomes

At the end of the course, the student will have the

CO1: Ability to **define**, **understand** and **explain** the DC and AC performance characteristics of Opamp, applications of Opamp, working of 555 timer and voltage regulators.	PO1
CO2: Ability to **apply** the knowledge of KVL and KCL to **obtain** voltage /current/waveform at different points in analog electronic circuits such as Opamp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators ,555 timers	PO2
CO3: Ability to **analyze** analog electronic circuits such as Opamp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators ,555 timers etc.to **obtain** voltage /current/waveform at different points that meet desired specifications .	PO3
CO4: Ability to **design** analog electronic circuits such as Opamp amplifiers, rectifiers, filters, waveform generators, PLL, data converters, regulators, comparators ,555 timers etc. that meet desired specifications	PO4
CO5: Ability to c**onduct experiments** using analog electronic components, electronic instruments to function as amplifiers, comparators, rectifiers, filters, astable and monostable circuits using 555 ,data converters	PO1, PO2 PO3, PO4 PO6,PO9
CO6: Ability to engage in **self-study/independent study** to formulate, design, implement, analyze and demonstrate an application using analog electronic components/ASLK/Multisim through a **mini-project** and submit the mini-project and make an oral presentation of the work	PO3, PO4, PO6, PO9, PO10, PO12,

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	40%
	Quiz (Best Two of Three)	10%
Laboratory Component	Laboratory component	30%
Self-Study Component	Seminar (Oral presentation with report)	10%
	Conduction and demonstration of an Open-Ended Experiment	10%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	**MICROCONTROLLERS** (Common to EC, TE, EE, IT, ML)

Course Code	15ES4GCMCS	Credits	6	L-T-P-S	3:0:1:2
CIE	100 marks (50% weightage)	SEE	100 marks (50% weightage)		

Pre-requisites Elements of Electronics Engineering Digital Electronics				
UNIT I				**[7 hours]**
INTRODUCTION TO MICROCOMPUTER AND MICROCONTROLLER: Introduction to Microprocessors, Internal organization of computer- Bus Structures, Harvard & Von-Neumann CPU architecture, **The 8051 Architecture:** Introduction, 8051 Microcontroller Hardware, Input / Output Pins, External Memory Interface.				
UNIT II				**[8 hours]**
MICROCONTROLLER PROGRAMMING Instruction set architecture-RISC & CISC CPU Architectures, Pipelining, Execution of an instruction, Addressing Modes and Instruction set. Example Demonstration using 8051 instruction set, Data transfer instructions, Arithmetic instructions, Logical instructions, Branching and Subroutines, Example programs.				
UNIT III				**[8 hours]**
CONCEPTS OF EMBEDDED 'C' PROGRAMMING.: Data types, examples in 8051 C, program structures, logical operations, Memory and I/O access, Programming peripherals (Examples: Timer / Counter), Programming serial communication (serial data input/output) - example programs using 8051				
UNIT IV				**[7 hours]**
INTERRUPTS AND INTERRUPT PROGRAMMING: Concept of Interrupts, Interrupts in 8051. Programming Timer Interrupts, Programming External Hardware Interrupts, Programming Serial Communication Interrupts				
UNIT V				**[6 hours]**
INTERFACING AND APPLICATIONS: Interfacing 8051 to LCD, DAC, ADC Stepper motor interfacing. Applications of microcontrollers				
LABORATORY EXPERIMENTS: Part A: Data Transfer, Logical-Byte/Bit manipulations, Jump and Subroutine Calls using Assembly language, counters and delay generation using timers, Embedded C programs Part B: Interfacing: LCD Display, Stepper motor control, logical interface, 7 segment interface, DAC and keyboard.				

Text Books:	
1.	"The 8051 Microcontroller Architecture, Programming & Applications", Kenneth J. Ayala 2e, Thomson Learning 2005
2.	"The 8051 Microcontroller and Embedded Systems – using assembly and C", Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D. McKinlay; PHI, 2006
Reference Books:	
1.	'Computer Organization and Architecture', Carl Hamacher, McGrawHill, 5th Edition
2.	http://cnx.org/contents/dadb4fd5-8390-4323-a056-

	f6381587e89a@1/Microcontroller%288051%29-Lab
E Books	
1.	nptel.ac.in/courses/Webcourse-contents/IIT.../microcontrollers
2.	http://freevideolectures.com/Course/3018/Microprocessors-and-Microcontrollers
MOOCs	
1.	**Embedded Systems - Shape The World-** https://www.edx.org/course/embedded-systems-shape-world-utaustinx-ut-6-02x
2.	**Electronic Interfaces: Bridging the Physical and Digital Worlds-** https://www.edx.org/course/electronic-interfaces-bridging-physical-uc-berkeleyx-ee40lx-0

Course Outcomes

At the end of the course, the student will have the

CO1: Ability to **understand** and **explain** computer based and memory based architecture, microcontroller, pipelining, addressing modes, data types in Embedded C, basics of serial communication, timer configuration and interrupt handling	PO1
CO2: Ability to **calculate** instruction execution time, delay, baud rate, and **write** assembly and C Code**, identify** the timer mode, serial communication mode and interrupt priorities	PO2
CO3: Ability to **debug**/ **analyze** the code in assembly as well as Embedded C	PO3
CO4: Ability to identify the IDE to **conduct experiments by** simulating, debugging and executing the assembly and Embedded C code	PO6
CO5: Ability to engage in **independent study/ self-study** by preparing a 5 min video on 'Applications of Microcontrollers for health, safety, environment and society'	PO7, PO8 PO10, PO12
CO6: Ability to work as an individual and as a team-member to design, formulate and implement experiments using microcontroller through conduction of an **Open-Ended experiments**	PO8, PO9, PO10, PO12

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	40%
	Quiz (Best Two of Three)	10%
Laboratory Component	Laboratory component	30%
Self-Study Component	Seminar (Oral presentation with report)	10%
	Conduction and demonstration of an Open-Ended Experiment	10%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	SIGNALS AND SYSTEMS (EE/EC/IT/ML)				
Course Code	15ES4GCSAS	Credits	4	L-T-P-S	3:1:0:0
CIE	100 marks (50% weightage)	SEE	100 marks (50% weightage)		

Pre-requisites				
Basic Electronics, Network Analysis, Engineering Mathematics				
UNIT I				**[10 hours]**
INTRODUCTION Definitions of a signal and a system, classification of signals, basic Operations on signals, elementary signals, Systems viewed as Interconnections of operations, properties of systems.				
UNIT II				**[10 hours]**
TIME-DOMAIN REPRESENTATIONS FOR LTI SYSTEMS: Convolution, impulse response representation, Convolution Sum and Convolution Integral, Properties of impulse response representation, Differential and difference equation Representations, Block diagram representations.				
UNIT III				**[08 hours]**
FOURIER SERIES: Introduction, Discrete time and continuous time Fourier series (derivation of trigonometric Fourier series representation are excluded), Properties of Fourier series (No proof), Applications of Fourier series. Sampling Theorem and Reconstruction.				
UNIT IV				**[10 hours]**
FOURIER SERIES: Introduction, Discrete time and continuous time Fourier series (derivation of trigonometric Fourier series representation are excluded), Properties of Fourier series (No proof), Applications of Fourier series. Sampling Theorem and Reconstruction.				
UNIT V				**[10 hours]**
Z-TRANSFORMS: Introduction, Z – transform, properties of ROC & Z – transforms Inverse Z–transforms, unilateral Z- Transform, analysis of LTI Systems and application to solve Difference equations.				

Text Books:	
1.	Simon Haykin and Barry Van Veen "Signals and Systems", John Wiley & Sons, 2001.Reprint 2002
2.	Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab, "Signals and Systems" Pearson Education Asia / PHI, 2nd edition, 1997. Indian Reprint 2002
Reference Books:	
1.	H. P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006
2.	B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005
3	Ganesh Rao and SatishTunga, "Signals and Systems", Sanguine Technical Publishers, 2004
E Books/SIGNALS AND SYSTEMS VIDEO LINKS	
1.	NPTEL lecture Video on Signals and Systems by Prof. S.C.Dutta Roy, http://www.satishkashyap.com/2012/04/iit-video-lectures-on-signals-and.html
2	NPTEL lecture Video on Signals and Systems by Prof. T.K. Basu, IIT Kharagpur.

.	http://www.nptel.ac.in/courses/108105065/
3.	NPTEL on line Course Modules–IIT Bombay –Signals and Systems http://www.cdeep.iitb.ac.in/nptel/Electrical%20&%20Comm%20Engg/Signals%20and%20System/TOC-M1.html
MOOCs	
1.	https://www.edx.org/course/signals-systems-part-1-iitbombayx-ee210-1x-0
2.	https://www.edx.org/course/signals-systems-part-2-iitbombayx-ee210-2x-0

Course Outcomes

At the end of the course, the student will have the

CO1: Ability to **define, understand**, and **explain** continuous time signals, systems, their time and frequency domain representation, equalizers, ideal and physically realizable filters	PO1
CO2: Ability to **classify** signals and systems, **obtain** the output for LTI systems using the time domain and the frequency domain representation, **obtain** the frequency domain representation for continuous time signals, **obtain** the transfer function, pole-zero plot of the Butterworth filters	PO2
CO3: Ability to **analyze** the given specifications for physical realizability, stability, **analyze** the designed system (compare with the desired specifications), **analyze** systems	PO3
CO4: Ability to **design** equalizers for a given system, **design** filters for given specifications	PO4

Assessment Pattern

Continuous Internal Assessments		**Marks 100 (Weightage 50%)**
Theory Component	Three Internals (Best Two of Three)	80%
	Blended MOOCs (IITBX) Quiz	20%
Semester End Examination (This is a written examination for THREE hours)		**Marks 100 (Weightage 50%)**

Course Title	**TECHNICAL WRITING** (EC only)				
Course Code	**15EC4DCTEW**	**Credits**	**1**	**L-T-P-S**	**0:0:1:0**
CIE	100 marks (50% weightage)	**SEE**			

Course Description

This course provides the student with a working knowledge of various types of technical communication, including the writing of proposals, instructions, and reports for both the specialist and the non-specialist.

CONTENTS TO BE PUBLISHED SHORTLY

MANDATORY MATHEMATICS COURSES FOR LATERAL ENTRY STUDENTS

Course Title	**Mathematics-I** (All Branches)				
Course Code	**15MA3IMMAT**	**Credits**	**0**	**L-T-P-S**	**0:0:0:0**
CIE	100 marks (100% weightage)				

Pre-requisites
Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration

UNIT I				**[9 hours]**

DIFFERENTIAL AND INTEGRAL CALCULUS

List of standard derivatives including hyperbolic functions, rules of differentiation. Differentiation of product of two functions using Leibnitz rule (direct problems). Taylor's and Maclaurin's series expansion for functions of single variable. List of standard integrals, integration by parts. Definite integrals – problems. **(7L+2T)**

UNIT II				**[10 hours]**

POLAR COORDINATES AND PARTIAL DERIVATIVES

Polar curves: Polar coordinates, angle between radius vector and tangent, angle between two polar curves. Partial differentiation. Total differentiation-Composite and Implicit functions. Taylor's and Maclaurin's series expansion for functions of two variables. Jacobians and their properties (without proof) – Problems. **(7L+3T)**

UNIT III				**[08 hours]**

FIRST ORDER ORDINARY DIFFERENTIAL EQUATIONS

Introduction to first order differential equations. Linear equation and its solution. Bernoulli's equation and its solution. Exact differential equation and its solution. Orthogonal Trajectories. **(6L+2T)**

UNIT IV				**[9 hours]**

SECOND AND HIGHER ORDER ORDINARY DIFFERENTIAL EQUATIONS

Ordinary differential equations with constant coefficients: Homogeneous differential equations, non-homogeneous differential equations – Particular integral for functions of the type f (x) = e^{ax}, sin(ax), cos(ax), x^n, e^{ax} sin(bx), e^{ax} cos(bx). Method of variation of parameters. Cauchy's and Legendre differential equations. **(7L+2T)**

UNIT V				**[8 hours]**

VECTOR CALCULUS AND ORTHOGONAL CURVILINEAR COORDINATES (OCC)

Recapitulation of scalars, vectors and operation on scalars and vectors. Scalar and vector point functions. Del operator, gradient-directional derivative, divergence, curl and Laplacian operator. Vector identities (without proof). Cylindrical and Spherical polar coordinate

systems. Expressing a vector point function in cylindrical and spherical systems. Expressions for gradient, divergence, curl and Laplacian in OCC. **(6L+2T)**

Text Books:	
1.	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
2.	Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw Hill.
Reference Books:	
1.	Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers
2.	Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd.
E Books	
1.	Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
2.	Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3.	http://ocw.mit.edu/courses/mathematics/ (online course material)
MOOCs	
1.	https:// www.khanacademy.org/Math
2.	https:// www.class-central.com/subject/math (MOOCS)
3.	E-learning: www.vtu.ac.in

Course Outcomes

At the end of the course, the student will have the

CO-1: Understand the basic concepts of differentiation and integration.
CO-2: Apply the concepts of polar curves and multivariate calculus.
CO-3: Apply analytical techniques to compute solutions of first and higher order ordinary differential equations.
CO-4: Apply techniques of vector calculus to engineering problems.
CO-5: Comprehend the generalization of vector calculus in curvilinear coordinate system.

Course Title	**Mathematics-II** (All Branches)				
Course Code	**15MA4IMMAT**	**Credits**	**0**	**L-T-P-S**	**0:0:0:0**
CIE	100 marks (100% weightage)				

Pre-requisites

Basic concepts of Trigonometry, Trigonometric formulas, concept of differentiation, concept of integration

UNIT I				**[8 hours]**

LAPLACE TRANSFORMS

Laplace transforms of standard functions. Properties and problems. Laplace Transform of Periodic functions with plotting. Unit step function.

(6L+2T)

UNIT II				**[9 hours]**

INVERSE LAPLACE TRANSFORMS

Inverse Laplace transforms of standard functions. Properties and problems. Solution of ODE-Initial and Boundary value Problems.

(7L+2T)

UNIT III				**[11 hours]**

DOUBLE INTEGRAL

Evaluation of double integral. Change of order of integration. Change of variables to polar coordinates. Application: Area.

(8L+3T)

UNIT IV				**[8 hours]**

TRIPLE INTEGRALS AND IMPROPER INTEGRALS

Evaluation of triple integral. Application: Volume. Gamma and Beta functions-definition Relation between Gamma and Beta functions. Properties and Problems.

(6L+2T)

UNIT V				**[8 hours]**

VECTOR INTEGRATION

Line integral. Green's theorem. Stokes' theorem. Gauss divergence theorem.

(6L+2T)

Text Books:

1.	Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Precise Textbook series, Vol. 1 and Vol. 2, 10th edition, 2014, Wiley- India.
2.	Advanced Engineering Mathematics, 4th edition, 2011, by Dennis G. Zill and Cullen, Jones and Bartlett India Pvt. Ltd

Reference Books:

1.	Higher Engineering Mathematics, B.S. Grewal, 43rd edition, 2014, Khanna Publishers.
2.	Higher Engineering Mathematics, B.V. Ramana, 7th reprint, 2009, Tata Mc. Graw

	Hill.
E Books	
1.	(1) Engineering Mathematics, K. A. Stroud, Dexter J. Booth, Industrial Press, 2001 http://books.google.co.in/books/about/Engineering_Mathematics.html?id=FZncL-xB8dEC&redir_esc=y.
2.	Advanced Engineering Mathematics, P. V. O'Neil, 5th Indian reprint, 2009, Cengage learning India Pvt. Ltd.
3.	http://ocw.mit.edu/courses/mathematics/ (online course material)
MOOCs	
1.	https:// www.khanacademy.org/Math
2.	https:// www.class-central.com/subject/math (MOOCS)
3.	E-learning: www.vtu.ac.in
Course Outcomes **At the end of the course, the student will have the**	
CO-1: Use Laplace transforms to solve differential equations.	
CO-2: Apply double integrals to compute areas.	
CO-3: Learn to use triple integrals in computing volumes.	
CO-4: Use Gamma and Beta functions to evaluate integrals.	
CO-5: Ability to understand the use of integral calculus in scalar and vector fields.	