MVJ COLLEGE OF ENGINEERING
Since 1982

Engineering A Better Tomorrow

An Autonomous Institute

MVJCE CURRICULUM

for

Bachelor of Engineering
in
Electronics and Communication Engineering

(Scheme 2020)

III-VIII Semester Syllabus

INSTITUTION VISION

To become an Institution of Academic excellence with International standards.

INSTITUTION MISSION

The Vision will be realized by

- Impart quality education along with Industrial exposure.
- Provide world class facilities to undertake research activities relevant to Industrial and professional needs.
- Promote entrepreneurship and value added education that is socially relevant with economic benefits.

DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING

Vision:

To be a place of academic excellence by imparting quality education, carrying out research and technology development in frontier areas of Electronics and Communication Engineering.

Mission:

1. **Professional Growth**: To shape graduates into hardcore professionals who would become effective leaders and noteworthy innovators in the technology areas of Electronics and Communication Engineering
2. **Lifelong Learning:** To motivate and encourage our students to engage in lifelong learning which would help them keep abreast with contemporary developments in their fields of operation and enable them to leverage on the power of knowledge to become outstanding performers in whatever careers they choose.
3. **Team Work:** To inculcate creative thinking through innovative and group work exercises which enhances the entrepreneur skills, employability and research capabilities.
4. **Skill Development:** Enable students to develop skills to solve complex technological problems of current times and also provide a framework for promoting collaborative and multidisciplinary activities.

Program Outcomes (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
2. **Problem analysis**: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

12. **Life-long learning:** Recognize the need for, and have the preparation and ability to Engage in independent and life-long learning in the broadest context of Technological change.

Program Specific Outcomes (PSOs)

1. **Interpretation Skills:** Design, verify and validate electronic functional elements for a variety of applications with skills to interpret and communicate results.
2. **Core Competencies:** Analysis, design and implementation of VLSI systems, communication systems and embedded systems.

Program Educational Objectives (PEOs)

1. **Professional Development:** Graduates will have a successful career in electronic and communication engineering or associated industries or higher education and research.
2. **Attitude towards Lifelong Learning:** Graduates will have the ability and attitude to adapt to evolving technological challenges.
3. **Technical Innovation:** To inculcate group work and team management skills to promote knowledge transfer leading to conceptualization and delivery of projects with varied complexity.

MVJ COLLEGE OF ENGINEERING, BENGALURU
(An Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, and Recognised by UGC under 2(f) and 12(B), Accredited by NBA & NAAC)

RULES AND REGULATIONS GOVERNING THE DEGREE OF BACHELOR OF ENGINEERING (B.E.)

(Registration, Attendance, Examinations, Evaluation and Award of Grades)

Effective from the academic year 2020 – 21

MVJ COLLEGE OF ENGINEERING, BENGALURU

(An Autonomous Institute affiliated to Visvesvaraya Technological University, Belagavi, Approved by AICTE, and Recognised by UGC under 2(f) and 12(B), Accredited by NBA & NAAC)

Index of Scheme and Syllabus for
Bachelor of Engineering in Electronics and Communication Engineering
(Scheme 2020) III - VIII Semester

1			**Short title and Commencement**: These Rules and Regulations may be called as "**MVJCE Rules and Regulations" Governing B.E. Programmes** for Implementation of academic autonomy. It will be in effect from the date of notification from UGC and VTU.
2			**Definitions of Key Words** The following are the definitions/descriptions that have been followed for the different terms used in the Regulations of B.E. Programmes: a. **Affiliating University**: Visvesvaraya Technological University (VTU), Belagavi. b. **Academic Autonomy**: means freedom granted by the Affiliating University to the college in all aspects conducting of its academic programmes for promoting academic excellence. c. **Autonomous College**: means a college notified as an autonomous college by the affiliating University as per its statutes i.e. VTU statutes on Autonomous Colleges (Amended) 2015 and further amended from time to time as per UGC regulations and guidelines. d. **Statutes**: means VTU statutes on Autonomous Colleges (Amended) 2015 and further amended from time to time. e. **Commission**: means University Grants Commission (UGC). f. **Council**: means All India Council for Technical Education (AICTE). g. **Course Instructor**: Teaching staff of the college appointed based on the norms laid down by the Affiliating University/Council. h. **Proctor**: Faculty member of the college appointed as per the norms. i. **Programme**: refers to a in a particular stream/ branch of Engineering/branch of specialization leading to award of Degree. It comprises events/activities, comprising of lectures/ tutorials/ laboratory work/field work, outreach activities/ project work/ vocational training/viva/seminars/Internship/ assignments/presentations/self-study etc., or a combination of some of these. j. **Branch**: Means Specialization or discipline of B.E. Degree Programme, such as Civil Engineering, Mechanical Engineering, etc. k. **Academic Year**: Means two main consecutive semesters (odd followed by an even) and a Supplementary (Summer) semester constitute one academic year. l. **Semester**: The B.E. Degree Programme is of four academic years comprising of eight Semesters in case of students admitted to I year/ I semester of the B.E. programme and three academic years comprising of six Semesters in case of students admitted to II year/ III semester of the B.E. programme (Admission through Lateral entry scheme), with the year being divided into two main

Semesters, Odd and Even of 19 to 20 weeks (with working days greater than or equal to 90) and a Supplementary (Summer) semester of 8 weeks. The odd semester may be scheduled from August, whereas even semester may be scheduled from January and Supplementary (Summer) semester starting from May/June of the year.

m. **Course**: Usually referred as 'paper' or 'subject' and is a component of a programme. All courses need not carry the same weightage. The courses should define learning objectives and learning outcomes. A course may be designed to comprise lectures/ tutorials/ laboratory work/ field work/ outreach activities/project work/ vocational training/viva/seminars/term papers/assignments/ presentations/ self-study etc., or a combination of some of these.
n. **Credit**: Refers to a unit by which the course work is measured. It also determines the number of hours of instructions required per week.
o. **Audit Courses (Non-Credit Course)/Mandatory Courses**: Means Knowledge/ Skill enhancing courses without the benefit of a grade or credit for a course.
p. **Choice Based Credit System (CBCS)**: Refers to customizing the course work for a student, through the prescribed courses (i.e., Core, Elective and soft skill courses).
q. **Course Registration**: Refers to formal registration for the courses in each Semester (Credits) by every student under the supervision of a Proctor (also called as Faculty Advisor, Mentor, Counselor etc.,) at the Institution.
r. **Course Evaluation**: Continuous Internal Evaluation (CIE) and Semester End Examinations (SEE) to constitute the major evaluation components prescribed for each Course, with only those students satisfying a minimum standard in CIE are being permitted to appear in SEE of the Course. CIE and SEE to carry equal weightage of 50:50 respectively, to enable each Course to be evaluated for 100 marks, irrespective of its Credits.
s. **Continuous Internal Evaluation (CIE)**: Refers to evaluation of student's achievement in the learning process. CIE shall be conducted by the Course Instructor and include mid-term/weekly/fortnightly class tests, homework, problem solving, group discussion, quiz, mini-project, activities & seminar throughout the Semester, with weightage for the different components being fixed. CIE through tests called the 'Internal Assessment Tests'.
t. **Semester end examinations (SEE)**: Refers to examination conducted at the college level at par with University level examination covering the entire Course Syllabus.

u. **Credit Based System (CBS):** Refers to quantification of course work, after a student completes teaching – learning process, followed by qualifying in both CIE and SEE. Under the CBS, the requirement for awarding a degree is prescribed in terms of total number of credits to be earned by the students.

v. **Credit Representation:** Refers to Credit Values for different academic activities considered, as per the Table.2. Credits for seminar, project phases, project viva–voce and internship shall be as specified in the Scheme of Teaching and Examination.

Table 2: Credit Values

Theory/Lectures (L) (hours/week/Semester)	Tutorials (T) (hours/week/Semester)	Laboratory/Practical (P) (hours/week/Semester)	Credits Sharing (L: T: P)	Total Credits
4	0	0	4:0:0	4
3	0	0	3:0:0	3
2	2	0	2:1:0	3
2	0	2	2:0:1	3
2	2	2	2:1:1	4
0	0	6	0:0:3	3
NOTE: Activities like, practical training, study tour and participation in Guest lecture shall not to carry Credits.				

w. **Letter Grade:** It is an index of the performance of students in a said course. Grades are denoted by letters S, A, B, C, D, E and F.

x. **Grading:** Is done using Letter Grades such as: S(Outstanding), A(Excellent), B (Very Good), C(Good), D(Above Average), E(Average) and F(Fail), as qualitative measure of achievement in each Course, based on the percentage of marks secured in (CIE plus SEE) of the Course and conversion to Grade effected using Absolute Grading.

Letter Grade and corresponding Grade Points on a typical 10 – Point							
Letter	S	A	B	C	D	E	F
Grade Point	10	09	08	07	06	04	00

y. **Grade Point (GP):** Refers to a numerical weightage allotted to each letter grade on a 10-point scale as under

z. **Passing Standards:** Refers to passing a Course only when getting GP greater than or equal to 04

aa. **Credit Point:** Is the product of grade point (GP) and number of credits for a course i.e.,

$$\textbf{Credit points (CrP)} = \textbf{GP} \times \textbf{Credits for the course}.$$

bb. **Semester Grade Point Average (SGPA):** Refers to a measure of academic performance of student/s in a semester. It is the ratio of total credit points secured by a student in various courses of a semester and the total course

			credits taken during that semester. cc. **Cumulative Grade Point Average (CGPA)**: Is a measure of overall cumulative performance of a student over all semesters. The CGPA is the ratio of total credit points earned by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. dd. **Transcript or Grade Card:** Refers to a certificate showing the grades earned by a student. A grade certificate shall be issued to all the registered students after every semester. The grade certificate will display the programme details (Course code, title, number of credits, grades secured) along with SGPA of that semester and CGPA earned till that semester.
3			**Preamble** MVJ College of Engineering (MVJCE), Bengaluru is an autonomous institute affiliated to Visvesvaraya Technological University, Belagavi and is one of the reputed institutes in the state of Karnataka and rated as one among the top institutes in the state by various rating agencies. Academic autonomy has provided a great opportunity for the institute to design/frame the curriculum that meets the global requirements, adopting teaching-learning process that brings out innovation, creativity latent, enhances rational, logical and objective thinking ability of students. The main advantage of academic autonomy is continuous learning and evaluation. Academic autonomy facilitates a shift over from examination centric to student learning centric. To bring this into reality is through understanding rules and regulations governing the academic programmes. Academic autonomy aids to emerge as a leading technological institute in the country with gain in confidence, gratitude and respect of all its stake holders especially students, alumni, parents and the society at large.
4			**Program Duration and Total Credits** The duration of various programmes and Number of Credits to be earned for award of degree is given in the Table 4.1.

Table 4.1: Programme Details

Sl. No.	Programmes	Duration	Total No. of Credits for the award of Degree	Maximum duration for obtaining degree
1.	B.E.	4 Years (Eight semesters)	175	8 Years
2.	B.E. (Lateral Entry)	3 Years (six semesters)	135	6 Years

			a) **Students admitted to 1st year B.E. programme** i. Students admitted to 1st year B.E. shall complete the programme within a period of eight academic years from the date of first admission, failing which student has to discontinue the Course. ii. Student who has not obtained eligibility to 3rd semester even after three academic years from the date of admission to 1st semester shall discontinue the programme or get readmitted to 1st year of the programme iii. Student who gets admitted to 3rd semester in three or less than three years shall complete the programme with or without break within eight academic years from the date of admission to 1st year, failing to which shall discontinue the programme or seek fresh admission following the prevailing admission procedure at that time. b) **Students admitted II Year B.E. under lateral entry** i. Students admitted II Year B.E. under lateral entry scheme shall complete the Programme within a period of six academic years from the date of first admission, failing which student has to discontinue the programme. ii. A student who has not obtained the eligibility to 5th semester even after two academic years from the date of admission shall discontinue the Programme or get readmitted to 3rd semester of the programme iii. Student who gets admitted to 5th semester in two or less than two years shall complete the programme with or without break within six academic years from the date of admission to 1st year, failing to which shall discontinue the programme or seek fresh admission following the prevailing admission procedure at that time.
5			Eligibility for Admission (As per the Government/University orders issued from time to time)
	5.1		For Regular students i. Admission to I year/ I semester Bachelor Degree in Engineering/ shall be open to the students who have passed the II PUC/ XII Standard/ Equivalent Examination with English as one of the Languages and obtained a Minimum of 45% of Marks in aggregate in Physics and Mathematics along with Chemistry / Bio-Technology / Biology / Electronics / Computer Science. ii. In case of SC/ST, Category -1 and OBC (2A, 2B, 3A and 3B) category students from Karnataka (Karnataka candidates only) the minimum marks for eligibility shall be 40 %.

			iii. With regard to the qualification earned from foreign countries, Equivalence certificate from the Association of Indian Universities and Eligibility Certificate from Affiliating University is Mandatory for admission to B.E. programme. In case of any dispute about the equivalence in qualification earned from foreign countries, the decision of the Affiliating University's Equivalence committee shall be the final in establishing the eligibility of the student.
	5.2		For Lateral Entry students i. Admission to II year/ III semester Bachelor Degree in Engineering/ Technology (Lateral Entry) shall be open to the Diploma holders and B.Sc. graduates. ii. Must have passed Diploma or equivalent examination as recognized by University and secured not less than forty-five percentage (45%) marks in the final year examination (fifth and sixth semesters) in the appropriate branch of engineering. In case of SC/ST and OBC students from Karnataka the minimum marks for eligibility shall be forty percent (40%). iii. Those candidates who have completed Diploma from other than Karnataka state shall provide the Equivalence/ Eligibility Certificate from the Director of Technical Education, Karnataka. B.Sc. Graduates i. Must have passed B.Sc. degree from a recognized University under the UGC or equivalent qualification as recognized by University and secured not less than forty-five percentage (45%) marks in aggregate (considering the marks of all six semesters). In case of SC/ST and OBC students from Karnataka (Karnataka candidates) the minimum marks for eligibility shall be forty percent (40%). Candidates must have studied Mathematics as subject of study at XII Standard. ii. Those students, who have passed a qualifying examination other than the PUC II examination of the Pre-University Education Board of Karnataka, have to obtain eligibility certificate for seeking admission to B.E. Degree Programme from Visvesvaraya Technological University, Belagavi.

6			Academic Administration Academic administration is monitored by the following academic committees / officers of the institute: - Governing Council (GC) - Academic Council (AC) - Institute Academic Affairs Committee (IAAC) - Departmental Academic Affairs Committee (DAAC) - Joint Board of Studies (JBoS) - Board of Studies (BoS) - Board of Examiners (BoE) - Programme Accreditation Committee (PAC) - Malpractice Enquiry Committee (MEC) - Grievance Redressal Cell (GRC) - Internal Quality Assurance Cell (IQAC) - Disciplinary Committee (DC) - Student Counseling Cell (SCC) - Departmental Project Evaluation Committee (DPEC) - Departmental Seminar Evaluation Committee (DSEC) - Interdisciplinary Project Evaluation Committee (IPEC) - Controller of Examination (CoE) - Dean of Academic Affairs (DAA) - Dean Student Welfare (DSW)
	6.1		**Governing Council (GC)**: Responsible for overall general and academic administration of the Institute.
	6.2		**Academic Council (AC)**: Responsible for overall academic regulations, curricula, scheme of syllabi, evaluation and approval of results.
	6.3		**Institute Academic Affairs Committee (IAAC)**: Responsible for implementation of all academic decisions of AC and monitoring the registration of students, formulation of guidelines for conduct of examination and evaluation and all the issues connected to the academic activity. Responsible for award of 'I' Grade and approving the course to be studied by students having shortage of credits for all award of degree. <u>Structure of IAAC</u> Chairman : Principal Members : Chairmen of all Boards of Studies : Vice-Principal

			: Controller of Examination : Registrar : Two senior faculty members appointed by Principal Member Secretary : Dean (Academic)
	6.4		**Departmental Academic Affairs Committee (DAAC):** Helps Dean of Academic Affairs and Heads of the Departments in the registration of all departmental courses and preparation of academic timetable. Responsible for constitution of Departmental Project Evaluation Committee (DPEC) for project evaluation and Departmental Seminar Evaluation Committee (DSEC) for the evaluation of student seminars and Industrial training/field training. Responsible for identification of courses to be offered during evening / summer semester, allotment of guides for mini and major projects and recommending a course to be studied by students having shortage of credits for award of degree. Approval of registration to different soft core course of failed students. <u>Structure of DAAC</u> Chairman : Head of the Department Members : Three senior faculty members appointed by Head of the Department Convener : Faculty member appointed by Head of the Department
	6.5		**Joint Board of Studies (JBoS):** Responsible for discussing common academic issues and recommend to academic issues and recommend to academic council for approval. <u>Structure of JBoS</u> Chairman : Principal Members : Chairmen of all Boards of Studies Invitees : Controller of Examination & Training & Placement Officer Member Secretary : Dean (Academic)
	6.6		**Board of Studies (BoS):** <u>Structure of BoS</u> Chairman : Head of the Department Members : All members of DAAC Convener : Convener DAAC • Two experts from outside the Institute • One expert from outside the Institute nominated by the Vice-Chancellor from a panel of six recommended by Principal. • One representative from industry/corporate sector/allied area relating to placement to be nominated by the AC.

			• One post graduate meritorious alumnus to be nominated by Principal as member • Chairman co-opts the following members. Co-opted: Experts from outside the Institute whenever special courses of studies are to be formulated. • Other members of the faculty of the same Department. **The term of nominated members shall be three years.** The functions of BoS are to: • Prepare the syllabi for various courses keeping in view the objectives of the institute, interest of the stakeholders and State / National/International and societal requirements for the consideration and approval of academic council. • Suggest Head of Department for improving teaching and evaluation techniques • Prepare panel of experts for appointment as examiners • Guide the department with respect to teaching, extension and other academic activities in the departments • Perform any other function assigned by the AC
	6.7		Board of Examiners (BoE) <u>Structure of BoE</u> Chairman : Head of the Department Members : Two or three faculty members covering different areas of specialization, recommended by HoD One /Two experts from other institutions. Convener : Faculty member appointed by Head of the Department The functions of BoE are to: • Scrutinize the question papers • Forward the panel of examiners for each course to the Controller of Examination • Prepare and approve the detailed scheme of evaluation pertaining to practical courses • Analyze the semester end examination results of all the semesters.
	6.8		Programme Accreditation Committee (PAC): Responsible for measuring the attainment of Cos (Course Outcomes), and Pos (Programme Outcomes) of each of the programme offered in the department and presenting the report to IAAC, PAC is constituted separately for each programme.

			Structure of PAC Chairman : Head of the Department Members : Two Associate Professors Two or Three Assistant Professors Convener : Faculty member appointed by Head of the Department
	6.9		**Malpractice Enquiry Committee (MEC):** To conduct enquiry of the students involved in malpractice and decide the nature of punishment to be awarded depending upon the gravity of the offence. Structure of MEC Chairman : Principal Members : Dean (Academic) : Vice-Principal : Registrar : Respective Head of Department/s : Legal advisor Member Secretary : Controller of Examinations
	6.10		**Grievance Redressal Cell (GRC):** Receives written complaints from the stakeholders regarding any kind of academic grievances. Examines the genuineness of the complaint and suggest remedies. Forward the recommendations to the chairperson of AC for implementation. Structure of AGC Chairman : Dean (Academic) Members : Vice-Principal : Registrar : Two or Three Senior faculty members appointed by Principal Member Secretary : Dean of Student Welfare

	6.11		**Internal Quality Assurance Cell (IQAC):** - Development and application of quality benchmarks. - Parameters for various academic and administrative activities of the institution. - Facilitating the creation of a learner-centric environment conducive to quality education and faculty maturation to adopt the required knowledge and technology for participatory teaching and learning process. - Collection and analysis of feedback from all stakeholders on quality-related institutional processes. - Dissemination of information on various quality parameters to all stakeholders. - Organizing inter and intra institutional workshops, seminars on quality related themes and promotion of quality circles. - Documentation of the various programmes/activities leading to quality improvement. - Acting as a nodal agency of the Institution for coordinating quality-related activities, including adoption and dissemination of best practices. - Development and maintenance of institutional database through MIS for the purpose of maintaining / enhancing the institutional quality. - Periodical conduct of Academic and Administrative Audit and its follow-up. - Preparation and submission of the Annual Quality Assurance Report (AQAR) as per guidelines and parameters of NAAC/NBA. <u>Structure of IQAC</u> Chairman : Principal Members : Dean (Academic) : Three Senior faculty members appointed by Principal : One member from Management : Few Senior administrative officers : One/ Two Nominees from local Society, Students and Alumni : One/ Two Nominees from Employers /Industrialists/Stakeholders : Registrar Member Secretary : Vice-Principal
	6.12		**Disciplinary Committee (DC):** Conduct enquiry pertaining to indiscipline and award suitable punishment. <u>Structure of DC</u> Chairman : Principal Members : Head of Department/s

			: Vice-Principal : Registrar : Dean of Student Welfare Invitees : Controller of Examinations Member Secretary : Dean (Academic)
	6.13		Student Counselling Cell (SCC): "Adolescence is a period when individual is over whelmed by a number of simultaneous developments, to meet this situation proper guidance is needed in this period. The teacher and institute encourage the development of effective maturity by providing the counselling and guidance". Whereas i feel dropping and withdrawal be advised by course co-ordinators.
	6.14		Departmental Project Evaluation Committee (DPEC): Structure of DPEC Chairman : Head of the Department Members : Two faculty members and guide Convener : Faculty member nominated by Head of the Department The functions of DPEC are to: • Evaluate project • Furnish the details of evaluation to concerned HoD
	6.15		Departmental Seminar Evaluation Committee (DSEC): Structure of DPEC Chairman : Head of the Department Members : Two faculty members and guide Convener : Faculty member nominated by Head of the Department The functions of DSEC are to: • Evaluate Technical seminar • Furnish the details of evaluation to concerned HoD
	6.16		Interdisciplinary Project Evaluation Committee (IPEC): Structure of IPEC Chairman : Nominated by IAAC Members : Two faculty members from each department Minimum six faculty nominated by Chairman Convener : Faculty member nominated by the Chairman The functions of IPEC are to: • Evaluate interdisciplinary projects • Furnish the details of evaluation to concerned HoDs

	6.17		The following officials are also involved in academic administration. **Controller of Examination (CoE):** Responsible for preparation of examination manual, all matters pertaining to smooth conduct of examinations, evaluation and grading, publication of results and printing of grade cards, provisional degree certificates and transcripts. Responsible for maintaining all records pertaining to examinations. **Dean of Academic Affairs (DAA):** Responsible for receiving, processing and maintaining all records pertaining to undergraduate program and post graduate programs including curricula, courses offered, academic calendar, records of drop, withdraw, rejection of results and long leave of students. Preparation of first year, OE/HS timetable **Dean of Student Welfare (DSW):** Attend to all student related problems and disciplinary matters.
7			**Academic Year** The breakup of academic year for regular semesters and supplementary (Summer) semester are given in the Tables 7.1 and 7.2. Details of vacation are given in Table 7.3.

Table 7.1: Break-up of academic year for regular semesters

Sl. No.	Action Plan	Odd Semester	Vacation between Odd and Even semesters	Even Semester	Vacation between Odd and Even semesters
1	Registration of courses	2 days (before the commencement of the semester)		2 days (before the commencement of the semester)	
2	Course Work	16 weeks		16 weeks	
3	Examination preparation holidays	1 week		1 week	
4	Semester End Examination	2 to 3 weeks		2 to 3 weeks	
	Total	19 to 20 weeks	1 to 2 weeks	19 to 20 weeks	10 weeks

Table 7.2: Break-up of summer semester

Sl.No.	Action Plan	Summer Semester
1	Registration of courses	1 day (The next working day after the announcement of even semester examination results)
2	Course Work	7 weeks
3	Examination preparation holidays	1 weeks
4	Semester End Examination	1 weeks
5	Vacation	1 weeks
	Total	**10 weeks**

Table 7.3: Details of vacations

Between odd and even semester	2 weeks
Between even and odd semester (which includes one week vacation between summer & odd semester	10 weeks
Total	**12 weeks**

8			General Structure of Credit Allocation

General Structure of Credit Allocation

Every course offered carries credits which are specified in the scheme of the study.

Credits allocation : 1 credit for 1 Lecture hour
1 credit for 2 Tutorial hours
1 credit for 2 Lab hours

For example : Engg. Maths-I carries 4.5 credits (4 lecture hrs. + 1 Tutorial hr.)
Engg. Physics carries 4 credits (4 lecture hrs.)
Physics Lab carries 1.5 credits (3 lab hrs.)

All courses carry a maximum of 100 marks.

A typical structure of the courses and credit allocation for Hard-core, Soft-core and Mandatory course (for undergraduate engineering programme) is given in Table 8.1.

Table 8.1: Categories of courses

Sl. No.	Course/Course Area	Type of Course	Credit Allocation
1.	Basic Sciences	Hardcore[1]	24
2.	Engineering Sciences	Hardcore[1]	20
3.	Professional Core courses	Hardcore[1]	75
4.	Professional Elective courses	Soft core[2]	18
5.	Open Electives	Soft core[2]	9
6.	Humanities & Social Sciences	Soft core[2]	8
7.	Project work, Seminar and others	Soft core[2]	21
8.	Soft Skills, Environmental Engineering on any other course offered by the respective departments for zero credits	Mandatory[3/4]	--

[1] If a student gets 'F' grade in a hard-core course, he/she should repeat that course in its entirety. *Further, if a student gets 'F' grade in credit course consecutively five times, he/she has to leave the Engineering program. However, this student can take re-admission to the 1st semester afresh.*

[2] If a student fails in a soft-core course he/she can re-register for same course or different course in the same soft-core group with the permission of DAAC and approved by IAAC

[3] **Students have to pass the mandatory courses for the award of the degree.**

[4] Any additional course/s taken by the student over and above the stipulated will not earn any credit.

9			Registration Students should register, for the courses as per the scheme of study, in each of the semester/s (odd / even) with the respective proctors. The dates for registration are specified in academic calendar of the Institute published before the commencement of academic year. Registration by the students should be completed within the dates specified in the academic calendar. **Registration after the last date is not permitted. Students should be present in person to obtain the approval (Form-1) from the proctor for registered courses.**
	9.1		Registration procedure i. On the day of registration, the students have to approach the concerned proctor. ii. Proctor will counsel the students and will advise the students regarding the courses to be registered during the current semester taking into account the performance of the student during the previous semester/s. iii. Students have to register through online mode using their credentials. iv. A print copy of the filled registration form **(Form-1)** shall be submitted to the Proctor along with fee paid receipt. v. The proctor will enroll the students for the courses as indicated in the registration form.
	9.2		Eligibility requirements for Registration to an academic year i. He/she should not have obtained 'F' grades in credit courses five times consecutively. ii. For the registration to odd semester, *the total number of courses Withdrawn (W), Dropped (DP), Not Eligible (NE), Failed (F), Incomplete grade (I) and X grade should not exceed 4.* iii. CGPA should be $\geq$ 5 at end of academic year. iv. Dues of the previous semester to the Institution, Hostel and Library are to be paid. v. Should not have any disciplinary proceeding pending against the candidate. Illustrations: a) A candidate seeking eligibility to 3rd semester should not have W, DP, NE, F, I or X grade in more than four courses of first, second and supplementary semesters taken together excluding mandatory courses. b) A candidate seeking eligibility to 5th semester should not have W, DP, NE, F, I or X grade in more than four courses of 1st to 4th semesters and supplementary semester put together excluding mandatory courses.

			c) A candidate seeking eligibility to 7^{th} semester should have passed in all the courses of 1^{st} and 2^{nd} semesters and should not have W, DP, NE, F, I or X grade in more than four courses of 3^{rd} to 6^{th} semesters and supplementary semester put together excluding mandatory courses. i. Dues of the previous semesters to the Institution, Hostel and Library are paid. ii. Should not have any disciplinary proceeding pending against the candidate.
	9.3		Registration for odd semester i. For registration to III, V and VII semesters, students should satisfy eligibility criteria as per the clause 9.2. ii. A student has to register for all the courses offered in the semester. iii. A student has to register for a minimum of 16 and a maximum of 28 credits including re-registered courses, if any.
	9.4		Registration for even semester i. All students are eligible to move from odd semester to even semester during the same academic year. ii. A student has to register for all the courses offered in a semester. **iii.** A student has to register for a minimum of 16 and a maximum of 28 credits including re-registered courses, if any.
	9.5		Registration of courses for 'DP','W', 'NE' and 'F' grades i. Students who have dropped, withdrawn, secured NE / F grade in courses of any semester should repeat those courses in their entirety to secure E or higher grades by re-registering in supplementary (Summer) semester or as and when offered in the regular semesters. ii. If a student has dropped, withdrawn, secured NE / F grade in a Professional Electives / OE / HS course, then student may re-register for the same or different course. **iii.** If a student gets F grade in project / seminar, he/she has to take up new project / seminar topic.

	9.6		**Registration for supplementary (Summer) semester** i. Supplementary semester is of eight weeks' duration and is offered at the end of even semester. ii. Supplementary semester is for students who have failed with F grade during regular semesters, dropped, withdrawn, secured NE grade in the courses. iii. The list of courses offered during the supplementary semester will be announced at the end of even semester. iv. Registration by the students should be completed on or before the registration dates specified in the academic calendar. v. Registration after the last date is not permitted. vi. A student is allowed to register for a maximum of four theory courses during the supplementary semester excluding one mandatory course provided that there is no overlap of timings even for one hour. vii. Dropping and withdrawal of courses are not allowed in supplementary semester. a) Compensatory Test will not be conducted in supplementary semester. b) X and I grades are not awarded in supplementary semester.
	9.7		**Course prerequisites** Certain courses need the knowledge of courses offered in the previous semesters, called prerequisites. Each department notifies the courses, which need prerequisites and the candidate shall register for such courses(s) only after he/she completes the prerequisites by securing at least E grade. Students are not permitted to register for the courses having prerequisites in the higher semester, if they had dropped or withdrawn the prerequisite courses in the previous semesters.
	9.8		**Registration for Elective courses (Professional and Open Electives)** i. List of elective courses offered will be published by the respective department ii. Student shall exercise his/her option in respect of elective course/s and register for the same offered by the department at the beginning of respective semester iii. Elective/s can be offered if the minimum number of students registered shall not be less than ten iv. However, the condition as stated in clause 9.8 (ii) shall not be applicable to the programme having class strength is less than 10. In such cases only one elective shall be offered v. The maximum number of registration to an elective may be restricted by the concerned department **vi.** Student may be permitted to opt for change of elective course/s within fifteen

			days from the date of commencement of the semester.
	9.9		Range of minimum and maximum credits to be earned in an academic year (inclusive of supplementary semester)
			i. I year ≥ 28 to ≤ 40 ii. II and III year ≥ 32 to ≤ 56
	9.10		Range of minimum and maximum credits to be registered per semester
			In each semester students have to register for a minimum of 16 and a maximum of 28 credits including re-registered courses, if any.
	9.11		Lateral entry i. Diploma Holders: Students admitted to Bachelor of Engineering at the III semester level have to register for mandatory non-credit courses "Additional Mathematics-1" in III semester and "Additional Mathematics-2" in IV semester respectively for award of degree. These students are exempted from studying a professional Core Course which they have already studied in their Diploma level. Also they have to study Communicative English as Non-credit Mandatory Course. ii. B.Sc. Degree holders: Students admitted to Bachelor of Engineering at the III semester level have to register for mandatory non-credit courses "Engineering Graphics and Elements of Civil Engineering and Mechanics for award of degree.
10			Attendance Requirement i. A candidate has to obtain a minimum attendance of 85% in each course to appear for the Semester End Examination (SEE). However, such of the students who have attendance between 75% and less than 85% may get condonation of attendance by Academic Council only on valid grounds such as hospitalization, participation in university and intercollegiate sports, cultural activities and participation in seminar, workshop and paper presentation with prior permission. Students must submit the request for condonation of attendance in the prescribed format with supporting documents and duly recommended by the Head of the Department at least one week before the commencement of examination, failing which condonation of attendance will not be considered. ii. Students having less than 75% are not eligible for condonation of attendance on any ground. iii. If a candidate fails to satisfy the minimum attendance requirements in any

			course, NE grade is awarded to that course. iv. The basis for the calculation of attendance shall be the period prescribed by the institute in its calendar of events. For I semester B.E. & lateral entry students, the attendance is reckoned from their date of admission. For all other semesters, attendance will be counted from the date of commencement of class as announced in the institute academic calendar. v. It is mandatory on the part of the students to regularly check the status of their attendance with the respective faculty.
11			Projects Projects consist of mini project spread over V & VI semesters and Major project spread over VII & VIII semesters.
	11.1		A. Mini Project The aim is to bring out creativity and innovation in the students preferably in the form of a working model. This project can be taken up by a group of students (normally four members) from the same or different departments. If the project demands, more man power, then the number of students in the group can be relaxed by the Heads of the concerned departments. i. The project is spread over two semesters (V & VI) and evaluated at the end of each semester. ii. No credit is allocated during V semester. iii. Mini project is evaluated during the VI semester for 100 marks (50% CIE and 50% SEE) iv. DAAC assigns guides for mini projects. v. Interdisciplinary projects have a guide from each of the participating departments.
	11.2		B. Major Project i. It is spread over VII and VIII semesters and evaluated at the end of each semester for the assignment credits. ii. The project may be based on; • Design aspects • Theoretical/Analytical Modelling • Computer Simulation • Developing Working Model iii. The project could be part of the research activity carried out in the department.

			iv. The literature survey should be one of the components of the project. v. The project can be carried outside the institute in a recognized industry/research lab. vi. Head of the Department and DAAC assign guides for the major project. • The project can be taken up by a group of students (normally four members) from the same or different departments. • Interdisciplinary projects have a guide from each of the participating departments. • The students should maintain a project diary consisting of day-to-day work carried out by them with monitoring by the guide on weekly basis. vii. Project Report completed in all respects and approved by the guide and HoD must be submitted at least one week before the commencement of theory examination of VIII semester. Reports submitted after the last date will not be evaluated in the even semester and I grade will be awarded to major project. The students have to register during supplementary semester or subsequent semester. viii. Plagiarism check has been made mandatory. The project report shall be summarily rejected, if the plagiarized content (similarity index excluding self-written research papers, common definitions) is > 25%. In such cases students have to resubmit the project report with prescribed fee within fortnight from the date of rejection. ix. Two chances shall be given for the resubmission. After two chances if the plagiarism level found unacceptable then, students have to repeat the project work entirely by reregistering during subsequent academic year.
12			Seminars Students of VII semester have to present a technical seminar on emerging area in the respective discipline.
13			Field training/Industrial Internship Students have to undergo this training for a period of 6 weeks (minimum) during the vacation between even and odd semesters of II and III year or III and IV year. Those students who are unable to complete during these periods will have to undergo the industrial training after the VIII semester and the VIII semester Grade Card will be issued only after the successful completion of industrial training by that student.

14			**Research Initiative at UG level** Students who have CGPA of 8.5 and above up to 4th semester and would like to pursue research work during 5th & 6th semesters are required to identify the area of research and the guide. The students have to submit the application to the concerned Head of the Department in the prescribed format (Form-6) available in the department. Students are exempted from studying one Open Elective and one Professional Elective course in 5th and 6th semesters.
15			**Examination and Evaluation** Evaluation of a student in each course is a continuous process, which is based on: - Continuous Internal Evaluation (CIE): 50% of the marks allotted for the course. - Semester End Examination (SEE): 50% of the marks allotted for the course.
	15.1		**Pattern of question papers for theory courses**
		15.1.1	**Internal Assessment (IA)** i. There will be three mandatory tests. ii. Question paper for the IA consists two parts i.e. Part A and part B. Part A will be a compulsory question consists of objective type or short answer type questions of 1 or 2 marks each for a total of 6 marks covering the syllabus during the periods specified. iii. Part B also covers the syllabus during the periods specified consists of two questions of 12 marks each having choices and may contain sub-divisions. Students have to answer two full questions. iv. Duration of each test is 90 minutes
		15.1.2	**Semester End examination** i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. iv. The duration of examination is 3 hours.
	15.2		**Examination and evaluation in theory courses**

15.2.1 **Continuous Internal Evaluation (CIE)**

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be:

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)
- Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

a) First test is conducted at the end of sixth week from the beginning of the semester. The syllabus for this test is the syllabus covered in the first six weeks. The duration will be of 90 minutes.

b) Second test is conducted at the end of tenth week. The syllabus for this examination is the syllabus covered between first test and second test. The duration will be of 90 minutes.

c) Third test is conducted at the end of fifteenth week. The syllabus for this examination is the syllabus covered between second test and third test. The duration will be of 90 minutes.

d) A quiz is a mini test of about 20 minutes' duration. One quiz during the period up to first test, second quiz between first test and second test.

Details of marks distribution for evaluation of hard-core & soft core courses is shown in Table 15.2.1(a)

Table 15.2.1 (a)Marks distribution

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 marks each i.e. $\sum$ (Marks obtained in each test)÷ 3	CIE (50)	30
Quizzes		2x 2 = 4
Activities/Experimentations related to courses		8
Mini Project / Case Studies		8
Semester End Examination	SEE (50)	50
	Total	**100**

e) It is mandatory for a student to appear for all three tests. If any student who is unable to attend any one or both tests on account of hospitalization only he/she is permitted to attend the compensatory test. He/she should have maintained a minimum of 85% attendance in that particular subject till the date of compensatory test. A request letter in the prescribed proforma

(Form-2) has to be submitted by the student to the Head of the Department within one week from the end of respective test which will be forwarded to Dean (Academic). The syllabus for compensatory test includes the syllabus covered from the beginning of the semester up to compensatory test time. The duration of test will be of 90 minutes. The marks secured in the compensatory examination are considered for computation of CIE in place of any one of the three tests in which student was absent. If a student was absent for all three tests, the marks secured in compensatory examination is considered for the I-test and he/she is considered as absent for remaining tests.

i. Students who have missed quizzes, tests on account of, participation in co-curricular activities, sports and cultural fests are permitted to take alternative quiz and test. The original copy of the letter shall be approved by the Principal recommended by Physical Education Director/Cultural Committee Chairman has to be submitted to Dean, Academic Affairs. The faulty in-charge will conduct the quiz/test.
ii. Compensatory tests will be conducted during 16th week from 3.30 to 5.00 PM on normal working days or weekends.
iii. **Compensatory test is not for improvement of marks. Compensatory test will not be given to students involved in malpractice either during tests and / or quizzes.**

f) Minimum of two assignments are to be submitted, first between I and II test, second between II test and last working day of that semester.

g) For mandatory courses two tests are conducted and the sum of the two is taken as Continuous Internal Evaluation (CIE) marks. There will be only one compensatory test for 25 marks. Allotment of marks for Mandatory course is shown in Table 15.2.1 (b)

Table 15.2.1 (b) CIE & SEE marks allotment for mandatory courses

Details		Marks
First Test	CIE (50)	25
Second Test		25
Semester End Examination	SEE (50)	50
	Total	**100**

h) To maintain transparency, the students are provided access to the valued Test answer scripts, quiz papers and assignments. It is mandatory for the students to check the quiz/test answer papers after evaluation and affix their signature.

i) Head of the Department announces the CIE marks in the department notice

			board prior to the commencement of semester end examination. Any discrepancy in CIE marks shall be brought to the notice of concerned faculty immediately by the students for redressal before the commencement of SEE. j) *If a student fails to obtain 40% (i.e., 20/50) of total marks allotted for CIE (Hardcore / Soft core courses) then, such a student is awarded NE grade and will not be permitted to take SEE. Such students have to repeat the course in its entirety by re-registering that course when it is offered.* k) Quizzes and Assignment: Questions for quizzes may be objective type, short answer type and numerical problems. Assignments shall be given on complex engineering problems and students have to use problem solving skills.
		15.2.2	Semester End Examination (SEE) i. Semester End Examination is conducted as per the academic calendar of the Institution. The examination is conducted for 100 marks and is reduced to 50 marks for computation of grades. ii. A student has to obtain a minimum of 40% (i.e., 20/50 marks) of the marks allotted to SEE, failing which F or X grade will be awarded for that course. Whereas X grade is awarded to a student who has minimum attendance of 85% and minimum of 90% in CIE. iii. SEE answer scripts are evaluated by the internal examiners normally the Course Instructor appointed by the Controller of Examination and normally 20% of the scripts moderated by the external examiners appointed by the Controller of Examination in consultation with respective BoEs. iv. If the difference between the marks awarded by two evaluators is less than 10%, then the average of the marks awarded by the two evaluators is taken for further processing. v. If the difference between the marks awarded by two evaluators is more than 10%, then a third evaluator assesses the answer script. The average marks of the nearest two evaluations are taken for further processing. If one of the three evaluation marks falls exactly midway between the other two, then higher two evaluation marks are taken for averaging.
	15.3		Evaluation of Practical courses

		15.3.1	**Continuous Internal Evaluation (CIE)**

i. CIE marks for the practical course is computed by adding the average of the marks secured by the student for conducting each of the experiment plus the marks secured in the test conducted and also the marks secured for the open ended experiments (experiments embedded with theory concepts of the course/s) at the end of the course.
ii. Head of the Department announces the CIE marks in the department notice board and submits a copy to Controller of Examination duly signed by the faculty in-charge at the end of the semester.
iii. If a student fails to obtain 50% (i.e., 25/50) of total marks allotted for CIE in Practical/Mini Project/Project/Internship then, such a student is awarded NE grade and will not be permitted to take SEE in the said course. Such students have to repeat the course in its entirety by re-registering that course when it is offered.

The breakup of CIE marks is given in the Table 15.3.1 9a) and (b)

Table 15.3.1 (a) Breakup of CIE marks for lab courses without Open Ended Experiments

Regular Lab Work and writing lab records	(20 + 15) 35 marks
Lab test and Viva-voce at the end of the semester	(10 + 5) 15 marks
Total	**50 marks**

Table 15.3.1 (b) Break up of CIE marks for lab courses with Open Ended Experiments

Regular Lab Work and writing lab records	(15 + 10) 25 marks
Lab test and Viva-voce at the end of the semester	(10 + 5) 15 marks
Evaluation of open ended experiment	10 marks
Total	**50 marks**

		15.3.2	**Semester End Examination (SEE)** Semester end practical examination is conducted jointly by one internal examiner and one external examiner. Break up of SEE marks is given in the Table 15.3.2

Table 15.3.2 Breakup of SEE marks for lab courses

Writing the procedure	10 marks
Conducting lab experiment(s)	20 marks
Analysis of experimental result & presentation	10 marks
Viva-voce related to the experiments	10 marks
Total	**50 marks**

For pass in practical course students has to secure minimum 40% of allotted marks (i.e. 20/50).

	15.4		**Evaluation of Projects, Seminars, Industrial / Field training & Co-curricular activities**
		15.4.1	*CIE for Mini Project* The CIE for mini project is spread over V and VI semesters. At the end of V semester student have to submit a report containing details of the work done. The breakup of marks of CIE for mini project is given in table 15.4.1

Table 15.4.1 Breakup of CIE marks for Mini Project

Evaluation at the end of V semester (DPEC)	15 marks
Evaluation at the end of VI semester (DPEC)	15 marks
Evaluation by Guide	20 marks
Total	**50 marks**

		15.4.2	SEE for Mini Project Mini project work will be jointly evaluated by one internal and one external examiner appointed by the Chairman BoE. The breakup of marks is shown in Table 15.4.2 For pass in mini students has to secure minimum 40% of allotted marks (i.e. 20/50).

Table 15.4.2 Breakup of SEE marks for Mini Project

Project Report, Presentation, Demonstration and Quality of work	30 marks
Viva-Voce	20 marks
Total	50 marks

If a student fails to satisfy the prescribed CIE and SEE, has to be repeated in its entirety by reregistering for the same.

		15.4.3	CIE for Major Project

At the end of VII semester, for major project, student has to give the seminar covering the literature survey and preliminary requirements/specifications/flow chart/design steps pertaining to the chosen project. Also, the students in the project batch have to submit a report to the respective guide.

The breakup of marks for CIE for major project at the end of VII semester is given in Table 15.4.3

Table 15.4.3 CIE marks break up for major project (during VII semester)

Relevance of the topic	10 marks
Report	20 marks
Evaluation by Guide	25 marks
Presentation	30 marks
Viva-voce	15 marks
Total	100 marks

CIE for report shall be awarded only on submission of report covering the literature survey and problem definition. Two credits are assigned for the work done during VII semester. However, there is no SEE for major project during VII semester.

15.4.4 CIE for major project during VIII semester

Major project is evaluated for 100 marks (50% CIE & 50% for SEE) during VIII semester. The breakup of CIE marks is given in table 15.4.5

15.4.5 Co-curricular Activities (Max of five marks)

Weightage of 5 marks is given for co-curricular activities, with an objective of inculcating in students, the culture of preparing and presenting papers, encouraging them to apply the technical knowledge for solving real life problems and motivating them towards self-study.

- 2 marks for presenting paper in National / International conference by maximum of two authors.
- Additional 2 marks for every additional paper presentation but not in the same conference and the paper should not be same.
- 2 marks for participation in hobby project exhibition.
- Additional 2 marks for participation in hobby project exhibition held at different technical institutions or different project.
- 3 marks for obtaining any prize other than first prize.
- 4 marks for obtaining first prize.
- 5 marks for publication in journals.

- 3 marks for every certification obtained from reputed companies like IBM, Microsoft and other organizations approved by the department.
- Additional 3 marks for every additional certification.
- For paper presentation, a maximum of two authors (first two) is considered and if the paper is from the project work, all the students are considered.
- Technical Quiz / Business Quiz / Auto Quiz
  2 marks for qualifying in Written Test
  3 marks for obtaining any prize other than first prize
  4 marks for obtaining first prize
- Hardware Debugging / Programming Contest
  2 marks for qualifying in Written Test
  3 marks for obtaining any prize other than first prize
  4 marks for obtaining first prize
- Robotics/Catia Design Contest/Cyber Eptymology/ Instantiania
  2 marks for participation
  3 marks for obtaining any prize other than first prize
  4 marks for obtaining first prize
- This weightage is considered for computing CIE for the Project Work at VIII semester. The paper presentation and participation in hobby project exhibition & other activities mentioned above may be in any semester (I to VIII sem).

In View of the proposed weightage for co-curricular activities, following is the modification in the breakup of CIE for major Project.

Table 15.4.5 CIE marks break up for major project (during VIII semester)

Seminar on project and demonstration	20 marks
Report	10 marks
Evaluation by Guide	15 marks
Co-curricular Activities	05 marks
Total	**50 marks**

15.4.6 **SEE for the major project**

SEE is conducted by one external examiner and one internal examiner. The breakup of marks is given in Table 15.4.6. For pass in project work students has to secure minimum 40% of allotted marks (i.e. 20/50).

Table 15.4.6 Breakup of SEE marks for major project

Project Report, Presentation, Demonstration and Quality of work	30 marks
Viva-Voce	20 marks
Total	**50 marks**

			If a student fails to satisfy the prescribed CIE and SEE, has to be repeated in its entirety by reregistering for the same.
	15.5		**Evaluation of Seminars** Students of VII semester have to present a technical seminar on emerging area in the respective discipline. Seminar is evaluated for 100 marks. The breakup of marks for the evaluation of seminar is given in Table 15.5. For pass students has to secure minimum 50% of allotted marks.

Table 15.5 Breakup of Seminar

Relevance of the topic	10 marks
Report	20 marks
Presentation	50 marks
Viva-voce	20 marks
Total	**100 marks**

Note: There is no CIE and SEE for seminar.

	15.6		**Evaluation of Field training/Industrial Internship** Evaluation of the Field training/Industrial Internship shall be conducted during VIII semester by internal and external examiners for 100 marks. The external examiner shall be from the Industry where the student carried out the Field training/Industrial Internship. In case of non-availability of external examiner, the concerned head of the department shall appoint an external examiner from the nearby college or a senior faculty member from outside the department in consultation with respective BOE and approved by Principal. The Field training/Industrial Internship carries two credits. A student has to get a minimum of 40% marks for a pass. If a student fails to complete the same, then the Field training/Industrial Internship has to be repeated in its entirety. For pass in internship students has to secure minimum 40% of allotted marks (i.e. 20/50). The breakup of marks for the evaluation of training is as in Table 15.6

Table 15.6 Marks break up for field training evaluation

Evaluation by the supervisor under whom the training was carried out	25 marks
Evaluation by DSEC	
i. Relevance of the Field training/Industrial Internship	10 marks
ii. Report	25 marks
iii. Evaluation	40 marks
Total	**100 marks**

	15.7		**Review of Answer Scripts** Evaluated Answer Scripts are made available to the students for review in presence of parents by registering for the same within the dates prescribed in the academic calendar.

	15.8		Extended (Revaluation)Evaluation The students, who have not satisfied with the evaluation in SEE, can apply for Extended Evaluation on payment of prescribed fee within the stipulated time as notified by the institute. Extended Evaluation is carried out by external examiners independently (who have not evaluated the answer script earlier). The highest marks among earlier awarded marks and the awarded by the external examiners is considered as the final marks in SEE for award of grade.
	15.9		Rejection of Results i. A student may reject his/her results of all the courses registered in a semester of an academic year *if he/she is not satisfied with the result of any semester,* subject to the condition that the maximum duration for the completion of the course as mentioned in Table 4.1 is not exceeded. The rejection is permitted only once during the entire program of study ii. Student who desire to reject the SEE results of a semester shall reject the total performance in all courses of semester (including CIE marks) either rejecting or retaining the CIE marks. iii. Student who desire to reject the total SEE performance of an odd/even semester including CIE marks, have to repeat that semester of prevailing scheme by taking readmission during the subsequent academic year/s. However, student is governed by clause 4 iv. If the student rejects the SEE permanence of odd semester excluding CIE marks shall be permitted to register the courses of next immediate even semester. v. If the student rejects the SEE permanence of even semester excluding CIE marks shall not be permitted to register the courses of next immediate odd semester as per clause 19. In such cases student shall take admission to the next odd semester of prevailing scheme during the subsequent academic year/s after obtaining eligibility. However, student is governed by clause 4 vi. Application for Rejection of results shall be submitted in the prescribed format **(Form-5)** to respective Head of the department within a week from the date of announce of results. Same shall be approved by the Principal. vii. Rejection of the performance of VII semester project work is not permitted viii. **Students who opt for rejection of results shall not be eligible for award of ranks and Honours Degree**.
16			Grade card - Grade card is issued normally within months' time from the date of

announcement of the results.

- The total number of activity points earned will be indicated in the Grade Card
- CGPA is computed by considering the latest grade obtained by the student in the courses repeated.
- After graduation, a student can apply for a consolidated grade report by paying prescribed fee for to the Institute.
- There is a provision for the issue of actual marks card after the graduation on payment of prescribed fee to the institute.

For obtaining a duplicate grade report, the student has to lodge a complaint in the jurisdictional police station and obtain the FIR. An affidavit on a stamp paper duly signed by a Notary and FIR should be submitted to the principal.

16.1 Percentage equivalence of the Grade Points

Sometimes, it would be necessary to provide equivalence of the CGPA with the percentages and/or class awarded as in the conventional system of declaring the result of university examinations. Conversion formula for the Conversion of CGPA into Percentage on a 10-points Scale is Given as Percentage of Marks Secured, $P = [\text{CGPA Earned} - 0.75] \times 10$

Illustration for A CGPA of 8.25:

$$P = [\text{CGPA Earned } 8.25 - 0.75] \times 10 = 75\ \%$$

Table 16.1(a) Percentage equivalence of grade points 10-points Scale

Grade point	Percentage of marks
5.75	50
6.25	55
6.75	60
7.25	65
7.75	70
8.25	75

Table 16.1(b) Class Designation

Grade point range	Class
≥ 5 &< 6.75	Second
$\geq 6.75 < 7.75$	First
≥ 7.75	Distinction

16.2 Letter Grades

Awarding Letter Grades

i. A letter grade is basically a qualitative measure indicating the performance of a student in that course, such as Outstanding (S), Excellent (A), Very Good (B), Good (C), Average (D), Poor (E) and unsatisfactory / Fail (F).

ii. Letter grades are awarded for each course based on the total marks obtained in CIE and SEE.

iii. Pass grades are awarded only when CIE≥ 40% and SEE ≥ 40%.

iv. The range of marks corresponding to letter grades is indicated in the Table 16.2. The grade point indicates the numerical value associated with each letter grade.

Table 16.2 Letter grades, grade points and corresponding marks range

Level	Out-standing	Excellent	Very Good	Good	Average	Poor	Fail
Letter grades	S	A	B	C	D	E	F
Grade points	10	9	8	7	6	4	0
Absolute Marks Range (%)	≥ 90	80 to 89	70 to 79	60 to 69	50 to 59	40 to 49	< 40

v. There are two other letter grades, Pass (PP) / Fail (NP) applicable for mandatory course. Grade PP is awarded only when SEE ≥ 40% (for 50 marks) and CIE + SEE ≥ 40% (for 100 marks), otherwise the grade NP is awarded.

16.3 Transitional Letter Grades

Transitional letter grades (I, X) are awarded in the following cases as per clause 16.3.1 and 16.3.2. I or X should be converted into one of the letter grades between S to E within that academic year.

16.3.1 Incomplete Grade (I)

A student who has missed SEE, due to valid reasons like his/her hospitalization/disaster in his/her family should immediately apply for the award of I grade in that course. Clash in SEE time table (permission from CoE has to be taken for clash in SEE time table). The IAAC subcommittee (Principal as Chairman, Deans and CoE, as members) will decide about awarding 'I' grade taking into consideration all the documentary evidences produced by the student. The student is permitted to appear for the SEE in that course, which is conducted in either even semester or in summer semester of that academic year. His/her CIE marks secured in the course earlier will be considered for the award of grade along with SEE marks.

If permission for 'I' grade is not accorded by IAAC subcommittee, then F grade is awarded for the course and the student has to re-register for the course in its entirety when it is offered.

'I' grade is not awarded for re-registered courses during Supplementary Semester Examination.

		16.3.2	X-Grade If a student has a minimum attendance of 85% and a minimum 90% in CIE and has obtained < 40% marks in SEE, in regular even or odd semester, then, he/she will be awarded X grade. - Such a student is permitted to appear for SEE conducted during that academic year. - If such a student fails to obtain E grade or above in regular or summer semester, he/she will be awarded F grade. The student should re-register for the same course in its entirety whenever the course is offered. - If such a student fails to appear for SEE either in even semester or in summer semester of that academic year, X grade will be automatically converted into 'F'-grade. - However, a student who has been awarded X-grade also has the option of: i. Reregistering of such courses either during summer semester or whenever the courses are offered. ii. Audit the courses during summer semester of that academic year by paying prescribed fees. iii. X-grade is not awarded during supplementary semester SEE.
	16.4		Dropping of the courses (DP)* - Student, who wants to drop a theory course, has to apply in a prescribed format (Form-3) through concerned teacher, Proctor and Head of the Department to the Dean (Academic) for permission. - Students are not permitted to drop theory course that are integrated with laboratory course in that semester/any other semester. - Mandatory courses cannot be dropped. - The dropping of course is allowed within the date specified in the academic calendar of that semester, usually eight weeks from the commencement of the semester. A student is allowed to drop a maximum of two courses. If the student drops the course within specified date, the fee for the course dropped will be adjusted for subsequent registration of the same course. The course dropped will not be indicated in the grade card. - Dropping of laboratory course(s) is not allowed. - Any re-registered course cannot be dropped. * A student can drop and or withdraw maximum of two courses.

	16.5		**Withdrawal Grade (W)*** A student, who wants to withdraw a theory course, has to apply in the prescribed proforma **(Form-4)** through the faculty who teaches the course, Proctor and Head of the Department to the Dean (Academic) for the permission to withdraw. **A student is not allowed to withdrawn/drop same course more than once.** Withdrawal of practical course(s) is not allowed. - Students are not permitted to withdraw theory courses that are integrated with laboratory course wither in that semester or in any other semester. - Withdrawal of a course is allowed within the specified date in the academic calendar. A student is not permitted to withdraw any course after the specified date in the academic calendar. - If a student withdraws the course after eight weeks from the commencement of the semester and up to fourteenth week, the registration fee will be forfeited. - Students have to reregister the withdrawn course after paying the prescribed fees in the summer semester or in the subsequent semesters during which the course is offered. - Transitional grades like withdrawal, incomplete and X grade are not awarded during summer semester.
	16.6		**Not Eligible Grade (NE)** Grade NE is awarded to the students who fail to secure attendance at least 85% and CIE of 40%.
	16.7		**Make-up Examination**: The students who has been awarded with 'X' or 'I' grades are eligible to attend make-up examinations as per the dates notified in Academic Calendar of the institution.
17			**Temporary Withdrawal** Student shall be permitted to withdraw temporarily on the grounds like, prolonged illness, grave calamity in the family or any other serious happening. The withdrawal hall be for periods which are integral multiples of a semester, provided that, i. Student applies to the college within at least 6 weeks of the commencement of semester or from the date student last attended the classes, whichever is later, stating the fully the reasons for such a withdrawal along with supporting documents endorsed by the parents/guardians ii. Such withdrawal shall be permitted only under the provisions of clause 4 iii. Student availing temporary withdrawal shall be required to pay tuition and other fee.

iv. Student will be entitled to avail temporary withdrawal facility only once during the programme. Any concession for the student shall be approved the Academic Council of the College

v. Student seeking temporary withdrawal facility shall not have any dues or demands at College/University including tuition and other fee. Once paid shall not be refunded

18 Academic Performance Evaluation

The academic performance of a student is indicated by two different indices, Semester Grade Point (SGPA) and Cumulative Grade Point Average (CGPA).

- SGPA is an indication of the performance of the student in the current semester. SGPA is calculated as below.

$$\text{SGPA}=\frac{\sum\ [(\text{Course credits})\ \text{x}\ (\text{grade points})]\ \text{for all course that semester excluding transitional grades}}{\sum\ [(\text{Course credits})\ \text{for all course registered in that semester including F grades and excluding W and DP courses.}}$$

- CGPA is an indication of the cumulative performance of the student from the first semester up to the current semester.

$$\text{CGPA}=\frac{\sum\ [(\text{Course credits})\ \text{x}\ (\text{grade points})]\ \text{for all course with letter grades are E and above from the I semester till the current semester}}{\sum\ [(\text{Course credits})\ \text{whose letter grades are E and above from the I semester till the current semester.}}$$

Illustrative Example Calculations of SGPA and CGPA for an academic year

Semester (Odd/Even/ Supplementary)	Course Code	Credits	Grade Obtained	Grade Points	Credit Points	SGPA, CGPA
I	MJXXX001	5:0:0	B	8	5 x 8 = 40	SGPA = 117/20 =5.85
I	MJXXX002	3:2:0	W	-	-	
I	MJXXX003	3:0:0	A	9	3 x 9 = 27	
I	MJXXX004	0:1:1	F	0	00	
I	MJXXX005	4:1:0	D	6	5 x 6 = 30	
I	MJXXX006	5:0:0	E	4	5 x 4 = 20	
	Total	**20 (18*)**		**Total**	**117**	

II	MJXXX007	3:1:1	C	7	7 x 5 = 35	SGPA =157/25 = 6.28
II	MJXXX008	4:0:0	B	8	8 x 4 = 35	
II	MJXXX009	3:0:0	D	6	3 x 6 = 18	
II	MJXXX010	4:1:0	E	4	5 x 4 = 20	
II	MJXXX011	2:1:1	A	9	4 x 9 = 36	CGPA

II	MJXXX012	2:0:0	F	0	00	=274/41 = 6.68
II	MJXXX013	0:2:0	B	8	2 x 8 = 16	
Total		25 (23*)	Total		157	

Supplementary	MJXXX002	3:2:0	D	6	5 x 6 = 30	SGPA = 56/9 = 6.22
Supplementary	MJXXX004	0:1:1	C	7	2 x 7 = 14	
Supplementary	MJXXX012	2:0:0	D	6	2 x 6 = 12	CGPA =330/50 = 6.60
Total		9	Total		56	

Note: Minimum CGPA to be earned at the end of each academic year is 5.0. SGPA and CGPA are normally calculated to the second decimal position, so that the CGPA, in particular, can be made use of in preparing the rank list of the student's performance at the college. If two students get the same CGPA, the tie would be resolved by considering the number of times a student has obtained higher SGPA and if it is still not resolved, the number of times a student has obtained higher grades like S, A, B etc., would be considered.

19 **Vertical Progression**

19.1 **For Regular students**

i. The CGPA has to be $\geq$ 5.00 at the end of each the academic year. However, failure to secure a minimum CGPA of 5.00 at the end of any academic year for the first time shall attract warning before approval to continue in the semester to follow.
ii. Faculty Advisor (Mentor) / Head of the Department shall advice the students to maintain a CGPA of $\geq$ 5.00.
iii. Should not have 'F' Grade in more than FOUR courses (Excluding Non-Credit Mandatory Courses).
iv. For admission to 3rd Semester student should not have 'F' Grade in more than FOUR courses in 1st,2ndand supplementary semesters put together
v. For admission to 5th Semester students can carry any FOUR courses of 1st and 2nd year i.e. 1st to 4th and supplementary semesters put together.
vi. For admission to 7th B.E. the students should have completed all the courses of first year and can carry any FOUR courses of 2nd and 3rd year i.e. 3rd to 6thand supplementary semesters put together.

	19.2		For Diploma Holders (Lateral Entry) i. The CGPA has to be ≥ 5.00 at the end of the academic year. However, failure to secure a minimum CGPA of 5.00 at the end of any academic year for the first time shall attract warning before approval to continue in the semester to follow. ii. Faculty Advisor (Mentor) / Head of the Department shall advice the students to maintain a CGPA of ≥ 5.00 at the end of each semester. iii. Should not have 'F' Grade in more than FOUR courses (Excluding Non-Credit Mandatory Courses). iv. For admission to 5^{th} Semester students can carry any FOUR courses of 2nd year i.e. 3rd, 4thand supplementary semesters put together. v. For admission to 7^{th} semester B.E. the students should have completed all the courses of first year and can carry any FOUR courses of 2nd and 3rd year i.e. 3rd to 6thand supplementary semesters put together. vi. Students admitted to Bachelor of Engineering at the III semester level will have to study mandatory non-credit courses "Additional Mathematics-1" in III semester and "Additional Mathematics-2" in V semester respectively. However, a pass or fail in this is not considered in vertical progression provided the attendance and CIE requirements are satisfied. vii. If student fails to satisfies attendance and CIE requirements has to reregister for the course to make him/herself to appear for SEE viii. Completion of "Additional Mathematics-1 and Additional Mathematics-2" is mandatory for award of degree.
	19.3		For B.Sc. students (Lateral Entry) i. The CGPA has to be ≥ 5.00 at the end of the academic year. However, failure to secure a minimum CGPA of 5.00 at the end of any academic year for the first time shall attract warning before approval to continue in the semester to follow. ii. Faculty Advisor (Mentor) / Head of the Department shall advice the students to maintain a CGPA of ≥ 5.00 at the end of each semester. iii. Should not have 'F' Grade in more than FOUR courses (Excluding Non-Credit Mandatory Courses). iv. For admission to 5th Semester students can carry any FOUR courses of 2nd year i.e. 3rd, 4th and supplementary semesters put together. v. For admission to 7th B.E. the students should have completed all the courses of first year and can carry any FOUR courses of 2nd and 3rd year i.e. 3rd to 6th

			and supplementary semesters put together. vi. Students admitted to Bachelor of Engineering at the III semester level will have to study additional courses. Like 'Engineering Graphics and Elements of Civil Engineering and Mechanics' in addition to the regular courses from III to VIII semester. However, a pass or fail in these is not considered in vertical progression provided the attendance and CIE requirements are satisfied. vii. If student fails to satisfies attendance and CIE requirements has to reregister for the course to make him/herself to appear for SEE viii. Completion of mandatory non-credit courses "Engineering Graphics and Elements of Civil Engineering and Mechanics are mandatory for award of degree.
20			Award of Degree
	20.1		Degree is awarded to students satisfying the following requirements: i. Students have registered for courses totalling to credits given in Table 4.1. ii. Should not have any transitional grades (I, W, X, NE, DP) in any of the courses. iii. Should have CGPA ≥ 5.00 at the end of last semester. In case, if the students not fulfil this requirement are permitted to appear again for SEE in full or Part of the previous year theory course/s by rejecting the performance of them (other than internship, technical seminar, project and laboratories) for any number of times subject to the provision of maximum duration of the programme, to make up the CGPA greater than or equal to 5.00 for the award of degree. iv. Should have passed in all the prescribed mandatory courses. v. Should have earned the desired number of activity points as per the AICTE' activity point programme as per clause 27 vi. Should not have any pending disciplinary proceedings. vii. Should not have dues to the institute.
	20.2		For award of B.E. (Honours) degree A student shall be declared to have completed the Programme B.E. degree and shall be eligible to get B.E. degree with Honours, provided, i. Should have undergone the stipulated Course work of all the semesters under the same scheme of Teaching and Examinations and has earned prescribed number of credits as per clause 4 ii. Should have maintained CGPA ≥ 8.5 without any backlogs. **iii.** Has earned additional 18 or more credits by earning final score ≥ 60% through University approved online courses like Swayam. NPTEL etc.

21			**Academic Counselling Cell** After the first test, the faculty in-charge reports to the HoD, about the students who have scored less than the minimum requirement of 40% in first two quizzes and first test. HoD, faculty in-charge and proctor counsel such students and advise them regarding the course to be dropped so that, he/she can concentrate on other courses and perform better. The HoD and proctor takes an undertaking from such students to the effect that he/she: - Shall attend all lectures, tutorials and laboratory classes regularly. - Shall not miss any quizzes and Tests. - Shall submit assignments regularly. - Shall work hard to improve his/her academic performance.
22			**Students Counselling Cell** The functions of Students Counselling Cell are to, i. Identify academically deficient and disturbed/distressed students through proctors and counsel them. Monitoring of such students with the help of psychiatrist and medical officer. ii. Explore ways and means to help the students to come out psychological issues. iii. Assign student mentor for regular monitoring of academic activities
23			**Malpractice in Examinations** Penalties and punishments to the students involved in malpractice during the examination.

Sl. No.	Nature of Malpractice	Penalty to be imposed
1.	Any form of revealing the identity of the candidate in the answer script of Semester End	Fine of Rs. 2500/- and award of F grade for that course.
2.	Possession of Manuscript printed or typed matter, Books or notes and written matter on Calculator / Instrument Box / electronic / wireless devices / Mobile phones, pen drives etc., or having any other written matter on the person (For Example, Palm, Hand, Leg, Cloths, Socks etc.,).	To deny the benefit of performance of the examination of all the courses for which the candidate has appeared by awarding **'F' Grade** in all the courses (both attended and to be attended of the particular examination conducted including arrear course if any), debar them for a further number of chances extending up to two semesters of examinations in all the courses including the arrears courses.

				3.	Detection of identical answers in the answer scripts of different Candidates or allowing a candidate to copy from his/her answer script.	To deny the benefit of performance of the examinations of all the courses for which the candidate has appeared by awarding **'F' Grade** in all the courses (both attended and to be attended of the particular examination conducted including arrear course if any), debar them for a further number of chances extending up to two semesters of examinations in all the courses including the arrears courses.	
				4.	Appeal to the examiner with or without money as enclosures to the SEE answer book / use of abusive / obscene language or threatening remarks in the SEE answer book.	To deny the benefit of performance of the examinations of all the courses for which the candidate has appeared by awarding **'F' Grade** in all the courses (both attended and to be attended of the particular examination conducted including arrear course if any), debar them for a further number of chances extending up to two semesters of examinations in all the courses including the arrears courses.	
				5.	Found giving or receiving assistance at the examination, passing the question paper with written answer / formulae / answer script / additional sheet / Graph Sheet / Drawing Sheet for purpose of copying.	To deny the benefit of performance of the examinations of all the courses for which the candidate has appeared by awarding **'F' Grade** in all the courses (both attended and to be attended of the particular examination conducted including arrear course if any), debar them for a further number of chances extending up to two semesters of examinations in all the courses including the arrears courses.	
				6.	Destroying the documentary evidence of malpractice.	To deny the benefit of performances of the examination of all the courses for which the candidate has appeared (both attended and to be attended of the particular examination conducted including arrear examinations) and debar him/her for a further number of chances extending up to Two more examinations.	
				7.	Insertion of additional sheets / Graph Sheets / Drawing Sheets, use of answer book which is not issued at the examination hall on that particular examination date.	To deny the benefit of performances of the examination of all the courses for which the candidate has appeared (both attended and to be attended of the particular examination conducted including arrear examinations) and debar him/her for a further number of chances extending up to Two more examinations.	

				8.	In case of Impersonation or found guilty of deliberate prior arrangement to cheat in the examination.	To deny the benefit of performances of the examination of all the courses for which the candidate has appeared and who has arranged another person to impersonate (both attended and to be attended of the particular examination conducted including arrear examinations to both the candidates) & debar him/her for a minimum of six more examinations. (for the person who has impersonated and on whom impersonation is done for both persons, the punishment shall extend up to reprimanding and also booking a case under Indian Penal Code-IPC.	
				9.	Abusing, threatening, and manhandling the examination authorities at the examination hall or in the premises of the examination centre / outside the centre as well as misconduct of a very serious nature.	To deny the benefit of performances of the examination of all the courses for which the candidate has appeared and who has arranged another person to impersonate (both attended and to be attended of the particular examination conducted including arrear examinations to both the candidates) & debar him/her for a minimum of six more examinations. (for the person who has impersonated and on whom impersonation is done for both persons, the punishment shall extend up to reprimanding and also booking a case under Indian Penal Code-IPC.	
				10.	Any other Malpractices not defined above but connected with the Examination.	Committee can recommend suitable penalties as deem fit.	
				The Chief superintendent shall allow the candidate to write all subsequent examinations and send the answer books to the office of the Controller of Examinations (CoE) on the following day.			
				The Examiner shall, if he / she suspects' malpractice while valuing the answer scripts or other material such as insertion of answer sheets, revealing of identity or enclosures, such as currency, shall return the answer scripts with reason in writing to the CoE by name and desist from further valuation. If already valued, marks shall not be entered in the regular marks list in which the marks awarded to other candidates are furnished but enter them in a			

			separate list which shall be enclosed in a sealed cover and forwarded to the CoE. The decision pertaining to above Penalties and Punishments may be communicated to all the concerned. Enquiry under Malpractice Cases Consideration Committee is independent of the criminal proceedings. If any, in the appropriate court of law. **Malpractice in Quizzes / Tests** If a student is involved in malpractices as defined for SEE in any course(s) of quiz / I test / II test / compensatory test. — 'NE' graded will be awarded for that course in that semester. He /She will not be permitted to appear for SEE for that course. He /She will not be permitted to Drop / Withdraw that course. ***However, depending on severity of malpractice, MPEC will impose penalty as deem fit, other than the one mentioned above.***
24			**Rules and Discipline** In order to maintain the sanctity and decorum in the campus and hostels, the following rules of discipline are observed by students: - The students should behave courteously with the members of the staff. - They should maintain silence in the library, classrooms and work quietly in drawing halls, laboratories and workshops. - Students coming late to the classes are not permitted to enter the class rooms. - They should not meddle with the machines, equipment and tools in the laboratories and workshops without the permission of the staff members in charge. They will be responsible for the damages and will have to pay for their replacement. - They should not absent themselves from the classes without the prior permission of the Principal. - Students should take the entire test without fail. - Students are forbidden from pasting posters in the institute premises and causing any damage to the property of the institute. - Smoking, consumption of alcoholic beverages and drugs are strictly forbidden. - Students are not to affix any notice or remove any office notice from the notice boards. - Use of Cell Phone is banned in classrooms, laboratories, library and in academic corridor.

			- Students using vehicles are required to leave them in parking places provided and are forbidden from parking in other places inside the campus causing disturbance to the classes.
25			Ragging and Punishment
	25.1		Ragging: Ragging means causing, inducing, compelling, forcing a student either by way of practical joke or otherwise, to do any act which detracts from human dignity or violates his/her person or exposes him/her to ridicule or to forebear from doing any lawful act by intimidating, wrongfully restraining, wrongfully confining, or injuring him/her or by using criminal force, extortion. The following perverse actions also constitute the ragging. i) Forcing to: Address seniors as SIRs, perform mass drills, copy class notes and practical records for seniors, and carry out various errands. Do menial jobs for seniors, Drink alcohol and consume drugs. Do acts with sexual overtones and homosexual acts leading to physical injury/mental torture or death. ii) Stripping / Kissing **iii)**Any other related or allied acts of commission would also from ragging.
	25.2		Punishment for Errant Students (Raggers) i) Filing of First Information Report (FIR) with the local police as per the Supreme Court direction. ii) Publishing the photographs of errant students (raggers) on the Notice Boards and in Local Newspapers. iii) Imprisonment for a term extendable up to one year or a fine of Rs. 2000/- or both. iv) Rustication, dismissal and expulsion from the Institute. v) Embossment on marks cards and other academic certificates that he/she was indulged in ragging. vi) Non eligibility for getting passport or visa. **vii)** Non eligibility for campus recruitment/cancellation, if selected already.
26			Disciplinary Actions and Related Matters i. Violation of code of conduct and disciplinary rules of the institute will be referred to the disciplinary committee. **ii.** Violation of code of conduct shall attract disciplinary action which may include punishment such as reprimand, disciplinary probation, fine, debarring from the examination, withdrawal of placement facilities, withholding grades/degree, cancellation of registration and even rustication from the institute.

27

Activity Point Programme

To enhance student's skills sets and along with an entrepreneurial capabilities and societal commitment to be apart from his/her Technical knowledge and skills to become successful as professionals, AICTE has brought a comprehensive activity programme for the award of Degree.

AICTE has framed a unique mechanism of awarding activity points over and above the academic programme grades and is mandatory for the student to earn desired number of activity points, where every student can choose activities as per likings in order to earn the AICTE activity points. These activities can spread over the years during the entire program as per the convenience of the student.

Table No. 27 Number of activity points to be earned

Sl. No	Level entry in the degree	Minimum Points to be earned
1	Day college Student admitted to 4 years Degree Programme	100
2	Student entering 3 years Degree programme through lateral entry	75
3	Students transferred from other Universities to fifth Semester	50

i. Activity points (non-credit) have no effect on SGPA/CGPA and will not be considered for vertical progression

ii. Activity points earned by the student will be reflected in the 8^{th} semester Grade Card

iii. In case student fail to earn the minimum prescribed activity points before the commencement of 8^{th} semester examinations, the eight semester grade card will be issued only after earning the minimum prescribed activity points.

iv. Students will be considered for the award of degree only after the release of 8^{th} semester Grade Card.

28

Termination from the Program

A student is required to withdraw from the program and leave the Institute on the following grounds;

i. Failure (securing F grade) in any credit course/s for five consecutive attempts.

ii. Failure to secure a CGPA $\geq$ 5.0 at the end each academic year, for the first time attracts a warning before approval to continue in the following semester. However, a student failing to secure CGPA $\geq$ 5.0 in five consecutive semesters has to withdraw from the engineering program. However, the student can take re-admission to 1st year.

			iii. Failure to meet the standards of discipline as prescribed by the Institute from time to time.
29			**Migration of Students**
	29.1		**Change of branch** Change of branch shall be during the beginning of III semester as per VTU/AICTE norms with permission of Registrar, VTU.
	29.2		**Change of College** **A.** Autonomous to another Autonomous College i. Students shall seek Change of College at beginning of 3rd and 5th semester from an autonomous college to another autonomous college subject to the availability of seats within the approved intake. ii. The students seeking transfer as per clause 29.2 (A) (i) shall have to obtain No Objection certificate from the University by producing No Objection certificates from both the colleges during the period as notified by VTU. iii. No transfer is permitted to 7^{th} semester B.E. programme. iv. Must have passed in all courses of previous semesters v. Complete additional course/s, if any, as per decision of Board of Studies on establishing matching equivalence between two schemes. Number of such additional courses shall not be more than four. A grade card shall be issued to that effect. Additional course/s shall not be considered for vertical progression, calculation of SGPA and CGPA. However, a pass in the additional course/s is mandatory for award of degree. vi. Shall earn the credits and complete the program within the maximum duration as per clause 4 vii. If the number of credits earned is less than the prescribed after the completion of all semesters of the programme under prevailing scheme, student shall register for a course or courses which are not studied earlier and make up the credits earned equal to or greater than required for the award of degree viii. If earned credits are more than prescribed, then CGPA shall be proportionally reduced to prescribed proramme credits. **B. Autonomous to Non- Autonomous College** i. Students shall seek Change of College at beginning of 3rd and 5th semester from an autonomous college to another autonomous college subject to the availability of seats within the approved intake. ii. The students seeking transfer as per clause 29.2 (B) (i) shall have to obtain No Objection certificate from the University by producing No Objection

			certificates from both the colleges during the period as notified by VTU. iii. No transfer is permitted to 7th semester B.E. programme. iv. Must have passed in all courses of previous semesters v. Shall adhere to the prevailing regulations governing transfer of students at the University
	29.3		**Change of University** i. Students seeking Change of College from one University (other than VTU) to an Autonomous college at beginning of 3rd and 5th semester subject to the availability of seats within the approved intake. ii. The students seeking transfer as per clause 29.3 (i) shall have to obtain No Objection certificate from the University by producing No Objection certificates from both the colleges during the period as notified by VTU. iii. No transfer is permitted to 7th semester B.E. programme. iv. Must have passed in all courses of previous semesters v. Complete additional course/s, if any, as per decision of Board of Studies on establishing matching equivalence between two schemes. Number of such additional courses shall not be more than four. A grade card shall be issued to that effect. Additional course/s shall not be considered for vertical progression, calculation of SGPA and CGPA. However, a pass in the additional course/s is mandatory for award of degree. vi. Shall earn the credits and complete the program within the maximum duration as per clause 4 vii. If the number of credits earned is less than the prescribed after the completion of all semesters of the programme under prevailing scheme, student shall register for a course or courses which are not studied earlier and make up the credits earned equal to or greater than required for the award of degree viii. If earned credits are more than prescribed, then CGPA shall be proportionally reduced to prescribed proramme credits.
30			**Award of Ranks, Medals and Prizes**
	30.1		i. For award of ranks in a specialization of B.E. the CGPA secured by the student from III to VIII semesters shall be considered ii. The additional credits earned for award of Honours degree shall not have any bearing for the declaration of rank

			iii. A student shall be eligible for a rank at the time of award of degree provided, the student, a) Has passed all the courses of I to VIII semesters in first attempt only in case student admitted to I year of the programme b) Has passed the courses (including mandatory non-credit) of III to VIII semesters in first attempt only in case student admitted to II year of the programme under lateral entry scheme. c) Not a repeater in any semester due to rejection of result/shortage of attendance etc d) Completed the course without any break/discontinuity e) Has not been transferred from any autonomous/ non-autonomous/University f) Total number of ranks awarded shall be 10% of the total students appeared for VIII the examination to a maximum of 10 ranks in a specialization g) Ranks in a specialization shall be awarded only if a minimum of 10 should have appeared in the VIII semester examinations h) In case fractional number of ranks, shall be rounded to higher integer only when the first decimal place is greater than or equal to 5.
	30.2		i. Ranks will be awarded based on the merit of the students as determined by CGPA. If more than one candidate has the same CGPA, then tie shall be resolved by considering number of times student has obtained higher SGPA. If it is not resolved even at this stage, then the award of rank shall be based on number of S-grades/number of A-grades/any other relevant criteria. ii. Ranks and awards are given for those students who were not involved in malpractice in test/quiz/examination and on whom no disciplinary action taken.
	30.3		Medals and Prizes shall be awarded based on the conditions stipulated by the Donor subject to the provisions of regulations framed for such awards.

MVJ College of Engineering, Whitefield, Bangalore

An Autonomous Institution, Affiliated to VTU, Belagavi

Scheme of Teaching and Examination 2020-21

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

III SEMESTER B.E. (Electronics & Communication Engineering)

S No	Course Type	Course Code	Course Title	Teaching Department	Teaching hours/week: Theory Lecture (L)	Tutorial (T)	Practical/ Drawing (P)	Examination: Duration in Hours	CIE Marks	SEE Marks	Total marks	Credits
1	BSC	MVJ20MEC31	Transforms, Fourier series and Numerical Methods	Mathematics	2	2	0	3	50	50	100	3
2	PCC	MVJ20EC32	Network Analysis	ECE	3	2	0	3	50	50	100	4
3	PCC	MVJ20EC33	Analog Electronics	ECE	3	0	0	3	50	50	100	3
4	PCC	MVJ20EC34	Digital System Design & Verilog	ECE	3	0	0	3	50	50	100	3
5	PCC	MVJ20EC35	Electromagnetics & Transmission Lines	ECE	3	0	0	3	50	50	100	3
6	PCC	MVJ20EC36	Computer Organization & Architecture	ECE	3	0	0	3	50	50	100	3
7	PCC	MVJ20ECL37	Analog Electronics Lab	ECE	0	2	2	3	50	50	100	2
8	PCC	MVJ20ECL38	Digital system Design & Verilog Lab	ECE	0	2	2	3	50	50	100	2
9	HSMC	MVJ20SK/BK39	Samskruthika Kannada/ Balake Kannada	Humanities	1	0	0	2	50	50	100	1
		MVJ20CPH39	CPH		1	0	0	2	50	50		
10	HSMC	MVJ20UHV310	Universal Human Values I	Humanities	1	0	0	2	50	50	100	1
10	BSC	MVJ20MATDIP31	Additional Mathematics-I	Mathematics	2	2	0	3	50	50	100	-
				Total	21	10	4	31	500	500	1000	25

Note: BSC: Basic Science, PCC: Professional Core Course , HSMC: Humanity and Social Science

MVJ19MXXDIP301- Mandatory non-credit course

IV SEMESTER B.E. (Electronics & Communication Engineering)

S No	Course		Course Title	Teaching Department	Teaching hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical /Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
	Type	Code			L	T	P					
1	BSC	MVJ20MEC41	Probability Theory, Complex variables and Optimization	Mathematics	2	2	0	3	50	50	100	3
2	PCC	MVJ20EC42	Signals and Systems	ECE	3	2	0	3	50	50	100	4
3	PCC	MVJ20EC43	Control System	ECE	3	0	0	3	50	50	100	3
4	PCC	MVJ20EC44	Linear Integrated Circuits	ECE	3	0	0	3	50	50	100	3
5	PCC	MVJ20EC45	Electronic Instrumentation	ECE	3	0	0	3	50	50	100	3
6	PCC	MVJ20EC46	Python foundation for Electronics Engineering	ECE	3	0	0	3	50	50	100	3
7	PCC	MVJ20ECL47	Linear Integrated Circuits Lab	ECE	0	2	2	3	50	50	100	2
8	PCC	MVJ20ECL48	Python Programming Lab	ECE	0	2	2	3	50	50	100	2
9	HSMC	MVJ20SK/BK49	Samskruthika Kannada/ Balake Kannada	Humanities	1	0	0	2	50	50	100	1
		MVJ20CPH49	CPH		1	0	0	2	50	50		
10	BSC	MVJ20MATDIP41	Additional Mathematics-II	Mathematics	2	2	0	3	50	50	100	-
				Total	20	10	4	29	500	500	1000	24

Note: BSC: Basic Science, PCC: Professional Core Course , HSMC: Humanity and Social Science
MVJ19MXXDIP401- Mandatory non-credit course

V SEMESTER B.E. (Electronics & Communication Engineering)

S No	Course		Course Title	Teaching Department	Teaching hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
	Type	Code			L	T	P					
1	HSMC	MVJ20TMEC51	Technical Management, Entrepreneurship & IPR	ECE	3	0	0	3	50	50	100	3
2	PCC	MVJ20EC52	ARM Microcontroller & Embedded System	ECE	3	2	0	3	50	50	100	4
3	PCC	MVJ20EC53	Digital Signal Processing	ECE	3	2	0	3	50	50	100	4
4	PCC	MVJ20EC54	Communication Systems	ECE	3	0	0	3	50	50	100	3
5	PE	MVJ20EC55X	Professional Elective-1	ECE	3	0	0	3	50	50	100	3
6	PCC	MVJ20ECL56	Embedded Controller Lab	ECE	0	2	2	3	50	50	100	2
7	PCC	MVJ20ECL57	Digital Signal Processing Lab	ECE	0	2	2	3	50	50	100	2
8	PCC	MVJ20ECL58	Communication Systems Lab	ECE	0	2	2	3	50	50	100	2
9	HSMC	MVJ20ENV59	Environmental Studies	Humanities	1	0	0	2	50	50	100	1
10	HSMC	MVJ20UHV510	Universal Human Values II	Humanities	2	0	0	2	50	50	100	2
				Total	**18**	**10**	**6**	**28**	**450**	**450**	**1000**	**26**

Note: PCC: Professional Core Course , PE: Professional Elective, HSMC: Humanity and Social Science

Professional Elective – 1

Course Code under MVJ20EC55X	Course Title
MVJ20EC551	Information Theory & Coding
MVJ20EC552	Operating system
MVJ20EC553	OOPS using C++
MVJ20EC554	Fuzzy logic Systems and Neural Networks

VI SEMESTER B.E. (Electronics & Communication Engineering)

S No	Course		Course Title	Teaching Department	Teaching hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
	Type	Code			L	T	P					
1	PCC	MVJ20EC61	Microwave & Antenna	ECE	3	2	0	3	50	50	100	4
2	PCC	MVJ20EC62	Computer Communication Networks	ECE	3	2	0	3	50	50	100	4
3	PE	MVJ20EC63X	Professional Elective-2	ECE	3	0	0	3	50	50	100	3
4	PE	MVJ20EC64X	Professional Elective-3	ECE	3	0	0	3	50	50	100	3
5	OE	MVJ20EC65X	Open Elective-1	ECE	3	0	0	3	50	50	100	3
6	PCC	MVJ20ECL66	Microwave & Antenna Lab	ECE	0	2	2	3	50	50	100	2
7	PCC	MVJ20ECL67	Computer communication Networks Lab	ECE	0	2	2	3	50	50	100	2
8	Proj	MVJ20ECP68	Mini-Project	ECE	0	0	4	3	50	50	100	2
				Total	**15**	**8**	**8**	**24**	**400**	**400**	**800**	**23**

Note: PCC: Professional Core Course , PE: Professional Elective, OE: Open Elective, Proj: Project Work

Professional Elective – 2

Course Code under MVJ20EC63X	Course Title
MVJ20EC631	Real Time Operating Systems
MVJ20EC632	Digital Image Processing
MVJ20EC633	Virtual & Augmented Reality
MVJ20EC634	Data structure using C++

Professional Elective – 3

Course Code under MVJ20EC64X	Course Title
MVJ20EC641	Lab View
MVJ20EC642	MEMS & sensor Design
MVJ20EC643	Machine Learning Design & Applications
MVJ20EC644	Medical Electronics

Open Elective-1	
Course Code under MVJ20EC65X	Course Title
MVJ20EC651	Digital Image Processing
MVJ20EC652	Principles of Communication
MVJ20EC653	Sensor Technology
MVJ20EC654	Introduction to MATLAB & Simulink

VII SEMESTER B.E. (Electronics & Communication Engineering)

S No	Course		Course Title	Teaching Department	Teaching hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
	Type	Code			L	T	P					
1	PCC	MVJ20EC71	VLSI System Design	ECE	3	2	0	3	50	50	100	4
2	PCC	MVJ20EC72	IoT & Wireless Sensor Network	ECE	3	2	0	3	50	50	100	4
3	PE	MVJ20EC73X	Professional Elective-4	ECE	3	0	0	3	50	50	100	3
4	PE	MVJ20EC74X	Professional Elective-5	ECE	3	0	0	3	50	50	100	3
5	OE	MVJ20EC75X	Open Elective-2	ECE	3	0	0	3	50	50	100	3
6	PCC	MVJ20ECL76	VLSI System Design Lab	ECE	0	2	2	3	50	50	100	2
7	PCC	MVJ20ECL77	IoT Lab	ECE	0	2	2	3	50	50	100	2
8	Proj	MVJ20ECP78	Project Phase-1	ECE	0	0	4	-	50	-	50	2
				Total	**15**	**8**	**8**	**21**	**400**	**350**	**750**	**23**

Note: PCC: Professional Core Course , PE: Professional Elective, OE: Open Elective, Proj: Project Work

Professional Elective-4

Course Code under MVJ20EC73X	Course Title
MVJ20EC731	Optical Communication
MVJ20EC732	Wireless & Cellular Communication
MVJ20EC733	Robotics & Automation
MVJ20EC734	System on chip Architecture

Professional Elective-5

Course Code under MVJ20EC74X	Course Title
MVJ20EC741	Automotive Embedded System
MVJ20EC742	Satellite & Radar Communication
MVJ20EC743	Artificial Intelligence & Data science
MVJ20EC744	Cryptography & Cyber security

Open Elective-2	
Course Code under MVJ20EC75X	Course Title
MVJ20EC751	Real-Time Operating System
MVJ20EC752	Industrial IoT
MVJ20EC753	Machine Learning Design & Application
MVJ20EC754	Robotics & Automation

VIII SEMESTER B.E. (Electronics & Communication Engineering)

S No	Course		Course Title	Teaching Department	Teaching hours/week			Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Duration in Hours	CIE Marks	SEE Marks	Total marks	
	Type	Code			L	T	P					
1	Proj	MVJ20ECP81	Project Phase-2	ECE	0	0	14	3	50	50	100	8
2	Int	MVJ20ECI82	Internship	ECE	-	-	-	3	50	50	100	3
3	Sem	MVJ20ECS83	Seminar	ECE	0	0	4	3	50	50	100	1
4	CRT	MVJ20ECC84	Certification	Industry/Institute	-	-	-	-	-	-	-	2
				Total	**0**	**0**	**18**	**15**	**250**	**250**	**500**	**14**

Note: PCC: Professional Core Course , PE: Professional Elective, OE: Open Elective, Proj: Project Work, Int.: Internship, Sem : Seminar, CRT: Certification Course (Can be carried out during the program period but same will reflect in the final semester grade card)

Certification course

Course Title (MVJ20ECC84)
Industry 4.0
Modern Robotics
R Programming
Data Analytics
Introduction to tensor flow for AI and ML
Cloud Networking

B.E, III Semester, Electronics & Communication Engineering

Course Title	TRANSFORMS, FOURIER SERIES AND NUMERICAL METHODS	Semester	III
Course Code	MVJ20MEC31	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 2 : 2: 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Solve the linear differential equations using Laplace transforms
- Apprehend and apply Fourier Series
- Realize and use of Fourier transforms and Z-Transforms
- Use of numerical methods to solve ordinary differential equation
- Use of statistical methods in curve fitting applications.

Module-1	RBT Level L1, L2, L3	8Hrs.

Laplace Transforms: Definition, Transforms of elementary functions, Properties, Periodic function, Unit step function.

Inverse Laplace Transforms: Inverse Laplace Transforms, Convolution theorem to find inverse Laplace transform. Solution of linear differential equations using Laplace transforms.

Experiential Learning: (Experiments which can be conducted on the concepts of contents

Applications: Analysis of electrical and electronic circuits, used in Signal processing and in control systems.

Video Link:

1. https://youtube/NFuwtTT7VPM

<table>
<tr><td>Module-2</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Fourier Series: Continuous and Discontinuous functions, Convergence and divergence of infinite series of positive terms, Periodic functions, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period.
Half Range Fourier Series: Half range fourier sine series and cosine series of period π and arbitrary period. Practical harmonic analysis
Experiential Learning: (Experiments which can be conducted on the concepts of contents
Applications: Fourier series solution to differential equation, Digital signal processing, spectrum analyzer.
Video Link:
1. https://youtu.be/r18Gi8lSkfM</td></tr>
<tr><td>Module-3</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Fourier Transforms: Infinite Fourier transform, Fourier Sine and Cosine transforms, Properties, Inverse Fourier transforms.
Z-Transforms: Definition, standard Z-transforms, damping rule, shifting rule, initial value and final value theorems. Inverse Z- transform.Application of Z-transforms to solve difference equations.
Experiential Learning: (Experiments which can be conducted on the concepts of contents
Applications: Fourier transforms used in image processing and Z-transforms in Digital signal processing.
Video Link:
1. https://youtube/spUNpyF58BY</td></tr>
<tr><td>Module-4</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Numerical solution of ordinary differential equations: Numerical solution of first order and first degree; Taylor's series method, modified Euler's method, Runge-Kutta method of fourth-order. Milne's and Adams- Bashforth predictor and corrector method.
Experiential Learning: (Experiments which can be conducted on the concepts of contents
Applications: To solve initial value problems
Video Link:</td></tr>
</table>

1. https://youtube/pbYn3MEZyms

Module-5	RBT Level L1, L2, L3	8Hrs.

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

Curve Fitting: Curve fitting by the method of least squares, fitting of linear, quadratic and geometric curve.

Experiential Learning: (Experiments which can be conducted on the concepts of contents

Applications: Applications of Correlation in Signal Processing and application of regression analysis in business

Video Link:

1. https://youtube/jwTvCxasICc

Course Outcomes:	
CO1	Learn to solve linear differential equations using Laplace transforms
CO2	Learn to represent a periodic function in terms of sine and cosine functions.
CO3	Evaluate Fourier transforms and use Z-transform to solve difference equations.
CO4	Learn to solve algebraic, transcendental and ordinary differential equations numerically.
CO5	Make use of the correlation and regression analysis to fit a suitable mathematical model for the statistical data

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 201
2.	Prof. G.B.Gururajachar, "Engineering Mathematics –III, Academic Excellent serie publications, 2016 – 17.
3.	Prof. G.B.Gururajachar, "Engineering Mathematics –IV, Academic Excellent serie publications, 2017 – 18.
Reference Books:	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10^{th} edition, 2014.
2.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.

3.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8th Edition
4.	H K Dass:"Advanced Engineering Mathematics"- S Chand & Company Ltd. 12th edition.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	-	-	-	-	-	-	1	-
CO2	3	3	-	3	-	-	-	-	-	-	-	1
CO3	2	3	-	3	-	-	-	-	-	-	1	-
CO4	3	3	-	3	-	-	-	-	-	-	-	-
CO5	3	3	-	2	-	-	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	NETWORK ANALYSIS	Semester	III
Course Code	MVJ20EC32	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2: 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to:

- Describe basic network concepts emphasizing source transformation source shifting, mesh and nodal techniques to solve for resistance/impedance, voltage, current and power.
- Study the graphical method of analyzing electrical networks.
- Explain network Thevenin's, Millman's, Superposition, Maximum Power transfer and Norton's Theorems and apply them in solving the problems related to Electrical Circuits.
- Explain the behaviour of networks subjected to transient conditions. Use applications of Laplace transform to solve network problems.
- Study two port network parameters like Z, Y, T and h and their inter-relationships.

Module-1	RBT Level L1,L2,L3,L4	10Hrs.

Prerequisites: *Ohm's law, Kirchhoff's laws*

Basic Concepts: Introduction, Practical sources, Source transformations, 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.

Laboratory Sessions/ Experimental learning: Find the current through and voltage across the load in the given circuit.

Applications: Simplification and analysis of analog circuits, microwave circuit analysis

Video link / Additional online information :

1. https://www.youtube.com/watch?v=UMhBgyK8F0U

Module-2	RBT Level L1,L2,L3,L4	10Hrs.

Graph Theory and Network equations: Graph of a network, Trees, Co-trees and Loops, Incidence Matrix, Cut-set Matrix, Tie-set Matrix and loop currents, Number of possible trees of a graph, Analysis of networks, Duality.

Laboratory Sessions/ Experimental learning: NA

Applications: Simplification and analysis of analog circuits, microwave circuit analysis

Video link / Additional online information:

1. https://www.youtube.com/watch?v=F8qiM3o0Jc0

Module-3	RBT Level L1,L2,L3,L4	10Hrs.

Network Theorems: Superposition Theorem, Millman's theorem, Thevenin's theorem, Norton's theorem, Maximum Power transfer theorem.

Laboratory Sessions/ Experimental learning: Verify superposition theorem for a given circuit.

Applications: Simplification and analysis of analog circuits, microwave circuit analysis.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=bnjiLg4xfh8

Module-4	RBT Level L1,L2,L3,L4	10Hrs.

Prerequisites: *Laplace Transforms, Properties of Laplace Transform and Inverse Laplace Transform using partial fraction method.*

Transient behaviour and initial conditions: Behaviour of circuit elements under switching condition and their Representation, evaluation of initial and final conditions in RL, RC and RLC circuits for DC and AC excitations, Applications of Laplace Transforms in circuit analysis: Application to circuits.

Laboratory Sessions/ Experimental learning: Plot the response of a series RLC circuit.

Applications: In the analysis of transmission lines and waveguides.

Video link / Additional online information :

1. https://www.youtube.com/watch?v=g-CGI7oUSCA

Module-5	RBT Level L1,L2,L3,L4	10Hrs.
Two port network parameters: Introduction, open circuit impedance parameter, short circuit admittance parameter, hybrid parameters, transmission parameter, relationship between parameters. **Laboratory Sessions/ Experimental learning:** 1. Measure two port parameters for a given network **Applications:** For analysis of communication systems and antennas. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=YLGrugmDvc0		

Course outcomes:	
CO1	Determine currents and voltages in a circuit using network simplification techniques.
CO2	To solve the network problems using graphical methods.
CO3	To simplify the complex circuits using network theorems.
CO4	To analyze simple DC circuits and AC circuits and applies the concepts to transient conditions.
CO5	Solve the given network using specified two port network parameters like Z or Y

Text Books:	
1.	M.E. Van Valkenberg (2000), "Network analysis", Prentice Hall of India, 3rd edition, 2000, ISBN: 9780136110958.
2.	Roy Choudhury, "Networks and systems", 2nd edition, New Age International Publications, 2006, ISBN: 9788122427677.
Reference Books:	
1.	Hayt, Kemmerly and Durbin –Engineering Circuit Analysis", TMH 7th Edition, 2010.
2.	J. David Irwin /R. Mark Nelms, "Basic Engineering Circuit Analysis", John Wiley, 8th edition, 2006.
3.	Charles K Alexander and Mathew N O Sadiku, "Fundamentals of Electric Circuits", Tata McGraw-Hill, 3rd Ed, 2009.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	1	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	2	2	1	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-
CO5	3	3	2	1	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	ANALOG ELECTRONICS	Semester	III
Course Code	MVJ20EC33	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0: 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- To know the biasing methods of BJT and its low frequency response for various configurations.
- Explain construction and characteristics of JFETs.
- Explain various types of FET biasing, and demonstrate the use of FET amplifiers.
- Understand the different topologies of feedback amplifiers and oscillators.
- Analyse the Power amplifier circuits in different modes of operation.

Module-1	RBT Level L1,L2,L3	8Hrs.

Prerequisites: Transistor basics

Transistor Biasing: Operating point, Fixed bias circuits, Emitter stabilized biased circuits, Voltage divider bias circuits, Collector feedback configuration, Transistor switching networks.

Transistor at Low Frequencies: The r_e transistor model, CE Fixed bias configuration, Voltage divider bias, Emitter follower, Analysis of CE configuration using h- parameter model-Fixed Bias Configuration.

Laboratory Sessions/ Experimental learning:

1. Simulate BJT Fixed Bias configuration using PSPICE.

Applications: Amplifier, Switch, Sensor and Display.

Video link/ Additional online information:

1. http://www.nptelvideos.in/2012/12/electronics.html

Module-2	RBT Level L1,L2,L3,L4	8Hrs.

Prerequisites: BJT,FET

BJT Small signal model and FET Amplifiers:

Transistor Frequency Response: General frequency considerations, low frequency response, Miller effect capacitance, High frequency response, multistage frequency effects. **Field Effect Transistors:** Construction and Characteristics of JFETs, Transfer Characteristics, Depletion type MOSFET, Enhancement type MOSFET. Laboratory Sessions/ Experimental learning: 1. Plot the transfer characteristics of n channel JFET using PSPICE. **Applications:** Analog switches, Phase shift oscillator, chopper, current limiter **Video link/ Additional online information:** 1. http://www.nptelvideos.in/2012/12/electronics.html		
Module-3	RBT Level L1,L2,L3	8Hrs.
Prerequisites: FET **FET Amplifiers:** JFET small signal model, Self-bias configuration-bypassed Rs, Common Gate configuration, Source-Follower Configuration. **General Amplifiers:** Cascade connections, Cascode connections, Darlington connections. Laboratory Sessions/ Experimental learning: 1. Design JFET Fixed Bias configuration using PSPICE. **Applications:** Darlington Transistor finds applications in Power Regulators, Audio Amplifier output stages, Controlling of Motors and light and touch sensors **Video link/ Additional online information:** 1. http://www.nptelvideos.in/2012/12/electronics-for-analog-signal.html		
Module-4	RBT Level L1,L2,L3	8Hrs.
Prerequisites: Feedback Amplifier, Oscillators **Feedback Amplifier:** The Four Basic Feedback Topologies, The series-shunt, series-series, shunt-shunt and shunt-series amplifiers, Practical feedback circuits. **Oscillators:** Oscillator operation, FET based Phase shift oscillator, Wien bridge oscillator, LC and Crystal Oscillators, UJT construction, UJT oscillators. Laboratory Sessions/ Experimental learning: 1. Design and test the voltage-shunt feedback amplifier and calculate the parameters		

using with and without feedback. **Applications:** Radios, Televisions, Communication systems, Computers, Industrial controlled applications. **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=xHNDrbB-iWY

Module-5	RBT Level L1,L2,L3	8Hrs.
Output Stages and Power Amplifiers: Introduction, Classification of output stages, Class A output stage, Class B output stage: Transfer Characteristics, Power Dissipation, Power Conversion efficiency, Class AB output stage, Class C tuned Amplifier. **Voltage Regulators:** Discrete transistor voltage regulation -Series and Shunt Voltage regulators. Laboratory Sessions/ Experimental learning: 1. Plot the frequency response using any classes of power amplifier **Applications:** Audio power amplifiers, Switching type power amplifiers and Wireless Communication **Video link/ Additional online information:** 1. http://www.nptelvideos.in/2012/12/electronics.html		

Course outcomes:	
CO1	Describe the working principle and biasing methods of BJT,
CO2	Analyse the frequency response of BJT Amplifier and working principle of FET.
CO3	Describe the performance characteristics of FET amplifier and Darlington Amplifier
CO4	Design various Feedback amplifiers and oscillators using BJT/FET
CO5	Understand the classes of amplifiers and Voltage regulator

Text Books:	
1.	Robert L.Boylestad and louis Nashelsky, “Electronic Devices and circuit Theory”, PHI/Pearson Education,11 TH Edition.

2.	Adel S Sedra, Kenneth C Smith "Microelectronic Circuits, Theory and Applications", 6th Edition, Oxford, 2015.ISBN:978-0-19-808913-1.
Reference Books:	
1.	Behzad Razavi, "Fundamentals of Microelectronics", John Weily ISBN 2013 978-81-265-2307-8,2nd Edition, 2013.
2.	K.A.Navas, "Electronics Lab Manual", Volume I, PHI, 5th Edition, 2015, ISBN: 9788120351424.
3.	J.Millman & .C.Halkia "Integrated Electronics", 2nd edition, 2010, TMH. ISBN 0-07-462245-5.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	-	-	-	-	-	2	2
CO2	3	2	2	2	-	-	-	-	-	-	2	1
CO3	3	2	3	1	-	-	-	-	-	-	1	2
CO4	3	2	2	1	-	-	-	-	-	-	2	1
CO5	3	2	2	1	-	-	-	-	-	-	1	1

High-3, Medium-2, Low-1

Course Title	DIGITAL SYSTEM DESIGN & VERILOG	Semester	III
Course Code	MVJ20EC34	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0: 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Familiarize with the simplification techniques & design various combinational digital circuits using logic gates.
- Introduce the analysis and design procedures for synchronous and asynchronous sequential circuits.
- Familiarize with Modern EDA tool such as Verilog.
- Acquire knowledge on different types of description in Verilog.
- Know the importance of Synthesis & programmable devices used for designing digital circuits.

Module-1	RBT Level L1,L2,L3	8Hrs.

Prerequisites: *Number systems, Boolean Algebra, Logic Gates, Comparison of Combinational & Sequential Circuits.*

Principles of combinational logic: Introduction, Canonical forms, Karnaugh maps-3, 4 variables, Quine- McClusky techniques- 3 & 4 variables.

Laboratory Sessions/ Experimental learning:

1. Study of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR.
2. Design a 4-bit Binary to Gray code converter using Pspice, a simulation tool.

Applications: OR gate in detecting exceed of threshold values and producing command signal for the system and AND gate in frequency measurement.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=FT03XrQ8Bi4

Module-2	RBT Level L1,L2,L3,L4	8Hrs.

Prerequisites: *Decoder, Encoders, Multiplexers & Demultiplexer*

Design and Analysis of combinational logic: Full Adder & Subtractors, Parallel Adder and Subtractor, Look ahead carry Adder, Binary comparators, Decoders & Multiplexers as minterm/maxterm Generator.

Introduction to HDL: Structure of HDL Module, Operators, Data types, Units and ports, Verilog constructs.

Laboratory Sessions/ Experimental learning:

1. Design a full adder using two half adders in Pspice tool.
2. Design an Adder cum Subtractor circuit which adds when input bit operation=1 or subtract if 0, using Pspice.
3. Design 4-bit comparator using IC7485.
4. Realize a Boolean expression using decoder IC74139.

Applications: Communication systems, Speed synchronization of multiple motors in industries.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=RZQTTfU9TNA,
2. https://www.youtube.com/watch?v=36hCizOk4PA,
3. https://www.youtube.com/watch?v=397DDnkBm8A

Module-3	RBT Level L1,L2,L3	8Hrs.

Prerequisites: *SR, JK, D, T flipflops*

Flip-Flops and its Applications: Latches and Flip Flops, Master-slave JK flip-flop, Timing concerns in sequential circuits, Shift Registers – SISO, SIPO, PISO PIPO, Universal shift register, Counters – Synchronous and Asynchronous.

HDL Concepts: Verilog statements- assign, if-else, case, loops, always.

Laboratory Sessions/ Experimental learning:

1. Develop the Verilog code for the following flip-flops SR, D, JK &T.
2. Design a 6-bit Register using D-Flipflop using Verilog which stores every bit for each clock cycle.

Applications: Frequency divider circuit, frequency counter.

Video link / Additional online information: 1. https://www.youtube.com/watch?v=Nxpei7Kp4Vs		
Module-4	RBT Level L1,L2,L3, L4	8Hrs.
Sequential Circuit Design: Characteristic equations, Design of a synchronous mod-n counter using clocked JK, D, T and SR flip-flops, Melay & Moore Models. **Programmable Logic Devices:** PLA, PAL, FPGA. Laboratory Sessions/ Experimental learning: 1. Design a Synchronous Counter for a given sequence- 0, 2, 4, 6, 0 using Verilog. 2. Design a 4-bit Asynchronous up/down counter using Pspice tool (D,T,JK,SR flipflops) 3. Design a 4-bit binary Synchronous up/down counter using Pspice tool. (D,T, JK, SR flipflops) 4. Implement ALU operations on FPGA **Applications:** Data synchronizer, Counter. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=O3If0Nr9to0		
Module-5	RBT Level L1,L2,L3	8Hrs.
Synthesis Basics: Introduction, Synthesis information from Entity and Module, Mapping Process and Always in the Hardware Domain. Laboratory Sessions/ Experimental learning: 1. VHDL code for weather forecast Entity. 2. Mapping logic operators. **Applications:** Timing verification, test documentation. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117108040/		

Course outcomes:	
CO1	Illustrate simplification of Algebraic equations using K-map & Quine-McCluskey Technique.
CO2	Use the modern engineering tools such as verilog, necessary for engineering practice.

CO3	Analyse& design different applications of Combinational & Sequential Circuits to meet desired need within realistic constraints.
CO4	Write code & verify the functionality of digital circuit/system using test benches to solve engineering problems in digital circuits.
CO5	Know the importance of Synthesis & programmable devices used for designing digital circuits.

Text Books:	
1.	John M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 20
2.	Donald D. Givone, "Digital Principles and Design", McGraw Hill, 2002.
3.	NazeihM.Botros- "HDL Programming (VHDL and Verilog)"- John Weily India Pvt. Ltd. 2008
Reference Books:	
1.	Samir Palnitkar "Verilog HDL: A Guide to Digital Design and Synthesis", Pearson Education, Second Edition
2.	Charles H Roth Jr., Larry L. Kinney "Fundamentals of Logic Design", Cengage Learning, 7th Edition

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	2
CO2	1	-	-	-	3	-	-	-	-	-	-	2
CO3	1	2	3	-	1	-	-	-	-	-	-	2
CO4	1	2	2	2	-	-	-	-	-	-	-	1
CO5	1	1	1	-	2	-	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	ELECTROMAGNETICS & TRANSMISSION LINES	Semester	III
Course Code	MVJ20EC35	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0: 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand the applications of Coulomb's law and Gauss law to different charge Distributions.
- Understand the physical significance of Biot-Savart's Law, Amperes' Circuital Law and Stokes' theorem for different current distributions.
- Know the physical interpretation of Maxwell's equations and its applications in plane waves.
- Understand wave propagation in lossless and in lossy media.
- Study the concepts of transmission line parameters and its applications.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: *Vector Algebra, Coordinate systems (Rectangular Coordinate System, Cylindrical Coordinate System and Spherical Coordinate System), gradient, divergence and curl*

Electrostatics: **Coulomb's Law, Electric Field Intensity, Flux density and potential:**

Coulomb's law, Electric field intensity, Field due to line charge, Field due to Sheet of charge, Field due to continuous volume charge distribution, Electric flux, Electric flux density, Electric potential, Potential difference.

Laboratory Sessions/ Experimental learning:

1. Determine the electric field intensity at a point due to uniform linear charge (ρ L) and point charges using MATLAB.

Applications: The Van de Graaff generator, Xerography, Ink Jet Printers and Electrostatic Painting, Smoke Precipitators and Electrostatic Air Cleaning.

Video link / Additional online information:

1. https://youtu.be/ckAVB3_NP2Q
2. https://youtu.be/IH2fFNaR9YM
3. https://youtu.be/JhTT-wew-OE

Module-2	RBT Level L1, L2, L3, L4	8Hrs.

Gauss' law, Divergence, Poisson's and Laplace's Equations: Gauss law, Application of Gauss' law, Maxwell's First equation (Electrostatistics), Divergence theorem, Current, Current density, The continuity equation, Boundary conditions (dielectric-dielectric, conductor-dielectric, conductor-free space), Poisson's and Laplace's Equations, Uniqueness theorem.

Laboratory Sessions/ Experimental learning:

1. Evaluate the current flowing through a given surface using MATLAB.
2. Verify the Divergence theorem using MATLAB.

Applications: Used for calculation electrical field for a symmetrical distribution of charges

Video link / Additional online information:

1. https://youtu.be/N_jUbFnlqEg
2. https://youtu.be/XtH2WAhvYIM
3. https://youtu.be/gu934FBac6g
4. https://youtu.be/hp9Jito4vPE

Module-3	RBT Level L1, L2, L3, L4	8Hrs.

Magnetostatics: Steady Magnetic Field: Biot-Savart Law, Ampere's circuital law, Curl, Stoke's theorem, Gauss's law for magnetic fields, Magnetic flux and Magnetic flux density, Magnetic Scalar and Vector Potentials.

Magnetic Forces and magnetic materials: Force on a moving charge and differential current element, Force between differential current elements, Magnetization, magnetic susceptibility, permeability, Magnetic boundary conditions, Inductances, magnetic energy, magnetic circuit.

Laboratory Sessions/ Experimental learning:

1. Determine the magnetic field intensity at a point due to magnetic field using MATLAB.

Applications: Motors, Generators, Loudspeakers, MRI

Video link / Additional online information : 1. https://youtu.be/ebGM_q19gY0 2. https://youtu.be/uXQbYJVzlQ0 3. https://youtu.be/aYRBXI63Oqk		
Module-4	RBT Level L1, L2, L3, L4	8Hrs.
Time varying Fields & Maxwell's Equation: Faraday's law, Displacement current, Maxwell's equation in differential and integral form, Time varying potentials. **Electromagnetic wave propagation:** Derivation of wave equations from Maxwell's equations, Relation between E and H, Wave propagation in - lossy dielectrics, lossless dielectrics, free space and good conductor, skin-effect, Poynting theorem. Laboratory Sessions/ Experimental learning: 1. Determine the parameters of wave using MATLAB. Applications: Optoelectronics Video link / Additional online information : 1. https://youtu.be/xxIb9Qv6t7E 2. https://youtu.be/_X061_y9Lqw 3. https://youtu.be/OoQS1ex4kJA		
Module-5	RBT Level L1, L2, L3, L4	8Hrs.
Transmission lines: Introduction, Transmission line parameters, Transmission line equations, input impedance, standing wave ratio and power. **Applications of transmission line:** Impedance matching and tuning: single stub tuning, double stub tuning, and the quarter wave transformer. Laboratory Sessions/ Experimental learning: 1. Simulation of micro strip transmission line using FEKO software. Applications: Telephone, Cable TV, Broadband network Video link / Additional online information: 1. https://youtu.be/z9GbnMPDCVA 2. https://youtu.be/yk1Mu9fQ6mA 3. https://youtu.be/PO5ExHOKIJM		

Course outcomes:	
CO1	Evaluate problems on electrostatic force, electric field due to point, linear, surface charge and volume charges.
CO2	Apply Gauss law to evaluate Electric fields due to different charge distributions by using Divergence Theorem. Determine potential and capacitance using Laplace equation and Poisson equation.
CO3	Apply Biot-Savart's and Ampere's laws for evaluating Magnetic field for different current configurations.
CO4	Apply Maxwell's equations for time varying fields and evaluate power associated with EM waves using Poynting theorem.
CO5	Determine the parameters of transmission lines for determining the impedance and admittance.

Text Books:	
1.	Matthew N. O. Sadiku, "Elements of Electromagnetics", Oxford University Press, Edition VII, 2018.
2.	David M Pozar, "Microwave Engineering", John Wiley & Sons, Inc., 4th edition, 2014.
Reference Books:	
1.	W.H. Hayt. J.A. Buck & M Jaleel Akhtar, "Engineering Electromagnetics", Tata McGraw – Hill, Edition VIII, 2014.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	-	1
CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	3	3	2	2	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	COMPUTER ORGANIZATION & ARCHITECTURE	Semester	III
Course Code	MVJ20EC36	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0: 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:		
• Explain the basic sub systems of a computer, their organization, structure and Operation. • Illustrate the concept of programs as sequences of machine instructions. • To understand the different ways of communicating with I/O devices and to introduce memory types including cache memories. • Describe memory hierarchy and concept of virtual memory. • To analyse concepts of Pipelining and other computing systems.		
Module-1	RBT Level L1,L2,L3	8Hrs.
Basic Structure of Computers: Computer Types, Functional Units, Basic Operational Concepts, Bus Structures, Software, Performance – Processor Clock, Basic Performance Equation. **Machine Instructions and Programs:** Numbers, Arithmetic Operations and Characters, IEEE standard for Floating point Numbers, Memory Location and Addresses, Memory Operations, Instructions and Instruction Sequencing. Laboratory Sessions/ Experimental learning: 1. Understanding various parts of CPU of a PC. 2. Study of Microprocessor and understanding of its various instruction **Applications:** Understand the functionality of the various units of computer. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=K7fnDf-P6_c#action=share 2. https://www.youtube.com/watch?v=9-9z32T-5WU#action=share		

3. https://www.youtube.com/watch?v=Szn_lwHal04#action=share		
Module-2	RBT Level L1,L2,L3	8Hrs.
Prerequisite :Number system **Addressing Modes:** Assembly Language, Basic Input and Output Operations, Stacks and Queues, Subroutines, Additional Instructions. **Laboratory Sessions/ Experimental learning:** 1. Write an ALP to find the sum of two numbers and verify if the sum is an even or odd number and simulate the output. 2. Write an ALP to transfer a block of data from one location to other and simulate the output. **Applications:** Project based on microprocessor. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=s4cVdsK3XiQ#action=share 2. https://www.youtube.com/watch?v=xKTNgA_ee58		
Module-3	RBT Level L1,L2,L3	8Hrs.
Input/Output Organization: Accessing I/O Devices, Interrupts – Interrupt Hardware, Enabling and Disabling Interrupts, Handling Multiple Devices, Controlling Device Requests, Direct Memory Access, and Buses. **Laboratory Sessions/ Experimental learning:** 1. Study any one input/output device and examine its various input output ports details. **Applications:** Interfacing of Peripheral devices **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=Y17TLZCSe4M#action=share 2. https://www.youtube.com/watch?v=Zw79moR2gFs		
Module-4	RBT Level L1,L2,L3	8Hrs.
Memory System: Basic Concepts, Semiconductor RAM Memories-Internal organization of memory chips, Static memories, Asynchronous DRAMS, Read Only Memories, Cash		

Memories, Mapping Functions, Replacement Algorithm, Virtual Memories, Secondary Storage-Magnetic Hard Disks. **Laboratory Sessions/ Experimental learning:** 1. Implement and simulate a simple memory unit which is capable of reading and writing data within a single clock cycle. **Applications:** Understanding the various memories **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=lpVyGPNyjEs#action= 2. https://www.youtube.com/watch?v=NhyIUpOj5V8#action=share 3. https://www.youtube.com/watch?v=xXk3WiPGux8#action=share 4. https://www.youtube.com/watch?v=aeDyDIo-G44#action=share			
Module-5		RBT Level L1,L2,L3	8Hrs.
Basic Processing Unit: Some Fundamental Concepts, Execution of a Complete Instruction, Multiple Bus Organization, Hardwired Control, Micro programmed Control, Pipelining, Basic concepts, Role of Cache memory, Pipeline Performance **Laboratory Sessions/ Experimental learning:** 1. Evaluate the possible control sequence for implementing a multiplication instruction using registers for a single bus organization **Applications:** Microprocessor **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=R41DfN3NpIM#action=share 2. https://www.youtube.com/watch?v=b5thcNYBrQc			

Course outcomes:	
CO1	Identify the functional units of the processor and the factors affecting the performance of a computer
CO2	Demonstrate the ability to classify the addressing modes, instructions sets and design programs.
CO3	Understand the different ways of accessing an input / output device including interrupts.

CO4	Illustrate the organization of different types of semiconductor and other secondary storage memories.
CO5	Illustrate the simple processor organization based on hardwired control and micro programmed control.

Text Books:	
1.	Carl Hamacher, ZvonkoVranesic, SafwatZaky: "Computer Organization", 6th Edition, Tata McGraw Hill, 2011.
Reference Books:	
1.	Andrew S. Tanenbaum, Todd Austin, "Structured Computer Organization", 6th Edition, Pearson, 2013.
2.	David A. Patterson, John L. Hennessy: "Computer Organization and Design – The Hardware / Software Interface ARM Edition", 4th Edition, Elsevier, 2009.
3.	William Stallings: "Computer Organization & Architecture", 7th Edition, PHI, 2006.
4.	Vincent P. Heuring& Harry F. Jordan: "Computer Systems Design and Architecture", 2nd Edition, Pearson Education, 2004.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	2	1	-	1	-	-	1
CO2	3	3	2	2	1	2	1	-	1	-	-	1
CO3	3	2	2	2	1	2	1	-	1	-	-	1
CO4	3	2	2	2	1	2	1	-	1	-	-	1
CO5	3	2	2	2	1	2	1	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	ANALOG ELECTRONICS LAB	Semester	III
Course Code	MVJ20ECL37	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0: 2: 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Understand the circuit schematic and its working.
- Study the characteristics of different electronic devices.
- Design and test simple electronic circuits as per the specifications using discrete Electronic components.
- Familiarize with EDA /PSPSICE software which can be used for electronic circuit Simulation.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
Hardware Experiments			
1	Wiring of RC coupled Single stage FET & BJT amplifier and determine the gain-frequency response, input and output impedances	L3	3
2	Wiring of BJT Darlington Emitter follower with and without bootstrapping and determination of the gain, input and output impedances.	L3	3
3	Design an oscillator with tank circuit having two inductances and one capacitance and compare the practical frequency with theoretical frequency.	L4	3
4	Design an oscillator with tank circuit having two capacitance and one inductance and compare the practical frequency with theoretical frequency.	L4	3
5	Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).	L3	2

6	Design an Oscillator using FET whose tank circuit produces a total phase shit of 180, and calculate the frequency of output waveform.	L4	3
7	Design an oscillator whose frequency is 2MHZ and compare with the theoretical frequency.	L4	2
8	Find a suitable power amplifier that removes the cross over distortion and calculate the efficiency	L3	3
Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, Circuit Lab or any other equivalent tool can be used)			
9	RC Phase Shift Ocsillator	L3	2
10	Colpitts And Hartley Oscillator	L3	2
11	Crystal Oscillator	L3	2
12	Half and Full wave Rectifier	L3	2

Course outcomes:	
CO1	Design and compare the impedance effect in BJT Darlington Emitter follower circuit
CO2	Design analog circuits using BJT/FETs and evaluate their performance characteristics.
CO3	Design of diode clipper and clamper circuits.
CO4	Compare the hardware and software results for different oscillator and filter circuits.
CO5	Simulate and analyse electronic Circuits for different applications.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	-	-	-	-
CO2	3	2	2	3	3	-	-	-	-	-	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-
CO4	2	1	2	2	3	-	-	-	-	-	-	-
CO5	2	1	2	1	3	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	DIGITAL SYSTEM DESIGN & VERILOG LAB	Semester	III
Course Code	MVJ20ECL38	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0: 2: 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Demorgan's Theorem, SOP, POS forms
- Full/Parallel Adders, Subtractors and code converter BCD to Excess-3 &vice versa.
- Flip-Flops, Shift registers and Counters.
- Familiarize with the CAD tool to write HDL programs.
- Understand simulation and synthesis of digital design.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
Rig up the circuit for the following and verify on IC Trainer Kit.			
1	Verify (a) Demorgan's Theorem for 2 variables. (b) The sum-of product and product-of-sum expressions using universal gates.	L3	3
2	Design and implement (a) Full Adder using basic logic gates. (b) Full subtractor using basic logic gates.	L4	3
3	(a) Design and implement (i) 4-bitParallelAdder/ Subtractor using IC 7483. (ii) BCD to Excess-3 code conversion and vice-versa. (b) Realize (i) Adder & Subtractors using IC 74153(ii) 4-variable function using IC 74151(8:1MUX)	L4	3
4	Realize the following flip-flops using NAND Gates.(a) Clocked SR Flip-Flop (b) JK Flip-Flop (c) D-Flip-Flop	L3	3

5	Realize the following shift registers using IC7474 a.SISO (b) SIPO (c) PISO (d) PIPO (e) Ring Counter (f) Johnson Counter.	L3	3
6	Realize (i) Design Mod – N Synchronous Up Counter & Down Counter using 7476 JK Flip-flop (ii) Mod-N Counter using IC7490 / 7476.	L3	3
Simulate the following using Verilog Code and Implement on FPGA			
7	Write a Verilog program for the following combinational designs a) 2 to 4 decoder b) 8 to 3 (encoder without priority & with priority) c). 8 to 1 multiplexer d) 4 bit binary to gray converter e) Multiplexer, De-multiplexer, Comparator.	L3	2
8	Design 4 bit binary, BCD counters with Synchronous reset and asynchronous reset and "any sequence"counters using Verilog code.	L4	2
9	Write HDL code to display messages on alpha numeric LCD display.	L3	2
10	Write a HDL code to control speed, direction of DC and Stepper motor	L3	2
11	Write HDL code to interface Hex key pad and display the key code on seven segment display.	L3	2
12	Write a HDL code to accept Analog signal, Temperature sensor and display the data on LCD or Seven Segment Display.	L3	2
Virtual Lab Links: http://vlabs.iitkgp.ernet.in/dec/			

Course outcomes:	
CO1	Demonstrate the truth table of various expressions and combinational circuits using logic gates.
CO2	Design and test various combinational circuits such as adders, subtractors, comparators, multiplexers and demultiplexers.
CO3	Construct and test flips-flops, counters, shift registers and Counters.

CO4	Write the Verilog/VHDL programs to simulate Combinational circuits in Dataflow, Behavioural and Gate level Abstractions.
CO5	Describe sequential circuits like flip flops and counters in Behavioural description and obtain simulation waveforms.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	1	-	-	-	-	-	-	-
CO2	1	-	-	-	3	-	-	-	-	-	-	-
CO3	1	2	3	-	3	-	-	-	-	-	-	-
CO4	1	2	2	2	3	-	-	-	-	-	-	-
CO5	1	1	1	-	2	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	SAMSKRUTHIKA KANNADA	Semester	III/IV
Course Code	MVJ20SK39/49	CIE	50
Total No. of Contact Hours	15	SEE	50
No. of Contact Hours/week	1 (L : T : P :: 1 :0 : 0)	Total	100
Credits	1	Exam. Duration	2Hrs

Course objective :This course will enable students to understand Kannada and communicate in Kannada language

- Samskruthika Kannada –Parichaya (Introduction to Adalitha kannada)
- Kannada Kavyagala parichaya (Kannada D Ra Bendre, Siddalingaiha)
- Adalithdalli Kannada Padagalu (Kannada Kagunitha Balake, Patra Lekhana, Prabhandha)
- Kannada Computer Gnyana (Kannada Shabdha Sangraha, Computer Paribashika padagalu)
- Activities in Kannada.

Module - 1	L1	3 Hrs
೧. ಕನ್ನಡ ಭಾಷೆ-ಸಂಕ್ಷಿಪ್ತ ವಿವರಣೆ. ೨. ಭಾಷಾ ಪ್ರಯೋಗಲ್ಲಾಗುವ ಲೋಪದೋಷಗಳು ಮತ್ತು ಅವುಗಳ ನಿವಾರಣೆ		
Module - 2	L1	3 Hrs
೧. ಲೇಖನ ಚಿಹ್ನೆಗಳು ಮತ್ತು ಅವುಗಳ ಉಪಯೋಗ ೨. ಪತ್ರ ವ್ಯವಹಾರ.		
Module - 3	L1	3 Hrs
೧. ಆಡಳಿತ ಪತ್ರಗಳು. ೨. ಸರ್ಕಾರದಆದೇಶ ಪತ್ರಗಳು		
Module - 4	L1	3 Hrs
೧. ಸಂಕೀಪ್ತ ಪ್ರಬಂಧರಚನೆ, ಪ್ರಬಂಧ ಮತ್ತು ಭಾಷಾಂತರ ೨. ಕನ್ನಡ ಶಬ್ದಸಂಗ್ರಹ		
Module - 5	L1	3 Hrs

೧. ಕಂಪ್ಯೂಟರ್ ಹಾಗೂ ಮಾಹಿತಿತಂತ್ರಜ್ಞಾನ

೨. ಪಾರಿಭಾಷಿಕ ಆಡಳಿತ ಕನ್ನಡ ಪದಗಳು ಮತ್ತು ತಾಂತ್ರಿಕ/ಕಂಪ್ಯೂಟರ್ ಪಾರಿಭಾಷಿಕ ಪದಗಳು.

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Assignment / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
Total		100

Textbooks:

1.	Adalitha Kannada – Dr. L Thimmesh, Prof. V Keshav Murthy

Course Title	BALAKE KANNADA	Semester	III/IV
Course Code	MVJ20BK39/49	CIE	50
Total No. of Contact Hours	15	SEE	50
No. of Contact Hours/week	1 (L : T : P :: 1 :0 : 0)	Total	100
Credits	1	Exam. Duration	2Hrs

Course objective :

This course will enable students to understand Kannada and communicate in Kannada language

- Vyavharika Kannada –Parichaya (Introduction to Vyavharika kannada)
- Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronounciation.
- Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).
- Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana)
- Activities in Kannada

Module - 1

Vyavharika Kannada –Parichaya (Introduction to Vyavharika kannada)

Module - 2

Kannada Aksharamaale haagu uchcharane(Kannada Alphabets and Pronounciation

Module - 3

Sambhashanegaagi Kannada Padagalu (Kannada Vocubulary for Communication).

Module - 4

Kannada Grammer in Conversations(Sambhasaneyalli Kannada Vyakarana)

Module - 5

Activities in Kannada

Scheme of Evaluation:

Details		Marks
Average of three Internal Assessment (IA) Tests of 30 Marks each i.e. Σ (Marks Obtained in each test) / 3	CIE(50)	30
Assignment / Case Studies / Quiz		20
Semester End Examination	SEE (50)	50
Total		100

Course Title	CONSTITUTION OF INDIA, PROFESSIONAL ETHICS AND CYBER LAW	Semester	III/IV
Course Code	MVJ20CPH39/49	CIE	50
Total No. of Contact Hours	15	SEE	50
No. of Contact Hours/week	1 (L : T : P :: 1 :0 : 0)	Total	100
Credits	1	Exam. Duration	2 Hrs

Course objective is to:		
• To know the fundamental political codes, structure, procedures, powers, and duties of Indian constitution, Indian government institutions, fundamental rights, directive principles and the duties of the citizens. • To provide overall legal literacy to the young technograts to manage complex societal issues in the present scenario. • To understand engineering ethics & their responsibilities, identify their individual roles and ethical responsibilities towards society.		
Module-1	RBT Level L1,L2,L3	3Hrs.
Introduction to Indian Constitution: The Necessity of the Constitution, The Societies before and after the Constitution adoption. Introduction to the Indian Constitution, The Making of the Constitution, The role of the Constituent Assembly – Preamble and Salient features of the Constitution of India. Fundamental Rights and its Restriction and Limitations in different Complex Situations. Directive Principles of State Policy (DPSP) and its present relevance in our society with examples. Fundamental Duties and its Scope and Significance in Nation Building.		
Module – II	RBT Level L1,L2,L3	3Hrs.
Union Executive and State Executive: Parliamentary System, Federal System, Centre-State Relations. Union Executive – President, Prime Minister, Union Cabinet, Parliament - LS and RS, Parliamentary Committees, Important Parliamentary Terminologies. Supreme Court of India, Judicial Reviews and Judicial Activism. State Executives –		

Governor, Chief Minister, State Cabinet, State Legislature, High Court and Subordinate Courts, Special Provisions (Article 370, 371, 371J) for some States.		
Module – III	RBT Level L1,L2,L3	3Hrs.
Elections, Amendments and Emergency Provisions: Elections, Electoral Process, and Election Commission of India, Election Laws. Amendments - Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44,61,73,74,75,86, and 91,94,95,100,101,118 and some important Case Studies. Recent Amendments with explanation. Important Judgements with Explanation and its impact on society (from the list of Supreme Court Judgements). Emergency Provisions, types of Emergencies and it's consequences. **Constitutional Special Provisions:** Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.		
Module – IV	RBT Level L1,L2,L3	3Hrs.
Professional / Engineering Ethics: Scope & Aims of Engineering & Professional Ethics - Business Ethics, Corporate Ethics, Personal Ethics. Engineering and Professionalism, Positive and Negative Faces of Engineering Ethics, Code of Ethics as defined in the website of Institution of Engineers (India): Profession, Professionalism, Professional Responsibility. Clash of Ethics, Conflicts of Interest. **Responsibilities in Engineering** - Responsibilities in Engineering and Engineering Standards, the impediments to Responsibility. Trust and Reliability in Engineering, IPRs (Intellectual Property Rights), Risks, Safety and liability in Engineering.		
Module – V	RBT Level L1,L2,L3	3Hrs.
Internet Laws, Cyber Crimes and Cyber Laws: Internet and Need for Cyber Laws, Modes of Regulation of Internet, Types of cyber terror capability, Net neutrality, Types of Cyber Crimes, India and cyber law, Cyber Crimes and the information Technology Act 2000, Internet Censorship, Cybercrimes and enforcement agencies.		

Course Outcomes: On completion of this course, students will be able to	
CO1	Have constitutional knowledge and legal literacy
CO2	Understand Engineering and Professional ethics and responsibilities of Engineers.

CO3	Understand the cybercrimes and cyber laws for cyber safety measure.

Text Books:	
1.	Constitution of India and Professional Ethics, T.S. Anupama, Sunstar Publisher
Reference Books:	
1.	Durga Das Basu (DD Basu): "Introduction to the Constitution on India", (Students Edition.) Prentice –Hall EEE, 19th/20th Edn., (Latest Edition) or 2008.
2.	Shubham Singles, Charles E. Haries, and Et al : "Constitution of India and Professional Ethics" by Cengage Learning India Private Limited, Latest Edition – 2018.
3	M.Govindarajan, S.Natarajan, V.S.Senthilkumar, "Engineering Ethics", Prentice – Hall of India Pvt. Ltd. New Delhi, 2004.
4.	M.V.Pylee, "An Introduction to Constitution of India", Vikas Publishing, 2002.
5.	Latest Publications of NHRC - Indian Institute of Human Rights, New Delhi.

Course Title	UNIVERSAL HUMAN VALUES I	Semester	III
Course Code	MVJ20UHV310	CIE	50
Total No. of Contact Hours	15	SEE	50
No. of Contact Hours/week	1 (L: T: P: 1 : 0 :0)	Total	100
Credits	1	Exam. Duration	2 Hrs.

Course objective is to: This course will enable the students to

- Perceive the need for developing a holistic perspective of life
- Sensitise the scope of life – individual, family (inter-personal relationship), society and nature/existence, Strengthening self-reflection
- Develop more confidence and commitment to understand, learn and act accordingly

Module-1	RBT Level L1,L2	3 Hrs

Welcome and Introductions: Getting to know each other (Self-exploration)

Aspirations and Concerns: Individual academic, career, Expectations of family, peers, society, nation, Fixing one's goals (Basic human aspirations Need for a holistic perspective Role of UHV)

Self-Management: Self-confidence, peer pressure, time management, anger, stress, Personality development, self-improvement (Harmony in the human Being)

Health: Health issues, healthy diet, healthy lifestyle, Hostel life (Harmony of the Self and Body Mental and physical health)

Relationships: Home sickness, gratitude, towards parents, teachers and, others Ragging and interaction, Competition and cooperation, Peer pressure (Harmony in relationship Feelings of trust, respect, gratitude, glory, love)

Society: Participation in society (Harmony in the society)

Natural Environment: Participation in nature (Harmony in nature/existence) **Video link:** 1. https://youtube.com/playlist?list=PLYwzG2fd7hzc4HerTNkc3pS_IvcCfKznV 2. https://youtube.com/playlist?list=PLYwzG2fd7hzcZz1DkrAegkKF4TseekPFv **Presentation:** https://fdp-si.aicte-india.org/AicteSipUHV_download.php		
Module-2	RBT Level L1,L2	3 Hrs
Introduction to Value Education: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario. **Video link:** 1. https://www.youtube.com/watch?v=85XCw8SU084 2. https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz 3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-3	RBT Level L1,L2	3 Hrs
Introduction to Harmony in the Human Being: Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body. **Video link:** 1. https://www.youtube.com/watch?v=GpuZo495F24 2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-4	RBT Level L1,L2	3 Hrs
Introduction to Harmony in the Family and Society: Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society.		

Video link:		
1. https://www.youtube.com/watch?v=F2KVW4WNnS8 2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-5	RBT Level L1,L2	3 Hrs
Introduction to Implications of the Holistic Understanding: Natural Acceptance of Human Values, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies. **Video link:** 1. https://www.youtube.com/watch?v=BikdYub6RY0 2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		

Course outcomes: On completion of the course, students would be able to	
CO1	Develop a holistic perspective about life
CO2	Explore his/her role (value) in all aspects of living – as an individual, as a member of a family, as a part of the society as an unit in nature
CO3	Become more responsible in life, and in handling problems with sustainable solutions
CO4	Have better critical ability
CO5	Become sensitive to their commitment

Scheme of Evaluation

Details		Marks
Assessment by Faculty mentor (Class Room Evaluation)	CIE(50)	10
Self-Assessment + Assessment by peers		20

Activities / Experimentations related to courses/Assignment		10
Mini Projects / Case Studies		10
Semester End Examination	SEE (50)	50
	Total	100

Text Books:

1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php
2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	1	-	-	-	2	2	3	2	1	2	1
CO2	-	1	-	-	-	2	2	3	2	1	2	1
CO3	-	1	-	-	-	2	2	3	2	1	2	1
CO4	-	1	-	-	-	2	2	3	2	1	2	1
CO5	-	1	-	-	-	2	2	3	2	1	2	1

High-3, Medium-2, Low-1

Course Title	ADDITIONAL MATHEMATICS-I (COMMON TO ALL BRANCHES)	Semester	III
Course Code	MVJ20MATDIP31	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T: P: 2 : 2 :0)	Total	100
Credits	-	Exam. Duration	3Hrs

Course objective is to: This course viz., aims to prepare the students: • To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.		
Module-1	RBT Level L1,L2	8Hrs.
Differential calculus: Recapitulations of successive differentiations -n^{th} derivative - Leibnitz theorem and Problems, Mean value theorem -Rolle's theorem, Lagrange's Mean value theorem , Cauchy's theorem and Taylor's theorem for function of one variables. Video Link: 1. https://users.math.msu.edu/users/gnagy/teaching/ode.pdf		
Module-2	RBT Level L1,L2	8 Hrs.
Integral Calculus: Review of elementary Integral calculus, Reduction formula $\int_0^{\frac{\pi}{2}} sin^m x\, dx$, $\int_0^{\frac{\pi}{2}} cos^m x\, dx$, $\int_0^{\frac{\pi}{2}} sin^m cos^n x\, dx$ and problems. Evaluation of double and triple integrals and Simples Problems. Video Link: 1. https://www.youtube.com/watch?v=rCWOdfQ3cwQ 2. https://nptel.ac.in/courses/111/105/111105122/		

Module-3	RBT Level L1,L2	8Hrs.
Vector Calculus: Derivative of vector valued functions, Velocity, Acceleration and related problems, Scalar and Vector point functions, Gradient, Divergence, Curl, Solenoidal and Irrotational vector fields. Vector identities - div (ϕA), curl (ϕA), curl (grad ϕ), div (curl A). **Video Link:** 1. https://www.whitman.edu/mathematics/calculus_online/chapter16.html		
Module-4	RBT Level L1,L2,L3	8 Hrs.
Probability: Introduction-Conditional Probability, Multiplication theorem, Independent events ,Baye's theorem and Problems. **Video Link:** 1. https://www.khanacademy.org/math/statistics-probability/probability-library 2. https://nptel.ac.in/courses/111/105/111105041/		
Module-5	RBT Level L1,L2,L3	8 Hrs.
Differential equation: Homogenous differential equation, Linear differential equation, Bernoulli's differential equation and Exact differential equation. **Video Link:** 1. https://www.mathsisfun.com/calculus/differential-equations.html		

Course outcomes:	
CO1	Apply the knowledge of Differential calculus in the modeling of various physical and engineering phenomena
CO2	Apply the concept of change of order of integration and variables to evaluate multiple integrals and their usage in computing the area and volumes.
CO3	Study on Vector calculus to understand the various solution to Application to Engineering problems.
CO4	Understand the basic Concepts of Probability
CO5	Solve first order linear differential equation analytically using standard methods.

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
Reference Books:	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
2.	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	3	0	0	0	0	0	0	1	1
CO2	2	3	0	3	0	0	0	0	0	0	1	1
CO3	2	2	0	2	0	0	0	0	0	0	1	0
CO4	3	2	0	3	0	0	0	0	0	0	0	1
CO5	3	3	0	2	0	0	0	0	0	0	0	0

High-3, Medium-2, Low-1

B.E, IV Semester, Electronics & Communication Engineering

Course Title	PROBABILITY THEORY, COMPLEX VARIABLES AND OPTIMIZATION	Semester	IV
Course Code	MVJ20MEC41	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 2 : 2: 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Apply discrete and continuous probability distributions in analyzing the probability models arising in engineering field.
- Learn the mathematical formulation of linear programming problem
- Understand the concepts of Complex variables and transformation for solving Engineering Problems.
- Understand the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.
- Learn the solutions of partial differential equations numerically.

Module-1	RBT Level L1, L2	8Hrs.

Probability Theory: Random variables (discrete and continuous), probability density function, cumulative density function.

Probability Distributions: Binomial distribution, Poisson distribution. Normal distribution, Exponential distribution, Joint probability distributions.

Applications: Discrete and continuous probability distributions help in analyzing the probability models arising in engineering field.

Video Link:

1. https://youtu.be/cp7_ZF2kNi4

Module-2	RBT Level L1, L2	8Hrs.
Optimization: Linear Programming, mathematical formulation of linear programming problem (LPP), Types of solutions, Graphical Method, simplex method, big-M method, Dual – simplex method. **Applications:** Applications of transport Problems **Video Link:** 1. https://youtu.be/WZIyL6pcItY		
Module-3	RBT Level L1, L2, L3	8Hrs.
Complex Variables: Functions of complex variables, Analytic function, Cauchy-Riemann equations in Cartesian and polar coordinates, Consequences of Cauchy-Riemann equations, Properties of analytic functions. Application to flow problems- complex potential, velocity potential, equipotential lines, stream functions, stream lines. **Applications:** Application to flow problems **Video Link:** 1. https://youtu.be/b5VUnapu-qs		
Module-4	RBT Level L1, L2, L3	8Hrs.
Complex line integrals- Cauchy's theorem and Cauchy's integral formula, Singularities, Types of Singularities, Poles, Residues-definitions, Cauchy residue theorem –Problems. Conformal transformation, Bilinear transformation and discussion of $w=z^2$, $w=e^z$ and $w=z+\frac{a^2}{z}(z\neq 0)$. **Applications:** To evaluate line integral of analytic function over closed curve **Video Link:** 1. https://youtu.be/qTDDFMAt7j4		
Module-5	RBT Level L2, L3	8Hrs.
Numerical solutions of PDE – Classification of second order equations, finite difference		

approximation to derivatives, solution of heat equations, solution of wave equations and solution of Laplace equation. **Applications**: To solve boundary value problems **Video Link**: 1. https://youtu.be/nNnnBMF03lI

Course Outcomes:	
CO1	Apply discrete and continuous probability distributions in analyzing the probabilit models arising in engineering field.
CO2	Learn the mathematical formulation of linear programming problem
CO3	Use the concepts of analytic function and complex potentials to solve the problem arising in electromagnetic fieldtheory
CO4	Utilize conformal transformation and complex integral arising in aerofoil theory Fluid flow visualization and image processing
CO5	Learn the numerical solutions of partial differentialequations

Text Books:	
1.	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2.	Prof. G.B.Gururajachar, "Engineering Mathematics –III, Academic Excellent series publications, 2016 – 17.
3.	Prof. G.B.Gururajachar, "Engineering Mathematics –IV, Academic Excellent series publications, 2017 – 18.
Reference Books:	
1.	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10^{th} edition, 2014.
2.	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
3.	Bali N. P. & Manish Goyal, "A text book of Engineering Mathematics", Laxmi Publications, 8^{th} Edition
4.	H K Dass:"Advanced Engineering Mathematics"- S Chand & Company Ltd. 12^{th} edition.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	3	-	-	-	-	-	-	1	1
CO2	3	3	-	3	-	-	-	-	-	-	1	-
CO3	3	2	-	2	-	-	-	-	-	-	-	-
CO4	3	3	-	3	-	-	-	-	-	-	-	1
CO5	3	3	-	3	-	-	-	-	-	-	1	-

High-3, Medium-2, Low-1

Course Title	SIGNALS AND SYSTEMS	Semester	IV
Course Code	MVJ20EC42	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to:

- Analyse the mathematical description of continuous and discrete time signals and systems.
- Analyse the signals in time domain using convolution sum and Integral.
- Determine the response of the LTI system to any input signal.
- Analyse Linear Time Invariant (LTI) systems in time and transform domains
- Apply the knowledge of frequency-domain representation and analysis concepts using Fourier analysis tools and Z-transform.

Module-1	RBT Level L1,L2,L3	10Hrs.

Prerequisites: Definition of step, ramp, impulse response

Introduction and Classification of signals: Definition of signal and systems, Communication and control system as examples, Classification of signals.

Basic Operations on signals: Amplitude scaling, addition, multiplication, differentiation, Integration, time scaling, time shift and time reversal.

Elementary signals/Functions: Exponential, sinusoidal, step, impulse and ramp functions. Expression of triangular, rectangular and other waveforms in terms of elementary signals

Laboratory Sessions/ Experimental learning:

1. Exploring concepts with MATLAB- Generation of both continuous time and discrete time signals of various kinds.
   a) Plot $y(x) = x^2\cos(x)$, $g(x) = x\cos(x)$, $f(x) = 2^x\sin(x)$, $0 \leq x \leq 2\pi$ in the same figure.
2. Generation of Signals & Signal Operations

Plot in the time interval $-5 \leq t \leq 10$, the following signals:

   a) $\delta(t) + 2\,\delta(t)$

b) u(t) +2 u(t)+1

c) r(t)+u(t)

Applications: Time shifting operation can be used in artificial intelligence, such as in systems that use Time Delay Neural Network, Multiplication of signals is exploited in the field of analog communication when performing amplitude modulation (AM), Differentiation of a signal is used in the field of image or video processing.

Video link / Additional online information :

1. https://nptel.ac.in/courses/108/104/108104100/

Module-2	RBT Level L1,L2,L3	10Hrs.

System Classification and properties: Linear-nonlinear, Time variant-invariant, Causal-non causal, static-dynamic, stable-unstable, invertible.

Time domain representation of LTI System: Impulse response of an LTI system, convolution sum, Convolution integral. Properties of convolution - Commutative property, Distributive property, Associative Property and system interconnection. Computation of convolution sum and convolution integral using graphical method for unit step and unit step, unit step and exponential, exponential and exponential, unit step and rectangular, and rectangular and rectangular.

Laboratory Sessions/ Experimental learning:

1. To compute convolution of two signals using MATLAB.
   a) A system is described by the impulse response h (t) =t, $0 \leq t \leq 10$. Compute and plot the response of the system to the input signal $x(t)=0.8^{t}$, $0 \leq t \leq 10$.
   b) Compute the convolution between the complex sequence =[3+2j,1+j,4+6j] and h=[1-2j,j,3-2j,2].

Applications: Convolution concepts are used in Artificial Intelligence, Image Processing, Signal filtering, Audio processing

Video link / Additional online information :

1. https://nptel.ac.in/courses/117105134/
2. http://www.digimat.in/nptel/courses/video/108108109/L63.html

Module-3	RBT Level L1,L2,L3	10Hrs.

Prerequisites: Basics of Fourier series concepts

LTI system Properties in terms of impulse response: Memoryless, Causal, Stable, Invertible, and step response. **Fourier Representation of Periodic Signals:** CTFS and DTFS and basic problems (excluding properties). **Laboratory Sessions/ Experimental learning:** 1. To analyse the spectrum of signal with Fourier series using MATLAB. a) Verify the linearity property of the given periodic signals x(t)=cos(t) and y(t)=sin(2t),scalars are a=3+2j,b=2. b) Verify the time reversal propertyof the given periodic signal x(t)=t cos(t) ,$0 \leq t \leq 2\pi$ in one period. **Applications**: Signal Processing, Control Theory, Communications Systems, Image and Video Processing, Biomedical Engineering (ECG, MRI), Oil extraction (Seismology), Music Industry (Audio) and Power Quality Analysis. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/111106046/ 2. https://nptel.ac.in/courses/111106111/			
Module-4		RBT Level L1,L2,L3,L4	10Hrs.
Prerequisites: Basics of Fourier transform concepts **Fourier Representation of aperiodic Signals**: Introduction to Fourier Transform & DTFT, Definition and basic problems. Properties of Fourier Transform: Linearity, Time shift, Frequency shift, scaling, Differentiation and Integration, Convolution and Modulation, Parseval's theorem and problems on properties of Fourier Transform. **Laboratory Sessions/ Experimental learning:** 1. Application of Fourier Transform in Modulation and Demodulation Technology using MATLAB. a) Compute the Fourier transform of the function $x(t) = e^{-t} u(t)$ b) Suppose that a signal x(t) is given by $x(t)=te^{-3t}$. Compute the Fourier transform X (w) of the signal of the signal x(t) and plot for $-20 \leq w \leq 20$ rad/sec. **Applications**: Fourier Transform in Modulation and Demodulation Technology, Frequency division multiplexing and time division multiplexing, In Filtering Technology			

Video link / Additional online information : 1. https://nptel.ac.in/courses/111102129/ 2. https://nptel.ac.in/courses/111106046/

Module-5	RBT Level L1,L2,L3	10Hrs.
Prerequisites: Basics of Z-transform concepts **The Z-Transforms:** Z transform, properties of the region of convergence, properties of the Z-transform, Inverse Z-transform, Causality and stability, Transform analysis of LTI systems. **Laboratory Sessions/ Experimental learning:** 1. To compute Z-transform of finite duration sequence using MATLAB. a) Compute the z-transform of the sequence fx(n)-[-3,5,6,7,8], $-2 \leq n \leq 2$. b) Compute the z-transform of the discrete-time signal $x(n)= n^2 u(n)$. c) Compute the convolution between the signals $X_1(z)=$ z/z-0.9 and $X_2(z)$=z /z+6 **Applications**: To analysis of digital filters, Used to simulate the continuous systems, Analyse the linear discrete system, Used to finding frequency response, Analysis of discrete signal, Helps in system design and analysis and also checks the systems stability, For automatic controls in telecommunication. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108104100/		

Course outcomes:	
CO1	Analyze the different types of signals and systems.
CO2	Develop input output relationship for linear time invariant system and understand the convolution operator for continuous and discrete time system.
CO3	Understand and resolve the signals in frequency domain using Fourier series.
CO4	Determine the spectral characteristics of continuous and discrete time signal using Fourier transform.
CO5	Compute Z-transforms, inverse Z- transforms and transfer functions of complex LTI systems

Text Books:	
1.	Simon Haykins and Barry Van Veen,"Signals and Systems", 2nd Edition, 2008, Wiley India. ISBN 9971-51-239-4.
2.	Ganesh Rao and SatishTunga, "Signals and Systems", Pearson/Sanguine,I Edition,2017.
Reference Books:	
1.	Alan V Oppenheim, Alan S, Willsky and A Hamid Nawab,"Signals and Systems" Pearson Education Asia / PHI, 2^{nd} edition, 1997. Indian Reprint 2002.
2.	Michael Roberts, "Fundamentals of Signals & Systems", 2^{nd} edition, Tata McGraw-Hill, 2010, ISBN 978-0-07-070221-9.
3.	H.P Hsu, R. Ranjan, "Signals and Systems", Scham's outlines, TMH, 2006.
4.	B. P. Lathi, "Linear Systems and Signals", Oxford University Press, 2005.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	-	-	1	1
CO2	3	3	2	3	3	-	-	-	-	-	3	2
CO3	3	3	2	3	3	-	-	-	-	-	3	1
CO4	3	3	2	2	3	-	-	-	-	-	3	1
CO5	3	2	2	3	2	-	-	-	-	-	3	2

High-3, Medium-2, Low-1

Course Title	CONTROL SYSTEM	Semester	IV
Course Code	MVJ20EC43	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Formulate the mathematical modelling of systems and understand the concepts of transfer function,
- Obtain transfer function using block diagram reduction and signal flow graph techniques.
- Analyse the response of first and second order systems using standard test signals and analyse steady state error.
- Analyse stability of systems using RH criteria, Root Locus, Nyquist, Bode plot and polar plot.
- Obtain state variable model for electrical systems.

Module-1	RBT Level L1, L2, L3	8Hrs.

Introduction to Control Systems: open loop and closed loop systems, Types of feedback, Differential equation of Physical Systems – Mechanical Systems, Electrical Systems, Analogous Systems.

Block diagrams and signal flow graphs: Transfer functions, Block diagram algebra and Signal Flow graphs.

Laboratory Sessions/ Experimental learning:

1. Determine and plot poles and zeros from the transfer function using MATLAB.

Applications: Electric Hand Drier, Automatic Washing Machine, DC motor,Automatic Electric Iron, Voltage Stabilizer

Video link / Additional online information :

1. https://youtu.be/R0E3uKSKdME
2. https://youtu.be/zXMklO-jxIo

3. https://youtu.be/tDXgiStzbcY		
Module-2	RBT Level L1, L2, L3	8Hrs.
Time Response of feedback control systems: Standard test signals, Unit step response of First and Second order Systems. Time response specifications, Time response specifications of second order systems, steady state errors and error constants. Introduction to Controllers **Laboratory Sessions/ Experimental learning:** 1. Obtain step and impulse response of a unity feedback first order system for a given forward path transfer function using MATLAB. 2. Obtain step and impulse response of a unity feedback second order system for a given forward path transfer function using MATLAB. **Applications:** Industrial Control systems **Video link / Additional online information :** 1. https://youtu.be/ziu1OTwUrbw 2. https://youtu.be/YuZ3iwA-47I		
Module-3	RBT Level L1, L2, L3,L4	8Hrs.
Stability analysis using RH Criteria and root locus: Concepts of stability, Necessary conditions for stability, Routh Hurwitz stability criterion, Relative stability analysis, Introduction to Root-Locus Techniques, the root locus concepts, Construction of root loci. **Laboratory Sessions/ Experimental learning:** 1. Obtain Root Locus Plot of the system for a given forward path transfer function using MATLAB. **Applications:**Used to determine the dynamic response of a s system **Video link / Additional online information:** 1. https://youtu.be/cez4InLZ7Pw 2. https://youtu.be/sUDoTw_LIbk 3. https://youtu.be/Irxppc_LCUk		

Module-4	RBT Level L1, L2, L3, L4	8Hrs.

Stability analysis using Nyquist criteria and Bode plots: Polar plot, Nyquist Stability criterion, Nyquist plots, Bode plots, Gain and phase margin.

Laboratory Sessions/ Experimental learning:

1. Obtain Bode Plot of the system for a given forward path transfer function using MATLAB.
2. Obtain Nyquist Plot of the system for a given forward path transfer function using MATLAB.

Applications: To determine a stability of a system

Video link / Additional online information:

1. https://youtu.be/QzTCRk4nkDg
2. https://youtu.be/Wi6xt7IyjA0

Module-5	RBT Level L1, L2, L3	8Hrs.

Introduction to State variable analysis: Concepts of state, state variable and state models for electrical systems, Solution of state equations, State transition matrix and its properties.

Laboratory Sessions/ Experimental learning:

1. Determining the solution of state equations using MATLAB.

Applications: State variables are used to describe the future response of a dynamic response

Video link / Additional online information:

1. https://youtu.be/xajgSUci9zs

Course outcomes:	
CO1	Write the mathematical model for electrical systems and find the transfer function using block diagram reduction technique and signal flow graph.
CO2	Analyze transient and steady state response of second order systems using standard test signals and analyze steady state error.

CO3	Analyze the stability of the systems by applying RH criteria and root locus techniques.
CO4	Analyze the stability of the system using frequency domain techniques such as Nyquist and Bode plots.
CO5	Write state space equations and solutions of a given electrical system.

Text Books:	
1.	Modern Control Engineering, K.Ogata, Pearson Education Asia/PHI, 4^{th} Edition, 2002. ISBN 978-81-203-4010-7.
2.	Nagarath and M.Gopal, – Control Systems Engineering||, New Age International (P) Limited, Publishers, Fifth edition-2005, ISBN: 81-224-2008-
Reference Books:	
1.	Automatic Control Systems||, Benjamin C. Kuo, John Wiley India Pvt. Ltd., 8^{th} Edition, 2008.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.
ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	1	-	-	-	-	-	-	-	-
CO2	3	2	2	1	-	-	-	-	-	-	-	-
CO3	3	2	2	2	-	-	-	-	-	-	-	-
CO4	3	2	2	2	-	-	-	-	-	-	-	-
CO5	3	2	2	1	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	LINEAR INTEGRATED CIRCUITS	Semester	IV
Course Code	MVJ20EC44	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Define the basic concepts of OP-Amp, various parameters of Op-Amp, its characteristics and specifications.
- Analyse Op-Amp circuits to determine Input Impedances, output Impedances and other performance parameters.
- Sketch and Explain typical Frequency Response graphs for each of the Filter circuits.
- Describe and Sketch the various switching circuits of Op-Amps and analyse its operations.
- Differentiate between various types of DACs and ADCs and evaluate the performance of each with neat circuit diagrams.

Module-1	RBT Level L1,L2,L3,L4	8Hrs.

Operational Amplifier Fundamentals: Basic Op-amp circuit, Op-Amp parameters – Input and output voltage, CMRR and PSRR, offset voltages and currents, Input and output impedance, Slew rate and Frequency limitations. OP-Amps as DC Amplifiers – Biasing OP-amps, Direct coupled voltage followers, Non-inverting amplifiers, inverting amplifiers, Summing amplifiers, and Difference amplifiers.

Laboratory Sessions/ Experimental learning:

1. To obtain the Gain of inverting & non inverting amplifier by varying the resistor values.

Applications: Sensors, Mixers.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=clTA0pONnMs

Module-2	RBT Level L1,L2,L3,L4	8Hrs.
Op-Amps as AC Amplifiers: Capacitor coupled voltage follower, High input impedance – Capacitor coupled voltage follower, Capacitor coupled non inverting amplifiers, High input impedance – Capacitor coupled Non-inverting amplifiers, Capacitor coupled inverting amplifiers, setting the upper cut-off frequency, Capacitor coupled difference amplifier. OP-Amp Applications: Current amplifiers, instrumentation amplifier, Precision Half wave rectifiers, Precision Full wave rectifiers - Half wave rectifier & Summing Amplifier. **Laboratory Sessions/ Experimental learning:** 1. Design and find the gain of a Differential Amplifier. **Applications:** Industrial areas (Temperature Indicator, Light Intensity Meter, Temperature Controller) **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=GjG8oshYNLQ		
Module-3	RBT Level L1,L2,L3,L4	8Hrs.
Op-amp Applications: Limiting circuits - Peak Clipper, Clamping circuits, Precision Rectifier Peak Detectors, Sample and hold circuits, Differentiating Circuit, Integrator Circuit, Phase shift oscillator, Wein bridge oscillator, Zero Crossing detectors, inverting Schmitt trigger, Log and antilog amplifiers, Multiplier, and divider. **Laboratory Sessions/ Experimental learning:** 1. Design and verify a sample and hold circuit using IC 741 opamp. **Applications:** Quartz watches, various radio, TV, and other communication devices, alarms and buzzes. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=xki9taCqsWY		
Module-4	RBT Level L1,L2,L3,L4	8Hrs.
Active Filters: First order and second order active Low-pass and high pass filters, Bandpass Filter, Band stop Filter.Voltage Regulators: Introduction, Series Op-amp		

regulator, IC voltage regulators, Voltage follower regulator, 723 general purpose regulators - Introduction, Low Voltage Regulator, High Voltage Regulator. **Laboratory Sessions/ Experimental learning:** 1. Design & setup a low voltage regulator for an output voltage of 6V using 723 IC. **Applications:** Communication systems, Audio systems and Biomedical instruments **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=y5s4bQnmV-g			
Module-5		RBT Level L1,L2,L3,L4	8Hrs.
Phase locked loop: Basic Principles, Phase detector/comparator, VCO. **DAC and ADC convertor:** DAC using R-2R, ADC using Successive approximation. **Other IC Application:** 555 timer, Basic timer circuit, 555 timer used as astable and monostable multivibratos. **Specialized IC Applications:** Introduction on Universal active filters, Power amplifiers-LM380 Power Audio amplifier. **Laboratory Sessions/ Experimental learning:** 1. Demonstrate a simple light circuit that uses a decade counter to drive two traffic lights and uses 555 timer chip as clock. **Applications:** PWM (Pulse Width Modulation) & PPM (Pulse Position Modulation), Analog frequency meters, Digital logic probes. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=-KMAQxc3J3g			

Course outcomes:	
CO1	Acquire knowledge about fundamental concepts of Op-Amp circuit and parameters.
CO2	Describe AC Amplifiers and application.
CO3	Develop circuits for Op-Amp based linear and non-linear circuits.
CO4	Acquire knowledge about Active Filters and Voltage Regulators.
CO5	Explain applications of linear ICs in phase detector, VCO, DAC, ADC and Timer.

Text Books:	
1.	"Operational Amplifiers and Linear IC"s", David A. Bell, 2nd edition, PHI/Pearson, 2004. ISBN 978-81-203-2359-9.
2.	"Linear Integrated Circuits", D. Roy Choudhury and Shail B. Jain, 4th edition, Reprint 2006, New Age International ISBN 978-81-224-3098-1.
Reference Books:	
1.	Ramakant A Gayakwad, "Op-Amps and Linear Integrated Circuits," Pearson, 4th Ed, 2015. ISBN 81-7808-501-1.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	3	2	2	-	1	-	-	-	1	1
CO2	3	3	3	3	3	-	1	-	-	-	1	1
CO3	3	2	3	2	2	-	1	-	-	-	1	1
CO4	3	3	2	2	3	-	1	-	-	-	1	1
CO5	3	3	3	2	3	-	1	-	-	-	1	1

High-3, Medium-2, Low-1

Course Title	ELECTRONIC INSTRUMENTATION	Semester	IV
Course Code	MVJ20EC45	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Define and describe accuracy and precision, types of errors.
- Describe the operation of Ammeters, Voltmeters, Multimeters and develop circuits for multirange Ammeters and Voltmeters.
- Describe functional concepts and operation of various Analog and Digital measuring instruments.
- Describe basic concepts and operation of Digital Voltmeters.
- Describe and discuss functioning and types of Oscilloscopes, Signal generators, AC and DC bridges, Transducers.

Module-1	RBT Level L1,L2,L3,L4	8Hrs.

Measurement and Error: Definitions, Accuracy, Precision, Resolution and Significant Figures, Types of Errors, Measurement error combinations.

Ammeters: DC Ammeter, Multirange Ammeter, The Ayrton Shunt or Universal Shunt, Requirements of Shunt, Extending of Ammeter Ranges, RF Ammeter (Thermocouple), Limitations of Thermocouple.

Voltmeters and Multimeters: Introduction, Basic Meter as a DC Voltmeter, DC Voltmeter, Multirange Voltmeter, Extending Voltmeter Ranges, Loading, AC Voltmeter using Rectifiers. True RMS Voltmeter, Multimeter.

Laboratory Sessions/ Experimental learning:

1. Understanding the structure of the ammeter, voltmeter, and ohmmeter. Learning how to use those meters and using them to measure the current, voltage, and resistance of an electric circuit.
2. Calibration of Voltmeters and Ammeters using Potentiometers.

Applications: Measuring Devices. Ammeters and Voltmeters are used as measuring devices in Laboratory for the measurement of current and voltage. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105153/ 2. https://www.digimat.in/nptel/courses/video/108105153/L13.html 3. https://www.digimat.in/nptel/courses/video/108105153/L14.html 4. https://www.digimat.in/nptel/courses/video/108105153/L15.html		
Module-2	RBT Level L1,L2,L3	8Hrs.
Digital Voltmeters: Introduction, RAMP technique, Dual Slope Integrating Type DVM, Integrating Type DVM, Most Commonly used principles of ADC, Successive Approximations, -Digit, Resolution and Sensitivity of Digital Meters, General Specifications of DVM **Digital Instruments:** Introduction, Digital Multimeters, Digital Frequency Meter, Digital Measurement of Time, Universal Counter, Digital Tachometer, Digital pH Meter, Digital Phase Meter, Digital Capacitance Meter. **Laboratory Sessions/ Experimental learning:** 1. Demonstrate how an universal counter can be used for measuring time, frequency, pulse rates, pulse counting, periodic times, speeds and velocities. **Applications:** Automatic Measurements. Digital Instruments provide greater speed, increased accuracy, better resolution, reduction in operator errors and the ability to provide automatic measurements in system application. **Video link / Additional online information :** 1. https://www.digimat.in/nptel/courses/video/108105153/L64.html 2. https://www.digimat.in/nptel/courses/video/108105153/L65.html		
Module-3	RBT Level L1,L2,L3	8Hrs.
Oscilloscopes: Introduction, Basic principles, CRT features, Block diagram of Oscilloscope, Simple CRO, Vertical Amplifier, Horizontal Deflecting System, Sweep or Time Base Generator, Measurement of Frequency by Lissajous Method, Digital Storage Oscilloscope.		

Signal Generators: Introduction, Fixed and Variable AF Oscillator, Standard Signal Generator, Laboratory Type Signal Generator, AF sine and Square Wave Generator, Function Generator. **Laboratory Sessions/ Experimental learning:** 1. Testing of Energy meters **Applications:** Laboratory Equipment. An oscilloscope can help the user get more detailed electrical measurements.A signal generator is usedto produce various patterns of voltage at a variety of frequencies and amplitudes. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/115/105/115105121/ 2. https://nptel.ac.in/courses/108/105/108105153/		
Module-4	**RBT Level** L1,L2,L3	8Hrs.
Measuring Instruments: Field Strength Meter, Stroboscope, Phase Meter, Q Meter, Megger. **Bridges:** Introduction, Wheatstone's bridge, Kelvin's Bridge; AC bridges, Capacitance Comparison Bridge, Inductance Comparison Bridge, Maxwell's bridge, Wien's bridge. **Laboratory Sessions/ Experimental learning:** 1. Measurement of Low Resistance by Kelvin's Double Bridge Method. 2. Measurement of Resistance using Wheatstone's bridge. **Applications:** Measurement and control. Measuring instruments are used for Control of processes and operations. Bridge circuits are used in measurement, filtering and power conversion applications. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=rQPemWEWNYg		
Module-5	**RBT Level** L1,L2,L3	8Hrs.
Transducers: Introduction, Electrical transducers, Selecting a transducer, Resistive transducer, Resistive position transducer, Strain gauges, Resistance thermometer, Thermistor, Inductive transducer, LVDT, Piezoelectric transducer, Photo cell, Photo voltaic cell, Semiconductor photo diode and transistor. **Laboratory Sessions/ Experimental learning:**		

1. Characteristics of RTD,Strain gauges,Photocell,LVDT

Applications: Automation and control.Transducers are used at the boundaries of automation, measurement, and control systems, where electrical signals are converted to and from other physical quantities.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=1uPTyjxZzyo
2. https://www.youtube.com/watch?v=nv3GuJArjNU
3. https://www.youtube.com/watch?v=f6miNLVGTqU

Course outcomes:	
CO1	Describe instrument measurement errors and calculate them.
CO2	Describe the operation of Ammeters, Voltmeters, Multimeters and develop circuits for multirange Ammeters and Voltmeters.
CO3	Describe functional concepts and operation of Digital voltmeters and instruments to measure voltage, frequency, time period, phase difference of signals, rotation speed, capacitance and pH of solutions.
CO4	Describe functional concepts and operation of various Analog measuring instruments to measure field Strength, impedance, stroboscopic speed, in/out of phase, Q of coils, insulation resistance.
CO5	Describe and discuss functioning and types of Oscilloscopes, Signal generators and Transducers.

Text Books:	
1.	H. S. Kalsi, "Electronic Instrumentation", McGraw Hill, 3 rd Edition, 2012, ISBN: 9780070702066.
2.	David A. Bell, "Electronic Instrumentation & Measurements", Oxford University Press PHI 2nd Edition, 2006, ISBN 81-203-2360-2.
Reference Books:	
1.	A. K. Sawhney, –Electronics and Electrical Measurements||, DhanpatRai& Sons. ISBN -81-7700-016-0

2.	A. D. Helfrick and W.D. Cooper, "Modern Electronic Instrumentation and Measuring Techniques", Pearson, 1st Edition, 2015, ISBN: 9789332556065.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	3	2	1	-	1	-	-	1
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CO3	3	3	3	2	3	2	1	-	1	-	-	1
CO4	3	3	2	2	3	2	1	-	1	-	-	1
CO5	3	3	3	2	3	2	1	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	PYTHON FOUNDATION FOR ELECTRONICS ENGINEERING	Semester	IV
Course Code	MVJ20EC46	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- To know the basics of Python Programming and to read and write simple Python programs with expression and statements.
- To develop Python programs with conditionals and loops.
- To define Python functions and call the function.
- To implement Python Programming in Arduino.
- To Understand the Python programming for Data Science.

Module-1	RBT Level L1, L2,L3	8Hrs.

Prerequisite: *Basic mathematical calculation skills and logical skills*

The Context of Software Development: Software, Development Tools, Learning Programming with Python, The Python Interactive Shell. Values and Variables, Integer and String Values, Variables and Assignment, Identifiers, Floating-point Numbers, Control Codes within Strings, User Input , Controlling the print , String , Multi-line Strings Writing a Python Program and a Longer Python program.

Laboratory Sessions/ Experimental learning:

1. Print "Python foundation for Electronics Engineering "by executing python programming.

Applications: Printing of Results from the modules.

Video link / Additional online information:

1. https://pythonprogramming.net › introduction-learn-python-3-tutorials

Module-2	RBT Level L1, L2,L3	8Hrs.
Expressions and Arithmetic: Expressions; Mixed Type Expressions; Operator Precedence and Associativity; Formatting Expressions; Errors ; Syntax Errors; Run-time Exceptions ; Logic Errors ; Arithmetic Operators; **Conditional Execution:** Boolean Expressions, Statements, Compound Boolean Expressions, Floating-point Equality, Nested Conditionals, Multi-way Versus Sequential Conditionals, Conditional Expressions, Errors, Logic Complexity **Laboratory Sessions/ Experimental learning:** 1. Find the Greatest Number among "12345, 32145 and 23154" by executing python programming. **Applications:** Arithmetic / Conditional Operations **Video link / Additional online information:** 1. https://www.coursera.org/lecture/interactive-python-1/arithmetic-expressions-rMvoA		
Module-3	RBT Level L1,,L2, L3	8Hrs.
Iterations And Functions; Iteration: While Statement; Definite Loops vs Indefinite Loops; for Statement; Nested Loops; Abnormal Loop Termination; while/else and for/else; Infinite. **Functions:** Introduction to Using Functions ; Functions and Modules ; Function Basics ; Types of Functions; Parameter Passing ; Documenting Functions and Custom Functions vs. Standard Functions Turtle Graphics ; Techniques for Importing Functions and Modules; Writing Functions. **Laboratory Sessions/ Experimental learning:** 1. Compute Square Root, Drawing a Tree, Printing Prime Numbers and Insisting on Proper Input by using Iterations. **Applications:** Iterative operations can be implemented **Video link / Additional online information:** 1. https://www.codementor.io/@kaushikpal/user-defined-functions-in-python-8s7wyc8k2		

Module-4	RBT Level L1,L2, L3	8Hrs.
Lists, Tuples, Dictionaries; Lists: list operations, slices, methods and parameters; **Tuples:** tuple assignment, tuple as return value; **Dictionaries:** operations and methods. **Arduino with Python:** Introduction to Arduino programming History; Why Arduino; Arduino variants; Comments; Variables; Constants; Data types; Conversions; Functions and statements; setup function; loop function; pin Mode function; Working with pins; Statements Laboratory Sessions/ Experimental learning: 1. How to apply the Firmata Protocol and to connect the Arduino board for python programming execution. Applications: Implementation of modules in Aurdino board **Video link / Additional online information :** 1. https://www.electronicshub.org/arduino-rf-transmitter-receiver-module/		
Module-5	RBT Level L4, L5	8Hrs.
Data Science and Python: Considering the emergence of data science; Outlining the core competencies of a data scientist ; Linking data science and big data ;Understanding the role of programming ; Creating the Data Science Pipeline ; Understanding Python's Role in Data Science; Considering the shifting profile of data scientists; Working with a multipurpose, simple, and efficient language; Learning to Use Python Fast. Laboratory Sessions/ Experimental learning: 1. How to Load, Train and View a simple model using python programming. Applications: Machine Learning Project in Python **Video link / Additional online information:** 1. https://data-flair.training/blogs/train-test-set-in-python-ml/		

Course outcomes:	
CO1	Understand the Basics of Python Programming
CO2	Implement the expression, conditional executions in Python flow.
CO3	Understand the iterations and functions in Python Programming.

CO4	Implement the Python Programming in Arduino.
CO5	Demonstrate python proficiency in handling Data Science.

Text Books:	
1.	Fundamentals of Python Programming, Richard L. Halterman, Southern Adventist University, Year: 2019
2.	Python Programming for Arduino, Pratik Desai ,Packt Publishing Ltd, 2015.
3.	Python for Data Science by Luca Massaron and John Paul MuellerPublished by: John Wiley & Sons, Inc., 2015.
Reference Books:	
1.	Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, Updated for Python 3, Shroff/O'Reilly Publishers, 2016 (http://greenteapress.com/wp/think- python/)

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	LINEAR INTEGRATED CIRCUITS LAB	Semester	IV
Course Code	MVJ20ECL47	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Design, Demonstrate and Analyse instrumentation amplifier, filters, DAC, adder, differentiator and integrator circuits, using op-amp.
- Design, demonstrate and Analyse multivibrators and oscillator circuits using Op-amp.
- Familiarize with EDA /PSPSICE software which can be used for electronic circuit Simulation.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
Hardware Experiments			
1	Design Adder, Integrator and Differentiator using Op-Amp.	L3	3
2	Design an instrumentation amplifier of a differential mode gain of "A" using three Amplifiers.	L3	3
3	Test a comparator circuit and design a Schmitt trigger for the given UTP and LTP values and obtain the hysteresis	L3	3
4	Design of RC Phase shift and Wien's bridge oscillators using Op-amp.	L4	3
5	To set up and study a triangular waveform generator using Op-amp for 1kHz frequency	L3	2
6	Design active second order Butterworth low pass and high pass filters	L3	3

7	Design 4-bit R – 2R Op-Amp Digital to Analog Converter (i) using 4 bit binary input from toggle switches and (ii) by generating digital inputs using mod-16 counter.	L4	3
8	Design of Monostable and Astable Multivibrator using 555 Timer.	L3	2
Simulation using EDA software (EDWinXP, PSpice, MultiSim, Proteus, CircuitLab or any other equivalent tool can be used)			
9	RC Phase shift oscillator using Op-amp	L3	2
10	Band-pass Filter and Narrow band-reject filter using Op-amp	L3	2
11	Relaxation oscillator using using Op-Amp.	L3	2
12	Monostable and Astable Multivibrator using 555 Timer	L3	2

Course outcomes:	
CO1	Gain hands-on experience in building analog systems for a given specification using the basic building blocks.
CO2	Design and analyse the performance of instrumentation amplifier and Schmitt Trigger.
CO3	Design and analyse the performance of LPF, HPF, DAC and oscillators using linear IC.
CO4	Analyse the working of 555 timer operations to generate signals/pulses.
CO5	Simulate and analyse electronic circuits for different applications.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	3	-	-	-	-	-	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-
CO5	3	3	1	1	-	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	PYTHON PROGRAMMING LAB	Semester	IV
Course Code	MVJ20ECL48	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Interpret the use of procedural statements like assignments, conditional statements, loops and function calls.
- Infer the supported data structures like lists, dictionaries and tuples in Python.
- Illustrate the application of matrices and regular expressions in building the Python programs.
- Discover the use of external modules in creating excel files and navigating the file systems.
- Describe the need for Object-oriented programming concepts in Python.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
1	Print all the Disarium numbers between 1 and 100.	L3	3
2	Encrypt the text using Caesar Cipher technique. Display the encrypted text. Prompt the user for input and the shift pattern.	L3	3
3	Perform Jump Search for a given key and report success or failure. Prompt the user to enter the key and a list of numbers.	L3	3
4	The celebrity problem is the problem of finding the celebrity among n people. A celebrity is someone who does not know anyone (including themselves) but is known by everyone. Write a Python program to solve the celebrity problem.	L3	3

5	Construct a linked list. Prompt the user for input. Remove any duplicate numbers from the linked list.	L3	3
6	Traverse a path and display all the files and subdirectories in each level till the deepest level for a given path. Also, display the total number of files and subdirectories	L3	4
7	How to create a menu drive with a dictionary for words and their meanings. How to add the Write functions to add a new entry (word: meaning), search for a particular word and retrieve meaning, given meaning find words with the same meaning, remove an entry, display all words sorted alphabetically.	L5	4
8	Identify a word with a sequence of one upper case letter followed by lower case letters.	L5	3
9	Plot the Line chart in MS Excel Sheet using Xlsx Writer module to display the annual net income of the companies.	L4	4

Course outcomes:	
CO1	Describe the Python language syntax including control statements, loops and functions to write programs for a wide variety problem in mathematics and science.
CO2	Examine the core data structures like lists, dictionaries, tuples and sets in Python to store, process and sort the data.
CO3	Interpret the concepts of Object-oriented programming as used in Python using encapsulation, polymorphism and inheritance.
CO4	Discover the capabilities of Python regular expression for data verification and utilize matrices for building performance efficient Python programs.
CO5	Identify the external modules for creating and writing data to excel files and inspect the file operations to navigate the file systems.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	3	-	-	-	-	-	-	-
CO2	3	2	2	3	3	-	-	-	-	-	-	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-
CO4	2	1	2	2	3	-	-	-	-	-	-	-
CO5	2	1	2	1	3	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	ADDITIONAL MATHEMATICS-II (COMMON TO ALL BRANCHES)	Semester	IV
Course Code	MVJ20MATDIP41	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L: T: P: 2 : 2 :0)	Total	100
Credits	-	Exam. Duration	3 Hours

Course objective is to: This course viz., aims to prepare the students:

- To familiarize the important and basic concepts of Differential calculus and Differential Equation, ordinary/partial differential equations and Vector calculus and analyse the engineering problems.

Module-1	RBT Level L1,L2	8Hrs.

Linear Algebra:

Introduction, Rank of a matrix-echelon form. Solution of system of linear equations – consistency. Gauss-elimination method and problems. Eigen values and Eigen vectors of square matrix and Problems.

Video Link:

1. https://www.math.ust.hk/~machas/matrix-algebra-for-engineers.pdf
2. https://nptel.ac.in/content/storage2/courses/122104018/node18.html

Module-2	RBT Level L1,L2	8 Hrs.

Differential calculus:

Tangent and normal, sub tangent and subnormal both Cartesian and polar forms. Increasing and decreasing functions, Maxima and Minima for a function of one variable. Point of inflections and Problems

Beta and Gamma functions:

Beta functions, Properties of Beta function and Gamma function ,Relation Between beta and Gamma function-simple problems.

Video Link: 1. https://www.youtube.com/watch?v=6RwOoPN2zqE 2. https://www.youtube.com/watch?v=s6F5yjY6jWk&list=PLMLsjhQWWlUqBoTCQDtYlloI-o-9hxp11 3. http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx		
Module-3	RBT Level L1,L2	8Hrs.
Analytical solid geometry : Introduction –Directional cosine and Directional ratio of a line, Equation of line in space-different forms, Angle between two line, shortest distance between two line, plane and equation of plane in different forms and problems. Video Link: 1. https://www.toppr.com/guides/maths/three-dimensional-geometry/ 2. https://www.toppr.com/guides/maths/three-dimensional-geometry/distance-between-skew-lines/		
Module-4	RBT Level L1,L2,L3	8 Hrs.
Probability: Random variable, Discrete probability distribution, Mean and variance of Random Variable, Theoretical distribution- Binomial distribution, Mean and variance Binomial distribution - Problems. Poisson distribution as a limiting case of Binomial distribution, Mean and variance of Poisson distribution. Normal Distribution-Basic properties of Normal distribution – standard form of normal distribution and Problems. Video Link: 1. https://nptel.ac.in/courses/111/105/111105041/ 2. https://www.mathsisfun.com/data/probability.html		
Module-5	RBT Level L1,L2,L3	8 Hrs.
Partial differential equation: Formation of PDE's by elimination of arbitrary constants and functions. Solution of non-homogeneous PDE by direct integration. Homogeneous PDEs involving derivative with respect to one independent variable only.		

Video Link:
1. http://tutorial.math.lamar.edu/Classes/DE/IntroPDE.aspx   2. https://www.studyyaar.com/index.php/module-video/watch/233-cauchys-legendres-de-a-method-of- variation-of-parameters

Course outcomes:	
CO1	Apply the knowledge of Matrices to solve the system of linear equations and to understand the concepts of Eigen value and Eigen vectors for engineering problems.
CO2	Demonstrate various physical models ,find Maxima and Minima for a function of one variable., Point of inflections and Problems .Understand Beta and Gamma function
CO3	Understand the 3-Dimentional geometry basic, Equation of line in space- different forms, Angle between two line and studying the shortest distance .
CO4	Concepts OF Probability related to engineering applications.
CO5	Construct a variety of partial differential equations and solution by exact methods.

Text Books:	
1	B.S. Grewal, "Higher Engineering Mathematics" Khanna Publishers, 43rd Edition, 2013.
2	Ramana B. V., "Higher Engineering Mathematics", Tata Mc Graw-Hill, 2006.
Reference Books:	
1	Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley-India publishers, 10th edition,2014.
2	G. B. Gururajachar: Calculus and Linear Algebra, Academic Excellent Series Publication, 2018-19

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests   - Quizzes/mini tests (4 marks)   - Mini Project / Case Studies (8 Marks)   - Activities/Experimentations related to courses (8 Marks)

SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	0	2	0	0	0	0	0	0	1	1
CO2	3	3	0	2	0	0	0	0	0	0	1	1
CO3	3	3	0	3	0	0	0	0	0	0	0	1
CO4	2	2	0	3	0	0	0	0	0	0	1	1
CO5	2	2	0	2	0	0	0	0	0	0	0	1

High-3, Medium-2, Low-1

B.E, V Semester, Electronics & Communication Engineering

Course Title	TECHNICAL MANAGEMENT, ENTREPRENEURSHIP & IPR	Semester	V
Course Code	MVJ20TMEC51	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Study the concepts of management, planning, organizing and staffing.
- Acquire the knowledge required to become an entrepreneur.
- Understand and choose the appropriate institutional support to succeed as an entrepreneur.
- Study the requirements towards the small-scale industries and project preparation.
- Understand the general principles of IPR, Concept and Theories, Criticisms of Intellectual Property Rights.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Basics of management system, roles and responsibilities.

Management: Introduction, Meaning, nature and characteristics of Management, Scope and Functional areas of management, Management as a science, art of profession, Management &Administration ,Roles of Management, Levels of Management, Managerial Skills, Management & Administration, Development of Management Thought early management approaches, Modern management approaches.

Planning: Nature, Importance, Types, Steps and Limitations of Planning, Decision Making: Meaning, Types and Steps in Decision Making

Laboratory session/Experiment:

1. Choose, Conduct & document a survey on the Management structure of an organization.

Applications: IT sectors and Institutional Research sectors. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/110/107/110107150/ 2. https://nptel.ac.in/courses/110/105/110105146/		
Module-2	RBT Level L1, L2, L3	8Hrs.
Organizing and Staffing: Nature and purpose of organization, Principles of organization, Span of Management, Types of organization, Departmentation Committees, Centralization Vs Decentralization of authority and responsibility, Span of control, MBO and MBE (Meaning Only) Nature and importance of staffing: Need and Importance, Recruitment and Selection Process. **Directing and Controlling:** Meaning and nature of directing Leadership styles, Motivation Theories, Communication: Meaning and importance, Leadership: Meaning, Characteristics, Behavioral Approach of Leadership; Coordination: Meaning, importance and Techniques of Coordination. Meaning and steps in Controlling, Essentials of a sound control system and Methods of establishing control system. **Laboratory session/Experiment:** 1. Document the job responsibilities of a manager level employee of an organization. **Applications:** IT sectors, Banking sectors and Institutional Research sectors. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/110/107/110107151/		
Module-3	RBT Level L3,L4	8Hrs.
Entrepreneur: Meaning of Entrepreneur, Evolution of the Concept, Functions of an Entrepreneur, Types of Entrepreneur, Entrepreneur - an emerging. Classification of Entrepreneurs, Concept of Entrepreneurship, Evolution of Entrepreneurship, Development of Entrepreneurship, Stages in entrepreneurial process, Role of Entrepreneurs in Economic Development, Entrepreneurship in India, Entrepreneurship-its Barriers. **Laboratory session/Experiment:** 1. Find, Fill and Document the application forms which are all need to start an enterprise.		

Applications: Core Industrial sectors, New Enterprises sectors. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/110/106/110106141/		
Module-4	RBT Level L3,L4,L5	8Hrs.
Small Scale Industries: Definition, Characteristics, Need and rationale, Objectives, Scope, role of SSI in Economic Development. Advantages of SSI, Steps to start and SSI-Government policy, Different Policies of SSI, Government Support for SSI during 5year plans. Impact of Liberalization, Privatization, Globalization on SSI Effect of WTO/GATT, Sickness in SSI sector, Problems for Small Scale Industries, Supporting Agencies of Government for SSI, Meaning, Nature of support, Objectives, Functions, Types of Help, Ancillary Industry and Tiny Industry. **Laboratory session/Experiment:** 1. Find, Fill and Document the application forms which are all need to start a small scale industry. **Applications:** Industrial sectors, and Institutional Research sectors. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=2I0XdF_uOuA 2. https://www.youtube.com/watch?v=jmx7SiCzay8		
Module-5	RBT Level L1, L2, L3	8Hrs.
Intellectual Property Rights: Introduction to Intellectual Property Rights, Copyrights, Trademarks, Designs and Design Patents, Semiconductor Integrated Circuits and Layout Designs. Ideas and Intellectual Property Rights, Contents of a Patent, Patent Draft, Filing Patent Applications, IPR Strategy and IPR Policy **Laboratory session/Experiment:** 1. Conduct a survey on Forms and Fees related to IPR. Document the application forms for the Grant of Patent. https://www.ipindia.gov.in/form-and-fees.htm **Applications:** Research works copyrights, Paper Publication and Patent filing. **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=RLQivEQUgUc 2. https://www.youtube.com/watch?v=NFTBbfYGM6A		

Course outcomes:	
CO1	Explain about the management and planning.
CO2	Apply the knowledge on organizing, staffing, directing and controlling.
CO3	Analyse the concept of Entrepreneurship.
CO4	Choose the requirements towards the small-scale industries and project preparation.
CO5	Understand the Concepts of Intellectual Property Rights

Text Books:	
1.	P.C.Tripathi, P.N.Reddy , "Principles of Management", Tata Mc Graw Hill, 5th edition, 2008.
2.	Poornima M Charantimath, "Entrepreneurship Development Small Business Enterprises", Pearson Education, 2008, ISBN 978-81-7758-260-4.
3.	Rachna Singh Puri & Arvind Viswanathan, "Practical Approach to Intellectual Property Rights", 1/e, I K International Publishing House Pvt. Ltd, 2009.
Reference Books:	
1.	Vasant Desai, "Dynamics of Entrepreneurial Development & Management", Himalaya Publishing House, 6th Edition, 2018.
2.	Stephen P Robbins, "Management", Pearson Education/PHI1, 7thEdition, 2003.
3.	Roberts Lusier Thomson, "Management Fundamentals - Concepts, Application, Skill Development", Fifth Edition, Thomson Publications, 2011.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	-	3	3	-	-	1	-	3	3	2	2	1
CO2	-	3	3	-	-	1	-	3	3	2	2	1
CO3	-	3	3	-	-	1	-	3	3	2	2	1
CO4	-	3	3	-	-	1	-	3	3	2	2	1
CO5	-	3	3	-	-	1	-	3	3	2	2	1

High-3, Medium-2, Low-1

Course Title	ARM MICROCONTROLLER & EMBEDDED SYSTEM	Semester	V
Course Code	MVJ20EC52	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to: • Provide students with the Knowledge of Microprocessors and its memory organization. • Provide a strong foundation about the principles, programming of Microcontrollers. • Programming and system design used in industrial and commercial applications. • Make the students to understand the necessary Hardware components of embedded system. • Emphasize the necessity of Real time operating system for embedded system Applications.		
Module-1	RBT Level L1, L2, L3, L5	10Hrs .

Prerequisites: Basics of Digital Systems and Computer organization

Introduction to Microprocessor: Introduction to 8085 - 8085 Architecture –Signal Description of 8085, Timing Diagrams - Interrupts - Addressing Modes - Instruction Set and Assembly Language Programming of 8085 – Introduction to 8086.

Laboratory Sessions/ Experimental learning:

1. 8085 ALP Programming

Applications: Electronics appliances, Controlling devices, Computers.

Video link / Additional online information:

1. https://nptel.ac.in/courses/108/103/108103157/
2. https://www.youtube.com/watch?v=95uGOJ1Ud2c&list=PLJGA4olwzpArvcdWULcRuMn2495g0n8j

Module-2	RBT Level L1, L2, L3, L6	10Hrs .
Prerequisites: Basics of Microprocessor **Introduction to Microcontrollers:** Overview of 8051 Microcontrollers, Architecture, I/O Ports, Memory Organization, Addressing Modes, Instruction Set of 8051 - Timer, Serial I/O, Parallel I/O, and Instruction set – Simple programs. **Laboratory Sessions/ Experimental learning:** 1. 8051 ALP Programming **Applications:** Security, Traffic control system, Surveillance **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104072/ 2. http://nptel.ac.in/downloads/106108100/		
Module-3	RBT Level L1, L2, L3, L5	10Hrs .
Prerequisites: Basics of Microcontroller **Introduction to RISC processors:** ARM features applications - ARM microcontrollers architecture – ARM Thumb architecture – ARM pipeline – Registers - Memory organization –Stack – Modes - Exceptions - ARM Cache – Virtual memory- Instruction set of ARM. **Laboratory Sessions/ Experimental learning:** 1. ARM programming exercises **Applications:** Industrial instrumentation devices, Process control devices. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/106/117106111/ 2. https://nptel.ac.in/courses/106/105/106105193/		
Module-4	RBT Level L1, L2, L3, L4	10Hrs.
Embedded System Components: Embedded Vs General computing systems, Classification of Embedded systems, Major application and purpose of ES, Elements of Embedded systems, RISC and CSIC, Sensor, Actuators, Optocouplers, Relay, Communication Interfaces (I2C,SPI,IrDA,Bluetooth,Wi-Fi,Zigbee)		

Laboratory Sessions/ Experimental learning: 1. Develop an embedded system using sensors and relay for any real time application. **Applications:** Vehicle control systems, Telecommunication, radio and satellite communications, Medical systems, Military, Systems with artificial intelligence and robotics. **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=gScYun0wzjA 2. http://www.nptelvideos.in/2012/11/embedded-systems.html 3. https://nptel.ac.in/courses/108/102/108102045/

Module-5	RBT Level L1, L2, L3	10Hrs .
RTOS and IDE for Embedded System Design: Basics of operating systems, Task, process and threads, Thread preemption, Preemptive Task scheduling techniques, Task Communication, Task synchronization issues – Racing and Deadlock, Semaphores, Embedded system Development Environment and debugging techniques. **Laboratory Sessions/ Experimental learning:** 1. Develop a prototype for Voice based Speed control system. **Applications:** Home appliance such as washing machine, microwave, Multimedia systems, Building control systems, Space operations, etc., **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/102/108102045/ 2. https://nptel.ac.in/courses/106/105/106105193/ 3. https://nptel.ac.in/courses/108/105/108105057/		

Course outcomes:	
CO1	Acquire the basic knowledge of functionalities of 8085 architectures and Assembly language programming.
CO2	Describe the architecture and functional block of 8051 microcontroller.
CO3	Apply the knowledge gained for Programming ARM cortex M3 for different applications.

CO4	Understand the basic Hardware components of Embedded system and their selection Methods.
CO5	Apply the concepts of real time operating system for embedded system applications.

Text Books:	
1.	Ramesh Gaonkar, “Microprocessor Architecture, Programming and Applications with the 8085” 6/e, 2013.
2.	Kenneth J Ayala, “The 8051 Microcontroller Architecture Programming and Application”, 2nd Edition, Penram International Publishers, 1996.
3.	Joseph Yiu, “The Definitive Guide to the ARM Cortex-M3”, 2nd Edition, Newnes, (Elsevier), 2010.
4.	Shibu K V, “Introduction to Embedded Systems”, Tata McGraw Hill Education Private Limited, 2nd Edition, 2009.
Reference Books:	
1.	Douglas V. Hall: “Microprocessors and Interfacing”, Revised 2nd Edition, TMH, 2006.
2.	A.K Ray & K.M. Burchandi, “Advanced Microprocessor and peripherals Architectures, Programming and interfacing”, 2nd edition, Tata McGraw-Hill, 2004.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO12
CO1	3	3	3	2	1	1	-	-	1	-	2	1
CO2	3	3	3	2	1	1	-	-	1	-	2	1
CO3	3	3	3	2	1	1	-	-	1	-	2	1
CO4	3	3	3	2	1	1	-	-	1	-	2	1
CO5	3	3	3	2	1	1	-	-	1	-	2	1

High-3, Medium-2, Low-1

Course Title	DIGITAL SIGNAL PROCESSING	Semester	V
Course Code	MVJ20EC53	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to:

- Understand the frequency domain sampling and reconstruction of discrete time signals.
- Study the properties and the development of efficient algorithms for the computation of DFT.
- Learn the procedures to design IIR filters from the analog filters using impulse invariance and bilinear transformation.
- Study the different windows used in the design of FIR filters and design appropriate filters based on the specifications.
- Learn DSP Processor Architecture and study the real time applications of DSP

Module-1	RBT Level L1, L2, L3, L4, L5	10Hrs.

Prerequisites: *DTFT and its properties.*

Discrete Fourier Transforms (DFT): Frequency domain sampling and reconstruction of discrete time signals, DFT as a linear transformation, its relationship with other transforms, Properties of DFT.

Laboratory Sessions/ Experimental learning:

1. DFT computation of square pulse and Sinc function using MATLAB.

Applications: Spectral Analysis of Signals, Frequency Response of Systems, Convolution via the Frequency Domain.

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105134/

2. https://youtu.be/gpv4h2fcKdA 3. https://youtu.be/BPa2Ysel834			
Module-2	RBT Level L1, L2, L3, L4, L5	10Hrs.	
Linear filtering methods based on the DFT: Use of DFT in Linear Filtering, Filtering of Long Data Sequences, overlap-save and overlap-add method. **Fast-Fourier-Transform (FFT) algorithms**: Efficient Computation of the DFT: Radix-2 FFT algorithms for the computation of DFT and IDFT, decimation-in-time and decimation-in-frequency Algorithms. **Laboratory Sessions/ Experimental learning:** 1. Computation of FFT of a given image and to plot magnitude and phase spectrum using MATLAB. **Applications:** Frequency domain filtering, video and audio signal processing. **Video link / Additional online information:** 1. https://youtu.be/ADnSkJnprBY 2. https://youtu.be/gg2lgResMc0 3. https://youtu.be/3fVu__fCSg0			
Module-3	RBT Level L1, L2, L3, L4, L6	10Hrs.	
Prerequisites: *L- Hospital rule, Sinc function* **Design of FIR Filters:** Symmetric and Antisymmetric FIR filters, Design of Linear-phase FIR filters using windows - Rectangular, Hamming, Hanning, Bartlett windows. Design of FIR filters using frequency sampling method. Structure for FIR Systems: Direct form, Cascade form and Lattice structures. **Laboratory Sessions/ Experimental learning:** 1. Design and implementation of Low pass FIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering. **Applications:** Noise suppression, Enhancement of selected frequency ranges, Removal or attenuation of selected frequencies			

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/108/105/108105055/
3. https://www.youtube.com/watch?v=nsK7mmRSTDY

Module-4	RBT Level L1, L2, L3, L4, L6	10Hrs.

Prerequisites: Types of filters

IIR filter design: Characteristics of commonly used analog filter – Butterworth and Chebyshev filters, analog to analog frequency transformations. Design of IIR Filters from analog filter using Butterworth filter: Impulse invariance, Bilinear transformation.

Laboratory Sessions/ Experimental learning:

1. Design and implementation of Low pass IIR filter to meet the desired specifications (using different window techniques) and test the filter with an audio file. Plot the spectrum of audio signal before and after filtering

Applications: Audio equalization, biomedical sensor signal processing, IoT/IIoT smart sensors and high-speed telecommunication/RF applications.

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/102/117102060/
2. https://nptel.ac.in/courses/108/105/108105055/

Module-5	RBT Level L1, L2, L3	10Hrs.

Prerequisites: Binary number system, basics of computer architecture

Digital Signal Processors: DSP Architecture, DSP Hardware Units, Fixed point format, Floating point Format, IEEE Floating point formats, FIR and IIR filter implementations in Fixed point systems. **Application of DSP to real systems**: Voice Processing, Music processing, Image processing and Radar processing.

Laboratory Sessions/ Experimental learning:

1. Generation of sinusoid and Plotting with CCS (TMS320C6713)

Applications: Audio, Military, Video & Imaging, Wireless

Video link / Additional online information:

1. https://www.youtube.com/watch?v=I-Itsu9S_uA
2. https://www.youtube.com/watch?v=SKuywStjBLY

Course outcomes:	
CO1	Compute DFT of real and complex discrete time signals
CO2	Analyse the computational complexity of DFT and FFT algorithms
CO3	Solve problems on FIR filter design and realize using digital computations.
CO4	Design and realize IIR digital filters
CO5	Illustrate the DSP processor architecture and to apply knowledge to various real time cases.

Text Books:	
1.	Proakis & Monalakis, "Digital signal processing – Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.
2.	Dr.D.Ganesh Rao, "Digital Signal Processing", Pearson Education, 2nd edition, 2011.
Reference Books:	
1.	Li Tan, Jean Jiang, "Digital Signal processing – Fundamentals and Applications", Academic Press, 2nd Edition, 2013, ISBN: 978-0-12-415893.
2.	S. Salivahanan, C. Gnanpriya, "Digital Signal processing", McGraw Hill, 2nd edition, 2009.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	1	-	-	1
CO2	3	3	3	2	2	1	-	-	1	-	-	1
CO3	3	3	3	2	2	1	-	-	1	-	-	1
CO4	3	3	3	2	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	COMMUNICATION SYSTEMS	Semester	V
Course Code	MVJ20EC54	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand the concepts of Analog Modulation schemes viz; AM, FM.
- Interpret the different types of noise in communication system.
- Learn the concepts of digitization of signals viz; sampling, quantizing and encoding.
- Analyze the Base Band data transmission system.
- Realize the basic concepts of coherent and Non-coherent digital modulation techniques and understand the basics of spread spectrum modulation.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Modulation, Need for Modulation and types of Modulation.

Amplitude Modulation: Introduction to AM, Time-Domain description, Frequency-Domain description, Generation of AM wave: Switching modulator, Detection of AM waves: Envelop detector. **Double side band suppressed carrier modulation (DSBSC):** Time-Domain description, Frequency-Domain representation, Generation of DSBSC waves: Ring modulator. Coherent detection of DSBSC modulated waves. Costas loop.

Single Side-Band Modulation (SSB): Single side-band modulation, Time-Domain description, Frequency-Domain description of SSB wave, Phase discrimination method for generating an SSB modulated wave.

Vestigial Side-Band Modulation (VSB): Time - Domain description, Frequency – Domain description, Generation of VSB modulated wave, Applications: Radio broadcasting, AM radio.

Laboratory Sessions/ Experimental learning:

1. Generation of AM signal using MATLAB

2. Generation of DSBSC signal using transistor

Applications: Broadcast transmissions, Air band radio, Quadrature amplitude modulation

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105143/
2. https://youtu.be/00ZbuhPruJw
3. https://youtu.be/rt08yTGv_z4
4. https://youtu.be/S8Jod9AtpN4
5. https://youtu.be/SxSPdjwXDQk

Module-2	RBT Level L1, L2, L3	8Hrs.

Frequency Modulation: Basic definitions, FM, narrow band FM, wide band FM, transmission bandwidth of FM waves, and generation of FM waves: indirect FM and direct FM.

Demodulation of FM waves: Phase-locked loop, Nonlinear model of the phase – locked loop, Linear model of the phase – locked loop, Nonlinear effects in FM systems.

Phase Modulation: Analog phase modulation, Digital phase modulation.

Noise: Introduction, Types of noise, Noise Figure, Equivalent noise temperature, Noise in AM receivers, Noise in FM receivers, Pre-emphasis and De-emphasis in FM.

Laboratory Sessions/ Experimental learning:

1. Generation of FM signal using MATLAB
2. Design of mixer

Applications: FM radio broadcasting, telemetry, radar, seismic prospecting, and monitoring new-borns for seizures via EEG, two-way radio systems, sound synthesis, magnetic tape-recording systems and some video-transmission systems.

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105143/
2. https://youtu.be/gsUaHawPy-w
3. https://youtu.be/jqJpbPseX2c
4. https://youtu.be/PmuZnJfheK4
5. https://youtu.be/QEubAxBfqKU

Module-3	RBT Level L1, L2, L3	8Hrs.

Digital Communication: Introduction to Digital Communication, Sampling theory, Practical aspects of sampling and signal recovery, PAM, Quantization.

Waveform Coding techniques: PCM – Sampling, Quantization, Encoding, Regeneration. DPCM, Delta Modulation (DM), Adaptive Delta Modulation, Line codes.

Laboratory Sessions/ Experimental learning:

1. Delta modulation using Matlab

Applications: Speech recognition systems, pattern recognition systems, digital audio in computers, CDs, digital telephony, telephone and radio communications, television systems.

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105077/
2. https://nptel.ac.in/courses/117/101/117101051/
3. https://youtu.be/s6vlXP3mYXk
4. https://youtu.be/HlGJ6xxbz8s

Module-4	RBT Level L1, L2, L3, L4	8Hrs.

Intersymbol Interference & Signal Space representation: Base band transmission: Discrete PAM Signals, Power spectra of Discrete PAM Signals, Inter Symbol Interference, Nyquist criterion for Distortion less Base band Binary Transmission, Eye diagram, Geometric representation of signals, Gram-Schmidt Orthogonalization procedure, Optimum receivers for coherent detection: Correlation Receivers and Matched Filter receiver.

Laboratory Sessions/ Experimental learning:

1. Eye diagram using Matlab

Applications: Ethernet, RFID marker localization signals, Radar Systems

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105077/
2. https://nptel.ac.in/courses/117/101/117101051/

Module-5	RBT Level L1, L2, L3, L4	8Hrs.

Prerequisites: Probability & Random Process

Pass band transmission: Digital modulation techniques: Phase shift Keying techniques using Coherent detection: Generation, Detection and Error probabilities of BPSK and QPSK, M–ary PSK, M–ary QAM,Frequency shift keying techniques using Coherent detection: BFSK generation, detection and error probability.

Non-coherent orthogonal modulation techniques: BFSK, DPSK Symbol representation, Block diagrams of Transmitter and Receiver, Probability of error (without derivation of probability of error equation)

Principles of Spread Spectrum Communication Systems: Model of a Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Systems (DSSS), Some applications of DS Spread Spectrum Signals, Generation of PN Sequences, Frequency Hopped Spread Spectrum (FHSS).

Laboratory Sessions/ Experimental learning:

1. Analyse constellation of 16-QAM Using MATLAB

Applications: CDMA, WiMAX (16d, 16e), telemetry, caller ID, garage door openers, wireless communication, mobile communication and Satellite Communication, LANs, Bluetooth, RFID, GPS, Wi-Fi, etc.,

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105077/
2. https://nptel.ac.in/courses/117/101/117101051/
3. https://nptel.ac.in/courses/117/105/117105136/
4. https://youtu.be/Ojmv3I4kDn4

Course outcomes:	
CO1	Examine the concepts of analog modulation techniques such as amplitude, frequency and phase modulation.
CO2	Analyze and compute performance of AM and FM receivers in the presence of noise.

CO3	Apply the concepts of sampling, quantization and encoding for digitization of signals.
CO4	Evaluate the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
CO5	Analyze the digital communication system with spread spectrum modulation.

Text Books:	
1.	Simon Haykins, "Communication Systems", 3rd Edition, John Willey, 1996.
2.	Simon Haykin, "Digital Communication Systems", John Wiley & sons, 1st Edition, 2014, ISBN 978-0-471-64735-5.
Reference Books:	
1.	Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley, 2003.
2.	John G Proakis and Masoud Salehi, "Fundamentals of Communication Systems", 2014 Edition, Pearson Education, ISBN 978-8-131-70573-5.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	-	-	-	1
CO2	3	3	3	2	1	1	-	-	-	-	-	1
CO3	3	3	3	2	1	1	-	-	-	-	-	1
CO4	3	3	3	2	1	1	-	-	-	-	-	1
CO5	3	3	3	2	1	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	INFORMATION THEORY & CODING	Semester	V
Course Code	MVJ20EC551	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand the concept of Entropy, Rate of information and order of the source with reference to dependent and independent source.
- Study various source encoding algorithms.
- Model discrete & continuous communication channels.
- Study various error control coding algorithms.
- Emphasize encoding and error correction circuits for different coding algorithms

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: *Probability theory, Encoder, and decoder concept*

Information Theory: Introduction, Measure of information, Information content of message, average information content of symbols in long independent sequences, average Information content of symbols in long dependent sequences, Markov Statistical Model of Information Sources, Entropy, and Information rate of Markoff Sources.

Laboratory session/Experiment:

1. Design a markoff model for calculating the steady state probabilities

Applications: Board games played with dice, Predicting the weather, Stock market.

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/104/117104129/

2. https://nptel.ac.in/courses/108/102/108102117/ 3. https://nptel.ac.in/courses/117/101/117101053/		
Module-2	RBT Level L1, L2, L3	8Hrs.
Source Coding: Source coding theorem, Prefix Codes, Kraft McMillan Inequality property – KMI Encoding of the Source Output, Shannon's Encoding Algorithm, Shannon Fanon Encoding Algorithm, Huffman codes, Extended Huffman coding, Arithmetic Coding, Lempel – Ziv Algorithm. **Laboratory session/Experiment:** 1. Design a digital image compression and encoding using LZW algorithm **Application:** Lossless compression **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=aTHVz5pECog 2. https://www.youtube.com/watch?v=yHw1ka-4g0s&t=358s 3. https://nptel.ac.in/courses/117/104/117104129/		
Module-3	RBT Level L1, L2, L3	8Hrs.
Information Channels: Communication Channels, Channel Models, Channel Matrix, Joint probability Matrix, Binary Symmetric Channel, System Entropies, Mutual Information, Channel Capacity, Channel Capacity of: Binary Symmetric Channel, Binary Erasure Channel, Muroga's Theorem, Continuous Channels, Fano's Inequality and the Converse to the Coding Theorem. **Laboratory session/Experiment:** 1. Compare the channel capacities of different channels **Applications:** To model data networks, where packets either arrive correctly or are lost due to buffer overflows or excessive delays. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/		

3. https://nptel.ac.in/courses/117/101/117101053/		
Module-4	RBT Level L1, L2, L3, L4	8Hrs.
Error Control Coding: Introduction, examples of Error control coding, methods of controlling Errors, Types of Errors, types of Codes, **Linear Block Codes:** matrix description of Linear Block Codes, Error Detection and Error Correction Capabilities of Linear Block Codes, Single Error Correcting Hamming Codes **Binary Cyclic Codes:** Algebraic Structure of Cyclic Codes, Encoding using an (n-k) Bit Shift register, Syndrome Calculation, Error Detection and Correction.		
Laboratory session/Experiment: 1. Design encoding circuit for(6,3)linear code **Applications**: Binary cyclic codes in stegnography **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/ 3. https://nptel.ac.in/courses/117/101/117101053/		
Module-5	RBT Level L1, L2, L3, L4, L5	8Hrs.
Some Important Cyclic Codes: Golay Codes, BCH Codes, Reed-Solomon Codes. **Convolution Codes:** Convolution Encoder, Time domain approach, Transform domain approach, Code Tree, Trellis and State Diagram, The Viterbi Algorithm. **Introduction to Cryptography:** Symmetric key and Asymmetric key cryptography. **Laboratory session/Experiment:** 1. Write a MATLAB code for Reed-Solomon code **Applications:** Satellite communications, Compact disc players, DVDs, disk drives, solid-state drives, quantum-resistant cryptography and two-dimensional bar codes. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/104/117104129/ 2. https://nptel.ac.in/courses/108/102/108102117/		

3.	https://nptel.ac.in/courses/117/101/117101053/

Course outcomes:	
CO1	Acquire the knowledge of dependent & independent Source, measure of information, Entropy, Rate of Information and Order of a source
CO2	Represent the information using Shannon Encoding, Shannon Fano, Prefix and Huffman Encoding Algorithms
CO3	Model the continuous and discrete communication channels using input, output and joint probabilities
CO4	Determine a codeword comprising of the check bits computed using Linear Block codes, cyclic codes & convolutional codes
CO5	Design the encoding and decoding circuits for Linear Block codes, cyclic codes, convolutional codes, BCH and Golay codes.
Text Books:	
1.	K. Sam Shanmugam, "Digital and analog communication systems", John Wiley India Pvt. Ltd, 1996.
2.	K Giridhar, "Information Theory And Coding", 4th Edition, Pooja Publication, Bangalore, 2001.
3.	Simon Haykin, "Digital communication", John Wiley India Pvt. Ltd, Third Edition, 2010.
Reference Books:	
1.	Muralidhar Kulkarni, K.S. Shivaprakasha, "Information Theory and Coding", Wiley India Pvt. Ltd, 2015, ISBN:978-81-265-5305-1.
2.	Ranjan Bose, "ITC and Cryptography", TMH, II edition, 2007
3.	J. Das, S. K. Mullick, P. K. Chatterjee, "Principles of digital communication", Wiley, Second edition 1986 - Technology & Engineering.
4.	Bernard Sklar, "Digital Communications – Fundamentals and Applications", Second Edition, Pearson Education, 2016, ISBN: 9780134724058.
5.	K.N.Haribhat, D.Ganesh Rao, "Information Theory and Coding", Cengage Learning, Second Edition, 2017.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	-	-	1	-	2	2
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CO3	3	3	3	2	-	1	-	-	1	-	2	2
CO4	3	3	3	2	-	1	-	-	1	-	2	2
CO5	3	3	3	2	-	1	-	-	1	-	2	2

High-3, Medium-2, Low-1

Course Title	OPERATING SYSTEM	Semester	V
Course Code	MVJ20EC552	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:		
• Understand the services provided by an operating system. • Learn how processes are synchronized and scheduled. • Identify different approaches of memory management and virtual memory management. • Study the structure and organization of the file system • Understand interprocess communication and deadlock situations.		
Module-1	RBT Level L1, L2	8Hrs.

Prerequisites: *Computer Organization and Architecture*

Introduction to Operating Systems: OS, Goals of an OS, Operation of an OS, Program's, Resource allocation techniques, Efficiency, System Performance and User Convenience, Classes of operating System, Batch processing, Multi programming, Time Sharing Systems, Real Time , distributed and modern Operating Systems.

Laboratory Sessions/ Experimental learning:

1. Case study: Basics of LINUX OS.

Applications:

- Controls the backing store and peripherals such as scanners and printers.
- Maintains security and access rights of users.
- Spooling (Simultaneous Peripheral Operation on Line)

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/105/106105214/
2. https://www.youtube.com/watch?v=qJ_bXhrUOkc&t=12s
3. https://www.youtube.com/watch?v=29JPq5JuKj8

Module-2	RBT Level L1, L2	8Hrs.

Process Management: OS View of Processes, PCB, Process States and Transitions, Threads, Kernel and User level Threads, Non-preemptive scheduling- FCFS and SRN, Preemptive Scheduling- RR and LCN, Long term, medium term and short term scheduling in a time sharing system.

Laboratory Sessions/ Experimental learning:

1. Case study on Processes and threads in Linux/ Windows/ UNIX Scheduling Algorithms

Applications:

- Organizes the use of memory between programs.
- Organizes processing time between programs and users.
- Install Operating Systems - Ubuntu Linux.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=Lf3xYcIzgeQ
2. https://www.youtube.com/watch?v=s1KsWNqezbY
3. https://www.youtube.com/watch?v=Q6rniXYg1UM

Module-3	RBT Level L1, L2, L3	8Hrs.

Memory Management: Static and Dynamic memory allocation, Contiguous Memory allocation, Non-Contiguous Memory Allocation, Paging, Segmentation, Segmentation with paging, Virtual Memory Management, Demand Paging, Paging Hardware, VM handler, Page replacement policies - FIFO, LRU.

Laboratory Sessions/ Experimental learning:

1. Case Study on Linux/ UNIX Memory Management.

Applications:

- Memory Management deals with the transfer of programs in and out of memory.
- Dynamically allocate portions of memory to programs at their request, and free it for reuse when no longer needed.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=MLbdsuxYAF4
2. https://www.youtube.com/watch?v=WqnwrWODLKs

3. https://www.youtube.com/watch?v=EbnaTJIf0ZE			
Module-4		RBT Level L1, L2, L3, L4	8Hrs.
File Systems: File systems and IOCS, Files and File Operations, Fundamental File Organizations, Directory structures, File Protection, Interface between File system and IOCS, Allocation of diskspace, Implementing file access, and File sharing schematics. **Laboratory Sessions/ Experimental learning:** 1. Case Study on UNIX/ Windows/ Linux File System. **Applications:** • Understand file handling operations (read, write, and append). • Basic understanding of how pointers are used **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=Fjz3PKJGe5s 2. https://www.youtube.com/watch?v=E3PshX16WEY			
Module-5		RBT Level L1, L2,L3	8Hrs.
Message Passing and Deadlocks: Overview of Message Passing, Implementing message passing, Mailboxes, Deadlocks, Deadlocks in resource allocation, Handling Deadlocks, Deadlock detection algorithm, Deadlock Prevention, Deadlock avoidance-Bankers algorithm. **Laboratory Sessions/ Experimental learning:** 1. Simulate Bankers Algorithm for Dead Lock Avoidance. **Applications:** Email management **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=rCHnS-ZX7PE 2. https://www.youtube.com/watch?v=vOfKOg0rFg4 3. https://www.youtube.com/watch?v=eJBoT0LbK2k			

Course outcomes:	
CO1	Summarize the goals, structure, operation and types of operating systems.
CO2	Apply scheduling techniques to find performance factors.

CO3	Apply suitable techniques for contiguous and non-contiguous memory allocation.
CO4	Interpret the organization of file systems and IOCS.
CO5	Describe message passing, deadlock detection and prevention methods.

Text Books:	
1.	Dhamdare, "Operating Systems – A concept based approach", by TMH, 2nd edition, 2009.
2.	Silberschatz and Galvin, "Operating systems concepts", John Wiley India Pvt. Ltd,5th edition, 2001.
Reference Books:	
1.	William Stalling, "Operating system–internals and design system", Pearson Education, 4th ed, 2006.
2.	Tannanbhaum, "Design of operating systems", TMH, 2001.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	-	-	1	-	-	1
CO2	3	3	2	2	2	1	-	-	1	-	-	1
CO3	3	3	2	2	2	1	-	-	1	-	-	1
CO4	3	3	2	2	2	1	-	-	1	-	-	1
CO5	3	3	2	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	OOPS USING C++	Semester	V
Course Code	MVJ20EC553	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Gain the basic knowledge on Object Oriented concepts.
- Study the operation of objects and classes and ability to develop applications using Object Oriented Programming Concepts.
- Analyse the problem statement and build programs using Inheritance in object oriented programming to solve real world problems.
- Study and implementation of C++ Constructors, Destructors and Polymorphism
- Analyse and implementation of exception handling and advance topics including templates, exceptions and Standard Template Library

Module-1	RBT Level L1, L2, L3, L6	8Hrs.

Prerequisites: *knowledge of C programming*

Introduction to Object Oriented Programming using C++: Traditional Versus Object Orientation Approach, Benefits and applications of OOPS, Characteristics of Object Oriented Programming Languages, Getting started with C++ syntax, data-type, variables, strings, functions, default values in functions, recursion, namespaces, operators, arrays and pointers, expressions, operator overloading and control structures in C++.

Laboratory Sessions/ Experimental learning:

1. Develop a program to design a Calculator
2. Develop a C++ program to find all roots of a quadratic equation ax2+bx+c=0.

Applications: Calculator Programming

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/105/106105151/

Module-2	RBT Level L1, L2, L3, L6	8Hrs.

Prerequisites: Expressions, Control structures, Functions in C

Program structure C++ Functions: Simple functions, Arguments passed by value and by reference Access specifiers : Private Public and Protected members , Specifying a class, C++ program with a class, Basics of object and class in C++, Programs on class and Object, Overloading of functions, Constructor Overloading-Inline functions, Friend function.

Laboratory Sessions/ Experimental learning:

1. Build a C++ Program to implement a sphere class with appropriate members and member function to find the surface area and the volume. (Surface = 4 π r2 and Volume = 4/ 3 π r3)
2. Develop a C++ program to implement Bank-SB-Account Class with member functions to deposit, withdraw and show the balance. assume appropriate data members

Applications: Universities and Academic Institutions, Railway booking

Video link / Additional online information:

1. https://www.digimat.in/nptel/courses/video/106101208/L01.html
2. https://www.youtube.com/playlist?list=PL0gIV7t6l2iIsR55zsSgeiOw9Bd_IUTbY

Module-3	RBT Level L1, L2, L3,L6	8Hrs.

Prerequisites: Knowledge of Classes and objects

Polymorphism: Static and Dynamic Binding , Operator Overloading, Overloading Unary Operators, Overloading Binary Operators, Constructors and their types, Destructor , Concept of Inheritance, Types of Inheritance: Single, Multiple, Multilevel, Hierarchical, Hybrid, Virtual Functions: Normal Member Functions Accessed with Pointers.

Laboratory Sessions/ Experimental learning:

1. Implement a program to enter salary and output income tax and net salary using multiple inheritance concept
2. Implement a program of maintaining banking account information system using multiple inheritance in C++ Programming. Here class savings derived from class account and class user. Use appropriate functions and variables

Applications: Banking software

Video link / Additional online information:

1. https://www.classcentral.com/course/swayam-programming-in-c-6704
2. http://www.infocobuild.com/education/audio-video-courses/computer-science/programming-in-cpp-iit-kharagpur.html

Module-4	RBT Level L1, L2, L3, L6	8Hrs.

Prerequisites: *Knowledge of Constructor and Destructors*

Pointers, Streams & Working with Files: Virtual Member Functions Accessed with Pointers, Abstract Classes and Pure Virtual Functions, Virtual Destructors, Virtual Base Classes, THIS Pointer. C++Type casting streams and stream classes, formatted and unformatted I/O operations, Output with manipulators, Classes for file stream operations.

Laboratory Sessions/ Experimental learning:

1. Implement a C++ program to implement flight class with data member as flight no., source, destination and fare. Write a member function to display the flight information using this pointer

Applications: Games, Advanced Computations and Graphics, Flight bookings

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/104/106104128/
2. https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-cs17/

Module-5	RBT Level L1, L2, L3, L6	8Hrs.

Prerequisites: *Knowledge of strings and its use*

Exception handling: Try, throw, and catch, exceptions and derived classes, function exception declaration, unexpected exceptions, exception when handling exceptions. Template: template classes, template functions. Standard Template Library, Fundamental idea about string, iterators, hashes, iostreams and other types.

Laboratory Sessions/ Experimental learning:

1. List out the real time applications of Exception Handling.
2. Create two classes Employee and Department. Make Department class, a friend class of Employee class. In order to access the private and protected members of Employee class into Department class explicitly pass an object of Department class to the member functions of Employee class. Display the net salary of employee using proper formatting.

Applications: Database Connectivity exception handling, Web form for users using exception handling

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106127/

Course outcomes:	
CO1	Summarize the basics of object oriented programming concepts
CO2	Illustrate the concepts of polymorphism in programs using overloading methods
CO3	Apply the Inheritance and ability to implement features of object oriented programming to solve real world problems by reducing the length of the code.
CO4	Utilize the concepts of Polymorphism by using virtual function and abstract class in programs
CO5	Apply the basics of exception handling and templates, exceptions and Standard Template Library

Text Books:	
1.	Robert Lafore, "Object -Oriented Programming in C++", Sams Publication, 4^{th} edition, 2002.
2.	E. Balagurusamy, "Object Oriented Programming with C++", 5th edition, Tata McGraw Education Hill , 2011.
Reference Books:	
1.	Ashok N. Kamthane, "Object oriented Programming with ANSI & Turbo C++", First Edition, Pearson India,2003.
2.	Reema Thareja ,"OOP WITH C++" , REVISED 1ST ED ,Paperback – 1, January 2018
3.	D Ravichandran, "Programming with C++", Second edition, Tata McGraw- Hill, 2003.

CIE Assessment:

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- Quizzes/mini tests (4 marks)

- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	1	-	-	1
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CO3	3	3	3	2	2	2	-	-	1	-	-	1
CO4	3	3	3	2	2	2	-	-	1	-	-	1
CO5	3	3	3	2	2	2	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	FUZZY LOGIC SYSTEMS AND NEURAL NETWORKS	Semester	V
Course Code	MVJ20EC554	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objectives is to:

- Make the students to understand about the concept of fuzzy set theory and fuzzy systems.
- Analyse the fuzzy system-based rules and fuzzy logic decision making.
- Understand the basics of Neural Networks and its architecture.
- Know about the single and multilayer feed forward networks.
- Provide the adequate knowledge about the Associative memory.

Module-1	RBT Level L1, L2, L3	8Hrs.

Fuzzy Set Theory: Fuzzy versus Crisp, Crisp sets, Fuzzy Sets, Crisp Relations, Fuzzy Relations.

Fuzzy Systems: Crisp Logic, Predicate Logic, Fuzzy Logic, Fuzzy Quantifiers, Fuzzy Interference, Fuzzy rule-based system, Defuzzification methods, Applications.

Laboratory Sessions/ Experimental learning:

1. Implementation of Fuzzy operations.
2. Implementation of Fuzzy relations.

Applications: Facial Pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid breaking systems.

Video link / Additional online information:

1. https://nptel.ac.in/courses/108/104/108104157/

Module-2	RBT Level L1, L2, L3	8Hrs.

Fuzzy Rule- Based Systems: Natural Language, Linguistic Hedges, Rule-Based Systems, Canonical Rule Forms, Decomposition of Compound Rules, Likelihood and Truth Qualification, Aggregation of Fuzzy Rules, Graphical Techniques of Inference.

Fuzzy Decision Making : Fuzzy Synthetic Evaluation, Fuzzy Ordering, Preference and consensus, Multi-objective Decision Making, Fuzzy Bayesian Decision Method, Decision Making under Fuzzy States and Fuzzy Actions.

Laboratory Sessions/ Experimental learning:

1. Development of fuzzy membership functions and Fuzzy set properties
2. Implementation of Air Conditioning system using Fuzzy Logic Algorithm.
3. Implementation of Facial Pattern Recognition using Fuzzy Logic Algorithm.

Applications: Facial Pattern recognition, air conditioners, washing machines, vacuum cleaners, antiskid breaking systems.

Video link / Additional online information:

1. https://www.digimat.in/nptel/courses/video/117105084/L01.html
2. https://www.digimat.in/nptel/courses/video/127105006/L01.html

Module-3	RBT Level L1, L2, L3	8Hrs.

Prerequisites: *Fundamentals of computing, Analysation, Mathematical calculations.*

Introduction to Neural Networks: Basic concepts of Neural networks, Human Brain, Model of an Artificial Neuron, Artificial Neural network architectures, Characteristics of Artificial Neural Networks, Learning methods, Taxonomy of Neural Network Architectures, Early Neural Network Architectures, Rosenblatt's perceptron, ADALINE and MADALINE networks.

Laboratory Sessions/ Experimental learning:

1. Implementation of Simple Neural Network in pattern recognition/matching.

Applications: Speech recognition, character recognition, human face recognition

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105084/

Module-4	RBT Level L1, L2, L3	8Hrs.

Back Propagation Networks: Architecture: The perceptron model, the solution, Single Layer Artificial Neural Network, Model of multilayer Perceptron. **Back propagation Learning**: Input layer, Hidden layer, Output layer Computations, Error calculation, Training of neural network, Steepest Descent, Effect of learning rate, Adding of Momentum term, Back propagation algorithm.

Laboratory Sessions/ Experimental learning:

1. Implementation of Perceptron Learning Algorithm for AND gate
2. Application of Back Propagation technique in financial data.

Applications: Voice Recognition, Financial forecasting

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106184/
2. https://nptel.ac.in/courses/108/108/108108148/

Module-5	RBT Level L1, L2, L3	8Hrs.

Associative Memory: Auto correlators, Hetero correlators, Wang et al's Multiple Encoding Strategy, Exponential BAM (Bidirectional Associative Memory), Associative memory for Real coded pattern pairs, Applications.

Laboratory Sessions/ Experimental learning:

1. Development of auto associative network using outer product rule

Applications: Used for parallel searches, speedup databases, page tables used by virtual memory in neural networks

Video link / Additional online information:

1. http://www.nptelvideos.in/2012/12/neural-networks-and-applications.html
2. https://nptel.ac.in/courses/117/105/117105084/

Course outcomes:	
CO1	Acquire the comprehensive knowledge of fuzzy set theory and fuzzy logic systems.
CO2	Apply the concepts of Fuzzy rule-based system and fuzzy decision making in real time applications.
CO3	Analyze the organization of the Brain, Biological and Artificial Neuron Models.

CO4	Design Perceptron Model, Single layer Artificial Neural Network, Back propagation network architecture, Model for Multilayer Perceptron.
CO5	Illustrate the concepts of associative memory in neural networks.

Text Books:	
1.	Rajasekharan and Rai, "Neural Networks, Fuzzy logic, Genetic algorithms: synthesis and applications" by – PHI Publication.
2.	Timothy. J. Ross, "Fuzzy logic with engineering applications", McGraw Hill International Edition, 1997.
Reference Books:	
1.	James A Freeman and Davis Skapura, "Neural Networks", Pearson Education, 2002.
2.	Simon Hakins, "Neural Networks", Pearson Education, 3rd Edition, 2009.
3.	John Yen, Rena Langari, "Fuzzy Logic, Intelligence, Control, and Information", Pearson Education, 2005.

CIE Assessment:
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SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	1	1	-	-	1	-	-	1
CO2	3	3	3	1	1	1	-	-	1	-	-	1
CO3	3	3	3	1	1	1	-	-	1	-	-	1
CO4	3	3	3	1	1	1	-	-	1	-	-	1
CO5	3	3	3	1	1	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	EMBEDDED CONTROLLER LAB	Semester	V
Course Code	MVJ20ECL56	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0: 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Make the students to understand the basics of microcontroller and its applications.
- Provide in depth-knowledge of 8051 Assembly language programming.
- Familiarize with Keil u Vision tool/compiler required for microcontroller programming.
- Develop C language programs and library functions for embedded system application.
- Learn Interfacing of external devices and I/O with ARM cortex M3.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
Programming using 8051			
1	Data transfer, Sorting, Finding largest element in an array	L3	3
2	Arithmetic Instructions-Addition/subtraction, multiplication and division, square (16 bits Arithmetic operations-bit addressable).	L3	3
3	Generate Fibonacci series.	L4	3
4	Code conversion: BCD-ASCII, ASCII-Decimal, Decimal-ASCII.	L3	3
5	Programs to generate delay, Programs using serial port and on-Chip timer/counter.	L3	3
Interfacing using ARM Cortex M3			
6	Demonstrate the use of external interrupt to toggle an LED On/Off.	L3	2
7	Interface a simple switch and display its status through Relay, Buzzer and LED.	L5	3

8	Interface a 4x4 keyboard and display the key code on an LCD.	L4	2
9	Interface a stepper motor and rotate it in clockwise and anti-clockwise direction.	L5	3
10	Interface a DAC and generate Triangular and Square waveforms.	L3	2
11	Interface and control DC Motor.	L3	3

Course outcomes:	
CO1	Enhance programming skills using Assembly language and C
CO2	Apply the knowledge gained from programming 8051 for different applications.
CO3	Interface and control external I/O devices with ARM cortex M3
CO4	Analyze the functions of various peripherals, peripheral registers of ARM cortex M3
CO5	Develop applications based on ARM cortex M3 Microcontrollers

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	2	-	-	1
CO2	3	3	3	2	2	2	-	-	2	-	-	1
CO3	3	3	3	2	2	2	-	-	2	-	-	1
CO4	3	3	3	2	2	2	-	-	2	-	-	1
CO5	3	3	3	2	2	2	-	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	DIGITAL SIGNAL PROCESSING LAB	Semester	V
Course Code	MVJ20ECL57	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Simulate discrete time signals and verification of sampling theorem
- Compute the DFT for a discrete signal and verification of its properties using MATLAB.
- Demonstrate convolution and correlation along with the verification of properties
- Compute and display the filtering operations and compare with the theoretical values
- Implement the DSP computations on DSP hardware and verify the result.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
Programming using Matlab			
1	Verification of sampling theorem.	L3	3
2	Linear and circular convolution of two given sequences, Commutative, distributive and associative property of convolution.	L3	3
3	Auto and cross correlation of two sequences and verification of their properties Solving a given difference equation.	L3	3
4	Computation of N point DFT of a given sequence and to plot magnitude and phase spectrum (using DFT equation and verify it by built-in routine).	L3	3
5	Verification of DFT properties (like Linearity and Parseval's theorem, etc.).	L4	3
6	Design and Implementation of FIR filter to meet given specifications (using different window techniques).	L3	3

7	Design and implementation of IIR filter to meet given specifications.	L4	2
Implementation using DSP Kit			
8	Linear convolution of two sequences.	L3	2
9	Circular convolution of two sequences.	L3	2
10	N Point DFT of a given sequence.	L3	3
11	Impulse response of first order and second order system.	L3	3

Course outcomes:	
CO1	Apply the concepts of analog to digital conversion of signals and frequency domain sampling of signals.
CO2	Analyze the properties of Linear and Circular convolution.
CO3	Model discrete time signals and systems and verification of its properties and results.
CO4	Examine discrete computations using DSP processor and verify the results.
CO5	Realize the digital filters using a simulation tool and verify the frequency and phase response.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	-	-	-	2	-	-	2
CO2	3	3	3	3	3	-	-	-	2	-	-	2
CO3	3	3	3	2	3	-	-	-	2	-	-	2
CO4	3	3	3	3	3	-	-	-	2	-	-	2
CO5	3	3	3	3	3	-	-	-	2	-	-	2

High-3, Medium-2, Low-1

Course Title	COMMUNICATION SYSTEMS LAB	Semester	V
Course Code	MVJ20ECL58	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0: 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Practice the basic theories of analog communication systems viz., Amplitude and Frequency modulation.
- Design various pulse modulation techniques.
- Understand and analyze the concepts of digitization of signals.
- Learn the basic theories of digital modulation techniques in practical.
- Simulate the digital communication concepts and compute and display various parameters along with plots/figures.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
Hardware Experiments			
1	Amplitude Modulation and Demodulation using transistor.	L3	3
2	Demonstrate Pulse sampling, flat top sampling and reconstruction.	L3	3
3	Pulse Amplitude Modulation and Detection.	L3	2
4	Pulse Width Modulation and Pulse Position Modulation.	L3	2
5	Frequency modulation using IC 8038/2206.	L3	3
6	Pre-emphasis & de-emphasis.	L3	2
7	TDM of two band limited signals.	L4	3
8	ASK generation & detection and FSK generation & detection.	L4	3
9	PSK generation and detection.	L3	3

Simulation Experiments using SCILAB/MATLAB/Simulink/LabVIEW			
10	Simulate NRZ, RZ and generate eye diagram for binary polar signalling.	L3	2
11	Pulse code modulation and demodulation system.	L3	2
12	Digital Modulation Schemes i) DPSK Transmitter and receiver, ii) QPSK Transmitter and Receiver.	L3	2

Course outcomes:	
CO1	Design and test the analog and digital modulation circuits.
CO2	Demonstrate various pulse modulation techniques such as PAM, PPM & PWM.
CO3	Design the circuit to sample an analog signal. Also design pre-emphasis & de-emphasis to improve the SNR.
CO4	Analyze the concept of TDM.
CO5	Simulate the digital modulation schemes with the display of waveforms.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO5	3	3	3	2	2	1	-	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	ENVIRONMENTAL STUDIES	Semester	V
Course Code	MVJ20ENV59	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	1 (L : T : P :: 1 : 0 : 0)	Total	100
Credits	1	Exam. Duration	2 Hrs

Course objective is to: This course will enable the students to

- Relate to interdisciplinary approach to complex environmental problems using basic tools of the natural and social sciences including geo-systems, biology, chemistry, economics, political science and international processes; Study drinking water quality standards and to illustrate qualitative analysis of water.
- Critically evaluate the science and policy ramifications of diverse energy portfolios on air and water quality, climate, weapons proliferation and societal stability.

Module-1	RBT Level L1, L2	6Hrs.

Introduction to environmental studies, Multidisciplinary nature of environmental studies; Scope and importance; Concept of sustainability and sustainable development.

Ecosystems (Structure and Function): Forest, Desert, Rivers, Ocean

Biodiversity: Types, Hot spots; Threats and Conservation of biodiversity, Deforestation.

Video link / Additional online information:

1. https://nptel.ac.in/courses/120108004/

Module-2	RBT Level L1, L2, L3	6Hrs.

Advances in Energy Systems (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind.

Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable Mining, Cloud Seeding, and Carbon Trading.

Video link / Additional online information:

1. https://nptel.ac.in/courses/120108004/		
Module-3	RBT Level L1, L2	6Hrs.
Environmental Pollution (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Ground Water Pollution; Noise pollution; Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects:** Bio-medical Waste; Solid waste; Hazardous waste; E-waste. **Video link**: 1. https://nptel.ac.in/courses/122/106/122106030/ 2. https://nptel.ac.in/courses/105/103/105103205/		
Module-4	RBT Level L1, L2	6Hrs.
Global Environmental Concerns (Concept, policies, and case-studies): Global Warming Climate Change; Acid Rain; Ozone Depletion; Fluoride problem in drinking water. **Video link:** 1. https://nptel.ac.in/courses/122/106/122106030/		
Module-5	RBT Level L1, L2, L3	6Hrs.
Latest Developments in Environmental Pollution Mitigation Tools (Concept and Applications): G.I.S. & Remote Sensing, Environment Impact Assessment, Environmental Management Systems, ISO 14001. **Video link:** 1. https://nptel.ac.in/courses/105/102/105102015/ 2. https://nptel.ac.in/courses/120/108/120108004/		

Course outcomes:	
CO1	Understand the principles of ecology and environmental issues that apply to air, land, and water issues on a global scale.

CO2	Develop critical thinking and/or observation skills, and apply them to the analysis of a problem or question related to the environment.
CO3	Demonstrate ecology knowledge of a complex relationship between biotic and a biotic components.
CO4	Apply their ecological knowledge to illustrate and graph a problem and describe the realities that managers face when dealing with complex issues.

Text Books:	
1.	Benny Joseph, "Environmental Studies", Tata Mc Graw – Hill. 2nd Edition, 2012.
2.	S M Prakash, "Environmental Studies", Pristine Publishing House, Mangalore 3rd Edition, 2018.
Reference Books:	
1.	Raman Siva Kumar, "Principals of Environmental Science and Engineering", Cengage learning, Singapur. 2nd Edition, 2005
2.	G.Tyler Miller Jr., "Environmental Science – working with the Earth", Thomson Brooks /Cole, 11th Edition, 2006.
3.	Pratiba Sing, Anoop Singh & Piyush Malaviya , "Text Book of Environmental and Ecology", Acme Learning Pvt. Ltd., New Delhi., 1st Edition.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	1	–	2	2	1	1	–	2	1
CO2	3	3	2	1	–	1	2	–	1	1	2	1
CO3	3	3	2	1	–	2	2	–	1	1	2	1
CO4	3	3	2	2	–	2	2	–	1	1	2	1

High-3, Medium-2, Low-1

Course Title	UNIVERSAL HUMAN VALUES - II	Semester	V
Course Code	MVJ20UHV510	CIE	50
Total No. of Contact Hours	20	SEE	50
No. of Contact Hours/week	2 (L: T : P : 2 : 0 :0)	Total	100
Credits	2	Exam. Duration	2 Hrs.

Course objective is to: This course will enable the students to

- Appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
- Facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way.
- Highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature.

Prerequisites: *Universal Human Values I*

Module-1	RBT Level L1,L2	4Hrs

Review on Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education), Self-exploration as the Process for Value Education, Happiness and Prosperity – Current Scenario,

Value Education: Understanding Value Education, Continuous Happiness and Prosperity – the Basic Human Aspirations, , Method to Fulfill the Basic Human Aspirations,

Practical Sessions: Sharing about Oneself (Tutorial 1), Exploring Human Consciousness (Tutorial 2), Exploring Natural Acceptance (Tutorial 3) **Video link:** 1. https://www.youtube.com/watch?v=85XCw8SU084 2. https://www.youtube.com/watch?v=E1STJoXCXUU&list=PLWDeKF97v9SP_Kt6jqzA3pZ3yA7g_OAQz 3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-2	RBT Level L1,L2	4Hrs
Review on Understanding Human being as the Co-existence of the Self and the Body, The Body as an Instrument of the Self, Harmony of the Self with the Body. Harmony in the Human Being: Distinguishing between the Needs of the Self and the Body, Understanding Harmony in the Self, Programme to ensure self-regulation and Health. **Practical Sessions:** Exploring the difference of Needs of Self and Body (Tutorial 4), Exploring Sources of Imagination in the Self (Tutorial 5), Exploring Harmony of Self with the Body (Tutorial 6). **Video link:** 1. https://www.youtube.com/watch?v=GpuZo495F24 2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-3	RBT Level L1,L2	4Hrs
Review on Harmony in the Family – the Basic Unit of Human Interaction, Other Feelings, Justice in Human-to-Human Relationship, Understanding Harmony in the Society. **Harmony in the Family and Society:** Trust' – the Foundational Value in Relationship, 'Respect' – as the Right Evaluation, Vision for the Universal Human Order, **Practical Sessions:** Exploring the Feeling of Trust (Tutorial 7), Exploring the Feeling of Respect (Tutorial 8), Exploring Systems to fulfill Human Goal (Tutorial 9).		

Video link: 1. https://www.youtube.com/watch?v=F2KVW4WNnS8 2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-4	RBT Level L1,L2	4Hrs
Harmony in the Nature/Existence: Understanding Harmony in the Nature, Interconnectedness, self-regulation and Mutual Fulfillment among the Four Orders of Nature, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. **Practical Sessions:** Exploring the Four Orders of Nature (Tutorial 10), Exploring Co-existence in Existence (Tutorial 11). Video link: 1. https://www.youtube.com/watch?v=1HR-QB2mCF0 2. https://www.youtube.com/watch?v=lfN8q0xUSpw 3. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw		
Module-5	RBT Level L1,L2	4Hrs
Review on Natural Acceptance of Human Values, Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Holistic Technologies, Production Systems and Management Models-Typical Case Studies. **Implications of the Holistic Understanding – a Look at Professional Ethics:** Definitiveness of (Ethical) Human Conduct, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession **Practical Sessions:** Exploring Ethical Human Conduct (Tutorial 12), Exploring Humanistic Models in Education (Tutorial 13), Exploring Steps of Transition towards Universal Human Order (Tutorial 14). Video link:		

1. https://www.youtube.com/watch?v=BikdYub6RY0 2. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw

Course outcomes: On completion of the course, students would be able to	
CO1	Explore themselves, get comfortable with each other and with the teacher
CO2	Enlist their desires and the desires are not vague.
CO3	Restate that the natural acceptance (intention) is always for living in harmony, only competence is lacking
CO4	Differentiate between the characteristics and activities of different orders and study the mutual fulfillment among them
CO5	Present sustainable solutions to the problems in society and nature

Scheme of Evaluation

Details		Marks
Assessment by Faculty mentor (Class Room Evaluation)	CIE(50)	10
Self-Assessment + Assessment by peers		20
Activities / Experimentations related to courses/Assignment		10
Mini Projects / Case Studies		10
Semester End Examination	SEE (50)	50
	Total	100

Text Books:	
1.	AICTE SIP UHV-I Teaching Material, https://fdp-si.aicte india.org/ AicteSipUHV _download.php

2.	A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1
3.	Teachers' Manual for A Foundation Course in Human Values and Professional Ethics, R R Gaur, R Asthana, G P Bagaria, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2
Reference Books:	
1.	Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010
2.	Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
3.	Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
4.	The Story of Stuff (Book).
5.	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO3	-	1	-	-	-	2	2	3	2	1	2	1
CO4	-	1	-	-	-	2	2	3	2	1	2	1
CO5	-	1	-	-	-	2	2	3	2	1	2	1

High-3, Medium-2, Low-1

B.E, VI Semester, Electronics & Communication Engineering

Course Title	MICROWAVE & ANTENNA	Semester	VI
Course Code	MVJ20EC61	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3: 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to: • Describe the microwave properties and its transmission media. • Describe microwave devices for several applications. • Understand the concept behind microwave systems. • Understand the basics of antenna theory. • Select antennas for specific applications		
Module-1	RBT Level L1, L2 ,L3	10Hrs.

Prerequisites: *Electromagnetics, wave propagation, waveguides*

Introduction to Microwaves: History of Microwaves, Microwave Frequency bands, General Applications of Microwaves, Advantages of Microwaves

Analysis of Microwave Transmission Lines: Transmission line equations & solutions, Smith Chart Basics, problems on smith chart, impedance matching using stub line, Introduction to strip lines, Micro strip lines, parallel strip lines, coplanar strip lines, shielded strip lines, Rectangular and circular waveguides-theory and analysis.

Laboratory Sessions/ Experimental learning:

1. Measurement of frequency, guide wavelength, power, VSWR and attenuation in microwave test bench.

Applications: Power transmission line, Telephone lines, Traces on Printed Circuit Boards, Traces on Multi-Chip Modules, Traces on Integrated Circuit Packages.

Video link / Additional online information:

1. https://lake.videoken.com/nptel/category/933/

Module-2	RBT Level L1, L2 , L3	10Hrs.

Microwave Passive components: Directional Coupler, Power Divider, Magic Tee, Wave-guide Corners, Bends, Twists, Attenuator, Circulator, Isolator and Resonator.

Microwave Active components: Tunnel diode, Varactor diodes, Step recovery diodes, Schottky Barrier diodes, PIN diodes, Gunn Diodes, IMPATT and TRAPATT diodes, Parametric Amplifiers, Microwave Transistors, Microwave oscillators and Mixers. Microwave tubes: Klystron, TWT, Magnetron.

Laboratory Sessions/ Experimental learning:

1. Study of the characteristics of Klystron tube and to determine its electronic tuning range.

Applications: Oscillators and mixers, power sources.

Video link / Additional online information:

1. https://lake.videoken.com/nptel/category/933/
2. https://www.daenotes.com/electronics/microwave-radar/microwave-tube-devices

Module-3	RBT Level L1, L2 , L3	10Hrs.

Microwave Systems: Wireless Communications system, Radar Systems, Radiometer Systems, Satellite Communication, Remote sensing, Microwave Propagation (Introduction and Block diagrams only)

Antenna Basics: Introduction, Basic Antenna Parameters, Patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity and Gain, Antenna Apertures, Effective Height, Bandwidth, Friis Transmission Equation, Antenna Field Zones & Polarization.

Laboratory Sessions/ Experimental learning:

1. To perform PC to PC Communication using Microwave test bench

Applications: Satellite communications, remote sensing, RADAR systems.

Video link / Additional online information:

1. https://lake.videoken.com/nptel/category/933/
2. https://lake.videoken.com/nptel/category/1052/

Module-4	RBT Level L1, L2, L3 ,L4	10Hrs.

Point Sources and Arrays: Introduction, Point Sources, Power Patterns, Power Theorem, Radiation Intensity, Field Patterns, Phase Patterns, Arrays of Two Isotropic Point Sources, Pattern Multiplication, Linear Arrays of n Isotropic Point Sources of equal Amplitude and Spacing, Phased Arrays.

Electric Dipoles: Introduction, Short Electric Dipole, Fields of a Short Dipole (General and Far Field Analyses), Radiation Resistance of a Short Dipole, Thin Linear Antenna (Field Analyses), Radiation Resistances of Lambda/2 Antenna.

Laboratory Sessions/ Experimental learning:

1. Simulation of antenna patterns using FEKO software.

Applications: two-way radio communications links, to broadcasting broadcast reception, general radio reception.

Video link / Additional online information:

1. https://lake.videoken.com/nptel/category/1052/

Module-5	RBT Level L1, L2, L3	10Hrs.

Antenna Types: Introduction to Loop Antenna, Small loop, Comparison of Far fields of Small Loop and Short Dipole, The Loop Antenna General Case, Far field Patterns of Circular Loop Antenna with Uniform Current, Radiation Resistance of Loops, Directivity of Circular Loop Antennas with Uniform Current, Microwave antennas, Horn antennas, Helical Antenna, Yagi-Uda array, Parabolic reflectors, Log periodic array, Plasma antenna, Antenna for GPR.

Laboratory Sessions/ Experimental learning:

1. Measurement of directivity and gain of Helical, Loop, Horn and Yagi antennas
2. Case study on 3-element printed Yagi-Uda antenna

Applications: wave propagation and communications

Video link / Additional online information:

1. https://lake.videoken.com/nptel/category/1052/

Course outcomes:	
CO1	Design and analyze microwave transmission lines.
CO2	Identify various passive microwave components for different applications.
CO3	Design and analyze microwave antennas
CO4	Examine various antenna parameters necessary for building an RF system.
CO5	Recommend various antenna configurations according to the applications.

Text Books:	
1.	Annapurna Das, Sisir K Das, "Microwave Engineering", TMH Publication, 2nd edition, 2010.
2.	Liao, "Microwave Devices and Circuits" , Pearson education, 3rd edition, 2003.
3.	John D. Krauss, Ronald J Marhefka and Ahmad S Khan, "Antennas and Wave Propagation", 4th Special Indian Edition , McGraw- Hill Education Pvt. Ltd., 2010.
Reference Books:	
1.	David M Pozar, "Microwave Engineering", John Wiley & Sons, Inc., 4th edition, 2014
2.	Constantine A. Balanis, "Antenna Theory: Analysis and Design", 3rd edition, John Wiley & Sons, 2009.

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	-	-	1	-	-	1
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CO3	3	3	3	2	1	1	-	-	1	-	1	1
CO4	3	3	3	2	1	1	1	-	1	-	1	1
CO5	3	3	3	2	1	1	1	-	1	-	1	1

High-3, Medium-2, Low-1

Course Title	COMPUTER COMMUNICATION NETWORKS	Semester	VI
Course Code	MVJ20EC62	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3: 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to:

- Understand the layering architecture of OSI reference model and TCP/IP protocol suite.
- Know about the protocols associated with each layer.
- Learn the different networking architectures and their representations.
- Acquire a knowledge of various routing techniques and the transport layer services.
- Learn the security features and functionality of application layer protocols.

Module - 1	RBT Level L1, L2, L3	10Hrs.

Prerequisites: Basic knowledge on computers & programming

Introduction: Data Communications: Components, Representations, Data Flow, Networks: Network criteria, Physical Structures, Network Types: LAN, WAN, Switching, Internet.

Network Models: Protocol Layering: Scenarios, Principles, Logical Connections, TCP/IP Protocol Suite: Layered Architecture, Layers in TCP/IP suite, Description of layers, Encapsulation and Decapsulation, Addressing, Multiplexing and Demultiplexing, The OSI Model: OSI Versus TCP/IP.

Laboratory Sessions/ Experimental learning:

1. Study and draw the layout of LAN connection in Computer Networks Lab in NetSim. List out the type of cabling involved.

Applications: Ethernet, Fibernet, Satellite Communication.

Video link / Additional online information:

1. http://www.redbooks.ibm.com/abstracts/gg243376.html 2. https://nptel.ac.in/courses/106/106/106106091/ 3. https://nptel.ac.in/courses/106/105/106105080/			
Module - 2	**RBT Level** **L1, L2, L3, L4**	**10Hrs.**
Data-Link Layer: Introduction: Nodes and Links, Services, Categories of link, Sublayers, Link Layer addressing: Types of addresses, ARP. Data Link Control (DLC) services: Framing, Flow and Error Control, Data Link Layer Protocols: Simple Protocol, Stop and Wait protocol, Piggybacking. **Media Access Control:** Random Access: ALOHA, CSMA, CSMA/CD, CSMA/CA. **Wired LANs: Ethernet:** Ethernet Protocol: IEEE802, Ethernet Evolution, Standard Ethernet: Characteristics, Addressing, Access Method, Efficiency, and Implementation. **Wireless LANs:** Introduction: Architectural Comparison, Characteristics, Access control **Laboratory Sessions/ Experimental learning:** 1. Study and analyse packet transfer using CSMA/CD and CSMA/CA using NetSim. **Applications:** Collision detection and avoidance in wired and wireless network. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105183/			
Module - 3	**RBT Level** **L1, L2, L3, L4, L6**	**10Hrs.**
Wireless LANs: Introduction: Architectural Comparison, Characteristics, IEEE 802.11: Architecture, MAC Sublayer, Addressing Mechanism, Physical Layer, Bluetooth: Architecture, Layers. **Connecting Devices:** Hubs, Switches. **Virtual LANs:** Membership, Configuration, Communication between Switches and Routers, Advantages. **Network Layer:** Introduction, Network Layer services: Packetizing, Routing and Forwarding, Other services, Packet Switching: Datagram Approach, Virtual Circuit Approach, IPV4 Addresses, Address Space, Classful Addressing, Classless Addressing, DHCP. **Laboratory Sessions/ Experimental learning:** 1. Study of different types of connecting devices.			

Applications: Bluetooth, WiFi, WiMax **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/102/117102062/		
Module - 4	**RBT Level** **L1, L2, L3, L4**	**10Hrs.**
Transport Layer: Introduction: Transport Layer Services, Connectionless and Connection oriented Protocols, Transport Layer Protocols: Simple protocol, Stop and wait protocol, Go-Back-N Protocol, Selective repeat protocol. **Transport-Layer Protocols in the Internet:** User Datagram Protocol: User Datagram, UDP Services, UDP Applications, Transmission Control Protocol: TCP Services, TCP Features, Segment, Connection, State Transition diagram, Windows in TCP, Flow control, Error control, TCP congestion control. **Laboratory Sessions/ Experimental learning**: 1. Study of IP addressing, subnet mask and subnetting. **Applications:** Routing and forwarding packets. **Video link / Additional online information:** 1. https://nptel.ac.in/content/storage2/courses/106105080/pdf/M6L2.pdf		
Module-5	**RBT Level** **L1, L2, L3**	**10Hrs.**
Application Layer: Introduction: providing services, Application- layer paradigms, Standard Client -Server Protocols: World wide web, Hyper Text Transfer Protocol, FTP: Two connections, Control Connection, Data Connection, Electronic Mail: Architecture, Wed Based Mail, Telnet: Local versus remote logging.Domain Name system: Name space, DNS in internet, Resolution, DNS Messages, Registrars, DDNS, security of DNS. **Laboratory Sessions/ Experimental learning**: 1. Transport analysis using TCP/UDP using NetSim. **Applications:** MS Teams, Zoom, Cisco webex **Video link / Additional online information:** 1. http://www.digimat.in/nptel/courses/video/106105183/L11.html 2. http://www.digimat.in/nptel/courses/video/106105183/L06.html		

Course outcomes:	
CO1	Analyze the layering architecture of computer networks and distinguish between the OSI reference model and TCP/IP protocol suite.
CO2	Apply the protocols and services of Physical and Data link layer.
CO3	Describe functions associated with network layer and connecting devices.
CO4	Analyze and apply the protocols and services of Transport layer.
CO5	Analyze and apply the protocols and services of application layer.

Text Books:	
1.	Behrouz A Forouzan," Data Communication and Networks", 3rd Ed. TMH.
2.	Andrew S Tanebaum, "Computer Networks", 4th Ed. PHI/ Pearson education.
Reference Books:	
1.	S. Keshav, "An Engineering approach to Computer Networks", 5th Ed. Pearson.
2.	W.A. Shay, "Understanding communication and Networks", Thomson.
3.	Irvine Olifer, "Computer Networks: Principles, Technology and Protocols", Wiley India.
4.	William Stalling, "Data and Computer communications", 7th Ed. PHI

CIE Assessment:

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CO3	3	3	3	3	2	1	-	2	1	-	-	1
CO4	3	3	3	3	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	2	1	-	-	1

High-3, Medium-2, Low-1

Course Title	REAL TIME OPERATING SYSTEMS	Semester	VI
Course Code	MVJ20EC631	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Acquire knowledge about concepts related to OS for Embedded Systems.
- Gain knowledge about different types of scheduling algorithms suitable for embedded real time systems.
- Introduce the principles of Inter process communication and multitasking applications.
- Explain the architecture of Linux Kernel and RTOS applications to Linux.
- Discuss Real-Time Programming in Linux and µC linux.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Basic Concepts of Operating systems and basics of task management and task scheduling.

Real Time Systems: Introduction, issues in real time computing, Structure of a real time system, task classes, performance measures for real time systems, task assignment and scheduling algorithms, mode changes, Fault tolerant scheduling, Real Time Models.

Laboratory Sessions/ Experimental learning:

1. Create an application that creates two tasks that wait on a timer whilst the main task loops.
2. Create an application that creates tasks and scheduling tasks.

Applications: Kiel RTOS for ARM (Keil RTX - ARM)

Video link / Additional online information: 1. https://nptel.ac.in/courses/106/105/106105036/ 2. https://nptel.ac.in/courses/106/105/106105172/		
Module-2	**RBT Level** **L1, L2, L3**	**8Hrs.**
μC/OS- II RTOS Concepts: Foreground/Background process, Resources, Tasks, Multitasking, Priorities, Schedulers, Kernel, Exclusion, Inter task communication, Interrupts, Clock ticks, μC/OS- II Kernel structure , μC/OS- II Initialisation, Starting μC/OS-II. **Laboratory Sessions/ Experimental learning:** 1. Write an Keil RTOS code that demonstrates the multitasking priority. 2. Write an Keil RTOS code that assigns priority and sets the time slice period to illustrate time slicing. **Applications:** 1. Email Spam and Malware Filtering 2. File Managers and Resource management systems **Video link / Additional online information:** 2. https://nptel.ac.in/courses/106/106/106106198/ 3. http://www.nptelvideos.in/2012/11/real-time-systems.html		
Module-3	**RBT Level** **L1, L2, L3**	**8Hrs.**
μC/OS- II RTOS Functions: Task Management, Time management, Semaphore management, Mutual exclusion semaphore, Event Management, Message management, Memory management, porting μC/OS- II – comparison and study of various RTOS like QNX, VX Works, Psos. **Laboratory Sessions/ Experimental learning:** 1. Write a Keil RTOS code to manage tasks to handle semaphore to overcome mutual exclusion. 2. Demonstrate Porting of μC/OS- II in Embedded processor. **Applications:**Traffic light controller system **Video link / Additional online information:**		

<table>
<tr><td colspan="4">1. https://nptel.ac.in/courses/106/105/106105215/
2. https://nptel.ac.in/courses/106/105/106105172/</td></tr>
<tr><td colspan="2">Module-4</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="4">Embedded Linux: Embedded Linux, Features, Embedded Linux Distributions, Architecture of Embedded Linux, Linux Kernel Architecture, User Space, Root File System, Linux Start, Up Sequence, GNU Cross Platform Tool chain, Porting Traditional RTOS Applications to Linux.
Laboratory Sessions/ Experimental learning:
1. Write an application that display two different messages in LCD display in two lines.
Applications: Smart Mobile Phone operating system development process demonstration.
Video link / Additional online information:
1. http://1.https//nptel.ac.in/courses/11706087/
2. https://nptel.ac.in/courses/106/106/106106198/</td></tr>
<tr><td colspan="2">Module-5</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="4">Real time Linux: Linux and Real-Time, Real-Time Programming in Linux, Hard Real-Time Linux, Building and Debugging, Building the Kernel, Integrated Development Environment, Kernel Debuggers, Embedded Drivers, Boardsupport packages, Introduction to µC linux.
Laboratory Sessions/ Experimental learning:
1. Creating and UART driver for USB bus.
Applications: Demonstration of ABS system in automobiles
Video link / Additional online information:
1. https://nptel.ac.in/courses/117102059/
2. http://www.nptelvideos.in/2012/11/real-time-systems.html
3. https://www.youtube.com/watch?v=HlU5cYqGLZE</td></tr>
<tr><td colspan="4">Course outcomes:</td></tr>
<tr><td>CO1</td><td colspan="3">Summarize fundamental principles for programming of real time systems with time and resource limitations.</td></tr>
<tr><td>CO2</td><td colspan="3">Develop RTOS based embedded real time applications.</td></tr>
</table>

CO3	Analyze the functions of real time operating systems.
CO4	Utilize RTOS software tool chain for Embedded Applications.
CO5	Develop real time kernals and Embedded Drivers.

Text Books:	
1.	Krishna C.M., Kang G. Shin, "Real Time Systems", Tata McGraw-Hill international Edition, 2010.
2.	Philip A.Laplante, "Real Time Systems Design and Analysis-An Engineers Handbook", II Edition-IEEE Press, IEEE Computer Society Press, 2001.
3	Jean J Labrosse, "MicroC/OS-II The Real Time Kernel" II Edition, CMP Books, 2002.
Reference Books:	
1.	P.Raghavan, Amol Lad, Sriram Neelakandan, "Embedded Linux System Design and Development",Auerbach Publications, Taylor& Francis Group, 2006.
2.	Christopher Hallinan, "Embedded Linux Primer, A Practical, Real-World Approach", II Edition Pearson Education, Inc., 2011.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	1	-	2	1
CO2	3	3	3	2	1	1	-	-	1	-	2	1
CO3	3	3	3	2	1	1	-	-	1	-	2	1
CO4	3	3	3	2	1	1	-	-	1	-	2	1
CO5	3	3	3	2	1	1	-	-	1	-	2	1

High-3, Medium-2, Low-1

Course Title	DIGITAL IMAGE PROCESSING	Semester	VI
Course Code	MVJ20EC632	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Learn the fundamentals of digital image processing
- Understand the image transforms and other image enhancement techniques used in digital image processing.
- Study the image restoration techniques and methods used in digital image processing
- Understand region-based segmentation and segmentation using morphological watersheds.
- Know the color fundamentals and various morphological image processing techniques.

Module-1	RBT Level L1, L2, L3, L4	8Hrs.

Prerequisites: Discrete Fourier Transform, MATLAB Basics

Introduction to Digital Image Processing: What is Digital Image Processing? Origin of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.

Laboratory Sessions/ Experimental learning:

1. Implementation and analysis of image sampling methods including uniform, grid, jittered and best candidate algorithms using MATLAB

Applications: Medical imaging, Robot vision, Character recognition, Remote Sensing.

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm			
Module-2	RBT Level L1, L2, L3, L4	8Hrs.
Spatial Domain:Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain**: Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image, Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering. **Laboratory Sessions/ Experimental learning**: 1. Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Applications**: Image Enhancement, Image Analysis **Video link / Additional online information**: 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm		
Module-3	RBT Level L1, L2, L3,L4	8Hrs.
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error(Wiener) Filtering, Constrained Least Squares Filtering. **Laboratory Sessions/ Experimental learning**: 1. Test the restoration with the Inverse Filter for deblurring and denoising. Identify the problem with the Inverse Filter and discuss the solution for the same. **Applications**: Image Enhancement, Image Analysis, Error detection and correction **Video link / Additional online information**: 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm		

Module-4	RBT Level L1, L2, L3, L4	8Hrs.
Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds. **Representation and Description:** Representation, Boundary descriptors. **Laboratory Sessions/ Experimental learning:** 1. Develop and implement a matlab code for Image segmentation using thresholding technique. **Applications:** Object tracking, Pattern recognition **Video link / Additional online information :** 1.https://nptel.ac.in/courses/117/105/117105079/ 2.https://www.tutorialspoint.com/dip/index.htm		

Module-5	RBT Level L1, L2, L3, L4	8Hrs.
Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing. **Morphological Image Processing:** Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. Four morphological principles, Skeletons and object marking. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of multimodal image fusion using MATLAB. **Applications:** Color conversion, Object marking **Video link / Additional online information:** 1.https://nptel.ac.in/courses/117/105/117105079/ 2.https://www.tutorialspoint.com/dip/index.htm		

Course outcomes:	
CO1	Analyze image processing algorithms used for sampling and quantization.
CO2	Apply and analyze image processing techniques in both the spatial and frequency (Fourier) domains.
CO3	Implement and analyse various image restoration algorithms

CO4	Design image analysis techniques for image segmentation and evaluate the methodologies for segmentation.
CO5	Conduct independent study and analyze various Morphological Image Processing techniques.

Text Books:	
1.	Rafel C Gonzalez and Richard E. Woods, "Digital Image Processing"-, PHI 3rd Edition, 2010.
2.	Milan Sonka, Vaclav Hlavac, Roger Boyle, –"Image Processing, Analysis, and Machine Vision‖", Cengage Learning, Fourth Edition, 2013, ISBN: 978-81-315-1883-0
Reference Books:	
1.	S.Jayaraman, S.Esakkirajan, T.Veerakumar, "Digital Image Processing"- Tata McGraw Hill 2014.
2.	A. K. Jain, "Fundamentals of Digital Image Processing"- Pearson 2004.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	1	-	-	1
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CO3	3	3	3	2	2	1	-	-	1	-	-	1
CO4	3	3	3	2	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	VIRTUAL & AUGMENTED REALITY	Semester	VI
Course Code	MVJ20EC633	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Establish and cultivate a broad and comprehensive understanding of the virtual reality and Augmented Reality.
- Exhibit various elements and components used in AR/VR Hardware
- Provide various factors involved in multisensory action of human being
- Provide a detailed analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR/AR modelling and programming.
- Understand virtual reality, augmented reality and using them to build Biomedical, engineering and robotics application.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: *Intermediate programming ability in object-oriented languages, Basic linear algebra*

Introduction to Immersive Technologies: A Brief History of Virtual Reality, The five Classic Components of a VR System, Early Commercial VR Technology , VR becomes an Industry, Reality, Virtuality and Immersion , VR, AR, MR, xR: similarities and differences.

Laboratory Sessions/ Experimental learning:

1. Choose an existing VR application and write a summary including a personal critical reflection on its look and feel especially in relation to immersion, presence, agency and interactivity.

Applications: VR in Sport, Mental Health, Medical Training.

Video link / Additional online information:

1. https://nptel.ac.in/courses/121/106/121106013/

Module-2	RBT Level L1, L2, L3	8Hrs.
Motion Tracking and Navigation: Position and Motion Trackers , Inside Out/Outside In , Tracker Performance Parameters , Optical, Active and Passive Trackers , Inertial and Hybrid Trackers, HMD Trackers , Magnetic Trackers , Mechanical Trackers , Ultrasonic Trackers , Navigation and Manipulation Interfaces , Tracker-Based Navigation/Manipulation Interfaces. **Laboratory Sessions/ Experimental learning:** 1. Design an immersive environment in Unity-3D or Unreal that will develop and enhance Work in groups. Start by building a simple 3D world that an interactive player can move around in. Connect the controllers and create a simple interaction loop. Measure velocity, acceleration, distances, and other motion and spatial parameters of the user and the controllers. **Applications:** Industrial Training and Simulation, Flight Training and Simulation, Pilot Head Tracking, Live Aircraft, Sports motion Analysis. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/106/106106138/		
Module-3	RBT Level L1, L2, L3	8Hrs.
The Human behind the lenses: Human Perception and Cognition , The Human Visual System, VR Health and Safety Issues, Effects of VR Simulations on Users , Cyber sickness, before and now Guidelines for Proper VR Usage. **Laboratory Sessions/ Experimental learning:** 1. Create a well-rounded multisensory action that is meaningful, safe and accommodates all senses, visual, auditory and tactile. **Applications:** Human–Computer Interaction, e-Sports, Games, Cultural heritage **Video link / Additional online information:** 1. https://nptel.ac.in/noc/courses/noc18/SEM1/noc18-ge08/		
Module-4	RBT Level L1, L2, L3	8Hrs.
Augmented and Mixed Reality: Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR, AR systems and functionality,		

Augmented reality methods, visualization techniques for augmented reality, wireless displays in educational augmented reality applications, mobile projection interfaces, marker-less tracking for augmented reality, enhancing interactivity in AR environments, evaluating AR systems. **Laboratory Sessions/ Experimental learning:** 1. Experiment with Photo grammetry and improve the visual look and feel of your environment **Applications:** Healthcare **Video link / Additional online information:** 1. https://www.coursera.org/learn/ar-technologies-video-streaming

Module-5	**RBT Level** **L1, L2, L3**	**8Hrs.**
Medical Applications of xR: Behavioural Therapy, Virtual and Augmented Surgery, Triage and Diagnostics, Applications of VR in Robotics: Robot Programming, Robot Tele operation. **Laboratory Sessions/ Experimental learning:** 1. Add a training component to your existing prototype. Define the mechanics that will progressively improve user's performance to mastery through an interaction loop using the dual concept of challenge / reinforcing. **Video link / Additional online information:** 1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5622235/		

Course outcomes:	
CO1	Acquire various principles and concepts of virtual reality and its application.
CO2	Understand the optical motion tracking and navigation in virtual reality.
CO3	Analyse and solve problems related to their expertise in Augment and Virtual Environments.
CO4	Develop detailed analysis of the engineering, scientific and functional aspects of VR systems and the fundamentals of VR modelling and programming.
CO5	Illustrate the knowledge of integrating hardware, software, tools for AR/VR technology.

Text Books:	
1.	C. Burdea and Philippe Coiffet, "Virtual Reality Technology", First Edition, Gregory, John Wiley and Sons, Inc.,2008
2.	Steven M. LaValle, "Virtual Reality", 2016. Online version: http://msl.cs.uiuc.edu/vr/
3.	Alan B. Craig, "Understanding Augmented Reality, Concepts and Applications", Morgan Kaufmann, First Edition, 2013.
4.	Dieter Schmalstieg and Tobias Hollerer, "Augmented Reality: Principles and Practice (Usability)" by Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
Reference Books:	
1.	Jason Jerald.,"The VR Book: Human-Centred Design for Virtual Reality", Association for Computing Machinery and Morgan and Claypool, New York, NY, USA, First Edition, 2015
2.	Steve Aukstakalnis, "Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability)", Addison-Wesley Professional; 1st edition, 2016.
3.	Robert Scoble and Shel Israel, "The Fourth Transformation: How Augmented Reality and Artificial Intelligence Will Change Everything", Patrick Brewster Press; 1st edition, 2016.
4.	Tony Parisi, "Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web, and Mobile", OReilly Media; 1st edition, 2015.
5.	Tony Parisi, "Programming 3D Applications with HTML5 and WebGL: 3D Animation and Visualization for Web Pages", OReilly Media; 1st edition, 2014.

CIE Assessment:
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SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	1	-	-	1	-	-	1
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CO3	3	3	3	2	3	1	-	-	1	-	-	1
CO4	3	3	3	2	3	1	-	-	1	-	-	1
CO5	3	3	3	2	3	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	DATA STRUCTURE USING C++	Semester	VI
Course Code	MVJ20EC634	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand the fundamentals of data structures and their applications in logic building and project assessment.
- Acquire the knowledge of algorithms of queues and stacks.
- Understand the concept of lists, trees and graphs.
- Analyze the importance of object oriented programming and class while developing an algorithm.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: *C++ data types, indexing ,basic concept of OOPS*

Introduction to Data Structure: Array, Functions and parameter's, Recursion, Class definition.

Performance analysis: Review of basic data structures - Stack, Queue, and Implementation using template classes in C++.

Laboratory Sessions/ Experimental learning:

1. Develop a mini project using C++, demonstrate the concept of Functions and Class.

Applications:

- Conversion from one form of expression to another
- Mathematical calculation for expression evaluation.

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://nptel.ac.in/courses/106/106/106106127/

Module-2	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Programming using the concept of Arrays and pointers

Linear List: Structures of Linear list, Array Representation, Vector Representation, Singly Linked lists and chains, operations insertion and deletion of element in an array, Application of Linear List.

Stacks: The abstract data types, Array Representation, Linked Representation, Applications of stack.

Laboratory Sessions/ Experimental learning:

1. Implementation of Towers of Hanoi using Stacks.

Applications:

- Towers of Hanoi.
- Parenthesis matching in an expression

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106127/
2. https://www.youtube.com/playlist?list=PL0gIV7t6l2iIsR55zsSgeiOw9Bd_IUTbY

Module-3	RBT Level L1, L2, L3, L6	8Hrs.

Prerequisites: Basic definition of Queues and Heaps in C++.

Queues: The ADT Queues, Create an Array Representation, Create a Linked Representation, Demonstrate Applications of Queues.

Priority queue: Develop Algorithm of a priority queue, Representation using binary tree, Implementation of a Priority Queue, Applications of Priority Queues.

Laboratory Sessions/ Experimental learning:

1. Develop an algorithm using C++ to demonstrate the concept of queues.

Applications:

- Programs for Departmental store bills
- Programs for Railway booking

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/102/106102064/
2. https://drive.google.com/file/d/0BzTQ7doC5eGSQTBicHo1UDgtOVU/view

Module-4	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Different searching and sorting algorithms using C++

Search trees: Definition, operations on search trees, implementation of a search tree.

Binary search trees: Definition, Operations like Searching, Insertion and Deletion from a binary tree, height of a Binary Tree, Applications of Binary trees.

Laboratory Sessions/ Experimental learning:

1. Solve Parenthesis Matching problem using binary search trees.

Applications:

- Can be used for Memory Management.
- In solving backtracking problems.

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/106/106106127/
2. https://nptel.ac.in/courses/106/105/106105225/

Module-5	RBT Level L1, L2, L3, L6	8Hrs.

Prerequisites: Concept of binary trees, list and arrays

AVL trees: Definition, Develop algorithm to find height of an AVL Tree, Operations like Insertion, Deletion and Searching. Comparison between Search Trees, Application of AVL trees, Hashing, Dictionaries.

Laboratory Sessions/ Experimental learning:

1. Print all the Disarium numbers between 1 and 100
2. Perform Jump Search for a given key and report success or failure. Prompt the user to enter the key and a list of numbers.

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106133/
2. https://nptel.ac.in/courses/106/105/106105225/
3. https://nptel.ac.in/courses/106/106/106106127/

Course outcomes:	
CO1	Acquire knowledge of time complexity and space complexity in order to implement an Algorithm using C++.

CO2	Apply the conceptsof data structures like List, stack in various applications.
CO3	Analyze and design of algorithms for Queues.
CO4	Utilize the operations of search trees and their applications.
CO5	Implement hashing in data structure and AVL trees.

Text Books:	
1.	S. Sahni, "Data structures, Algorithms and Applications in C++", University Press (In Pvt.Ltd, 2nd edition, Universities Press Orient Longman Pvt. Ltd.
2.	Michael T. Goodrich, R. Tamassia and .Mount, "Data structures and Algorithms in C Wiley student edition, John Wiley and Sons.
Reference Books:	
1.	Mark Allen Weiss, "Data structures and Algorithm Analysis in C++", Pearson Educati Ltd., Second Edition.

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iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO3	3	3	2	2	2	1	-	-	1	-	-	1
CO4	3	3	2	2	2	1	-	-	1	-	-	1
CO5	3	3	2	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	LABVIEW	Semester	VI
Course Code	MVJ20EC641	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Explore the basics of Virtual Instrumentation.
- Differentiate and handle the analog and digital I/Os.
- Use LabVIEW for real time experiments.
- Analyze tools and applications in Virtual Instrumentation.

Module-1	RBT Level L1, L2	8Hrs.

Prerequisites: *Fundamentals of C-Programing, Basic Electrical and Electronics.*

GRAPHICAL SYSTEM DESIGN: Graphical System Design (GSD) model, Design flow with GSD, VI and traditional instrument, Hardware and Software in VI, Test, control and design in the engineering process, VI beyond personal computer, GSD using LabView, Graphical Programming and Textual Programming.

INTRODUCTION TO LABVIEW: Introduction, Advantages of LabView, Software environment, Creating and Saving a VI, Front Panel Toolbar, Block Diagram Toolbar, Palettes, Panel Controls and Indicators, Data types, Keyboard Shortcuts.

Laboratory Sessions/Experimental Learning:

1. Perform basic arithmetic & Boolean Operations using LabView

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=VQ7kL6knMdo

Module-2	RBT Level L1, L2, L3	8Hrs.

MODULAR PROGRAMMING: Modular Programming In Labview, Build A VI Front Panel and Block Diagram, Creating an Icon, Building a Connector Pane, Creating, Opening And Editing SUBVIs,

REPETITION AND LOOPS: For Loops, While Loops, Structure Tunnels, Terminals Inside Or Outside Loops, Shift Registers, Feedback Nodes, Control Timing, Communicating Among Multiple Loops, Local & Global Variables.

ARRAYS: Creating 1-D, 2-D And Multidimensional Arrays, Deleting, Inserting, Replacing, Elements, Array Functions, Matrix Operations with Arrays, Polymorphism.

Laboratory Sessions/ Experimental learning:

1. Find the sum of 'n' numbers using FOR loop using LabView
2. To perform the factorial of a given number using WHILE loop
3. To sort even numbers using WHILE loop in an array
4. To find the maximum and minimum variable from an array.

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=WKvRDIuUNNs

Module-3	RBT Level L1, L2, L3	8Hrs.

PLOTTING DATA: Types of Waveforms, Graphs, Charts, Data Type, XY Graphs, Intensity Graphs And Charts, Digital Waveform Graphs, 3D Graphs, Customizing Graphs And Charts, Customizing Graphs, Customizing 3D Graphs, and Displaying Special Planes on the XY Graph.

STRUCTURES, STRINGS AND FILE I/O: Case, Sequence, Customizing Structures, Timed Structures, Formula Nodes, Event Structure, String Functions, Formatting Strings, Basics of File Input/Output, File I/O VIs, and Creating a Relative Path.

Laboratory Sessions/ Experimental learning:

1. To bundle and unbundle a cluster.
2. To perform functions using flat and stacked sequence.

3. To create a sine wave using formula node.

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=kdPyGcJNQbM
2. https://www.youtube.com/watch?v=c6hLkFsQ-VU

Module-4	RBT Level L1, L2, L3	8Hrs.

DATA ACQUISITION: Transducers, Signals And Signal Conditioning, DAQ Hardware Configuration, Analog Inputs & Outputs, Counters, DAG Software Architecture, Assistant, Selecting and Configuring a Data Acquisition Device, Components of Computer Based Measurement System.

Laboratory Sessions/ Experimental learning:

1. Temperature sensor using LabView and NI myDAQ.
2. To apply filtering technique for a given input signal
3. To perform discrete cosine transform on the given signal

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=fIy6XT3CdPQ

Module-5	RBT Level L1, L2, L3	8Hrs.

IMAQ VISION: Vision Basics, Image Processing and Analysis, Particle Analysis, Machine Vision, Machine Vision Hardware and Software.

Laboratory Sessions/ Experimental learning:

1. Build a complete machine vision system.
2. Acquire and Display images with NI-IMAQ driver software.

Applications: Instrumentation, Control Systems, Embedded Systems, Speech Signal Processing, Image Processing, Robotics & VLSI.

Video link/ Additional online information:

1.	https://www.youtube.com/watch?v=4vDS4CRGhL0&list=PL3qqtKcHarV1yCaDZBQHXunX6MAwhXny1

Course outcomes:	
CO1	Familiarize with basic concepts, tools and functions of LabView Programming.
CO2	Develop Virtual Instrumentation using LabVIEW.
CO3	Appreciate the technologies related to VI for Industrial Applications.
CO4	Use DAQ for Real Time Applications.
CO5	Illustrate the basic design approaches for various Tools and Functions in IMAQ Vision.

Text Books:	
1.	Jovitha Jerome, Virtual Instrumentation using LabVIEW, PHI publications, 2010
2.	BehzadEhsani, Data Acquisition using LabVIEW, Packt Publishing, 2016.
Reference Books:	
1.	John Essick, Hands-On-Introduction to LabVIEW for Scientists and Engineers – Fourth Edition, OXFORD Publications, 2016
2.	Richard Jennings & Fabiola De La Cueva, LabVIEW Graphical Programming - Fifth Edition, McGraw-Hill, 2018.
3.	Robert H. Bishop, 'Learning with Lab-view', Prentice Hall, 2003.

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)

SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	3	-	-	-	-	-	-	-
CO2	3	2	2	-	3	-	-	-	-	-	-	-
CO3	3	2	2	-	3	-	-	-	-	-	-	-
CO4	3	2	2	-	3	-	-	-	-	-	-	-
CO5	3	2	2	-	3	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	MEMS & SENSOR DESIGN	Semester	VI
Course Code	MVJ20EC642	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand the overview of Microsystems and their applications.
- Study the working principles of Micro sensors and Micro Actuators.
- Acquire the knowledge of various Microsystems Fabrication Processes.
- Illustrate the Microsystems Design consideration.
- Know the basics of NEMS and its applications.

Module-1	RBT Level L1, L2	8Hrs.

Prerequisites: *Fundamentals of Physics (Mechanics, Optics, Electricity and magnetism),Fundamentals of Inorganic Chemistry*

MEMS Overview: MEMS and Microsystems, Typical MEMS and Microsystems products: Microgears, Micromotors, Microturbines & Micro-optical components, History of MEMS development, Intrinsic characteristics of MEMS, Application of Microsystems in various Industries.

Laboratory Sessions/ Experimental learning:

1. An introduction to Comsol Multiphysics which is ideally suited for MEMS applications.

Applications: Airbag Systems, Controlling automotive movement changes.

Video link / Additional online information :

2. https://nptel.ac.in/courses/117/105/117105082/
3. https://nptel.ac.in/courses/108/108/108108147/
4. http://www.nptelvideos.in/2012/12/mems-microsystems.html
5. https://youtu.be/j9y0gfN9WMg

Module-2	RBT Level L1, L2, L3	8Hrs.

MEMS Sensors: Acoustic wave sensors, Biomedical & Biosensors, Chemical sensors, Optical sensors, Pressure sensor and thermal sensors, Piezo-resistive and Piezo-electric sensors.

Laboratory Sessions/ Experimental learning:

1. Case study of Blood Pressure Sensors

Applications: Satellite launch vehicle, industries, automobile, medical, consumer applications

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105082/
2. https://nptel.ac.in/courses/108/108/108108113/
3. https://nptel.ac.in/courses/108/108/108108147/
4. http://www.nptelvideos.in/2012/12/mems-microsystems.html

Module-3	RBT Level L1, L2, L3	8Hrs.

Microactuation: Actuation using thermal forces, Actuation using shape memory Alloys, Actuation using piezoelectric effect, Actuation using Electrostatic forces (Parallel plate, Torsion bar, Comb drive actuators),

MEMS with Microactuators: Microgrippers, Miniature Microphones, Micromotors, Microactutors with mechanical inertia, Microfluidics.

Laboratory Sessions/ Experimental learning:

1. Case studies on MEMS Microphone.

Applications: Optical, RF and industrial applications.

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105082/

Module-4	RBT Level L1, L2, L3	8Hrs.

Microsystems Fabrication Processes: Photolithography, Ion implantation, Diffusion, Oxidation, Chemical Vapor Deposition, Physical Vapor Deposition, Deposition by Epitaxy, Etching.

Bulk Micro manufacturing: Overview of Etching, Isotropic & Anisotropic Etching, Wet Etchants, Etch Stop, Dry Etching. **Surface Micromachining**: Description, Process, Mechanical Problems Associated with Surface Micromachining **Laboratory Sessions/ Experimental learning:** 1. Study the process involved in LIGA micromanufacturing **Applications**: Hybrid integrated circuits, integrated passive devices & sensors. **Video link / Additional online information:** 4. https://nptel.ac.in/courses/117/105/117105082/ 5. https://nptel.ac.in/courses/108/108/108108113/ 6. https://nptel.ac.in/courses/108/108/108108147/ 7. http://www.nptelvideos.in/2012/12/mems-microsystems.html

Module-5	RBT Level L1, L2, L3	8Hrs.

Microsystems Design: Introduction, Design Considerations, Process Design, Mechanical Design, Computer Aided Design. **Introduction to NEMS**: Micro and Nanoscale Technologies, General Principle of Nanofabrication, Nanoproducts, Applications of Nanoproducts. **Laboratory Sessions/ Experimental learning:** 1. Design Capacitive Pressure Sensor using Comsol Multiphysics. **Applications**: To measure blood pressure within the body, detect ions, to perform biological tests, displays, tunable Lasers, smart phones, mobile infrastructure, IoT and defense. **Video link / Additional online information:** 3. https://nptel.ac.in/courses/117/105/117105082/ 4. http://www.nptelvideos.in/2012/12/mems-microsystems.html

Course outcomes:	
CO1	Appreciate the technologies related to MEMS.
CO2	Gain knowledge of various Microsensors.
CO3	Understand actuators for MEMS applications.

CO4	Analyze the fabrication process involved with MEMS devices
CO5	Illustrate the basic design approaches for various sensors. Understand overview of NEMS.

Text Books:	
1.	Tai-Ran Hsu, "MEMS and Micro systems: Design, Manufacture and Nanoscale Engineering", 2nd Ed, John Wiley & Sons, Inc. 2008.
2.	Chang Liu, "Foundation of MEMS", 2011, 2nd ed., Pearson Education India.
Reference Books:	
1.	Rai Choudhury, "MEMS and MOEMS Technology and Applications", PHI Learning Private Limited, India, 2013.
2.	Marc Madou, "Fundamentals of Micro fabrication", CRC press, 1997.
3.	Stephen D. Senturia, "Micro system Design", Kluwer Academic Publishers, 2001.
4.	Sergey Edward Lyshevski, "MEMS and NEMS: Systems, Devices, and Structures", CRC Press, 2002.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

iv. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

v. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

vi. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	2	2	1	-	1	-	-	1
CO2	3	2	1	1	-	2	1	-	1	-	-	1
CO3	3	2	1	1	-	2	1	-	1	-	-	1
CO4	3	3	2	2	-	2	1	-	1	-	-	1
CO5	3	3	3	2	2	2	1	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	MACHINE LEARNING DESIGN & APPLICATIONS	Semester	VI
Course Code	MVJ20EC643	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Define machine learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised and reinforcement learning.
- Understand the basic concepts of learning and decision trees.
- Understand neural networks and Bayesian techniques for problems appear in machine learning
- Gain the knowledge on instant based learning and reinforced learning.
- Perform statistical analysis of machine learning techniques.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: *Basics of binary tree, Decision Tree*

Introduction, Concept learning and Decision trees: Machine Learning Design, Applications of Machine learning, Learning Problems, Well posed learning problems, Designing a Learning system, Concept Learning, Perspective and Issues in Machine Learning.

Laboratory Sessions/ Experimental learning:

1. Implement and demonstrate the FIND-S Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

Applications: Data training samples, Speech Recognition algorithm.

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/106/106106139/

2. https://www.digimat.in/nptel/courses/video/106105152/L01.html

Module-2	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Data structures, Decision Tree and binary tree

Decision Tree Learning and Artificial Neural Networks: Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms.

Laboratory Sessions/ Experimental learning:

1. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Applications: Email Spam and Malware Filtering,ID3 algorithm, Self-driving cars

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106198/
2. https://www.youtube.com/watch?v=fPLxFXiS9fU

Module-3	RBT Level L1, L2, L3, L6	8Hrs.

Bayesian and Computational Learning: Introduction, Analyze Bayes theorem, Bayes theorem demonstration and concept learning, ML and LS error hypothesis, ML for predicting probabilities, MDL principle, Naive Bayes classifier, Bayesian belief networks, EM algorithm

Laboratory Sessions/ Experimental learning:

1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Applications: Artificial Neural Network, Virtual Personal Assistant, Online Fraud Detection.

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/105/106105215/

Module-4	RBT Level L1, L2, L3	8Hrs.

Instant Based Learning and Learning set of rules: Demonstrate K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning and Develop Sequential Covering Algorithms.

Reinforcement Learning: Introduction, Evaluate Learning Task, Q Learning

Laboratory Sessions/ Experimental learning:

1. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

Applications: Market segmentation, Document clustering

Video link / Additional online information :

1. http://1.https//nptel.ac.in/courses/11706087/
2. https://nptel.ac.in/courses/106/106/106106198/

Module-5	RBT Level L1, L2, L3, L6	8Hrs.

Analytical Learning: Perfect Domain Theories, Explanation Based Learning, Inductive, Analytical Approaches, FOCL Algorithm.

Real life applications of Machine learning: Develop an algorithm and flowchart for Traffic prediction, Image recognition and Self-driving cars.

Laboratory Sessions/ Experimental learning:

1. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Applications: Regression algorithm, Tower of Hanoi.

Video link / Additional online information:

1. https://nptel.ac.in/courses/117102059/

Course outcomes:	
CO1	Choose the learning techniques and investigate concept learning.
CO2	Identify the characteristics of decision tree and solve problems associated with
CO3	Apply effectively neural networks for appropriate applications.

CO4	Apply Bayesian techniques and derive effectively learning rules
CO5	Evaluate hypothesis and investigate instant based learning and reinforced learning.

Text Books:	
1.	Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.
Reference Books:	
1.	Ethem Alpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2.	T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	-	-	-	2	-	-	1
CO2	3	3	3	2	2	1	-	-	2	-	-	1
CO3	3	3	3	3	3	1	-	-	2	-	-	1
CO4	3	3	3	3	3	1	1	-	2	-	-	1
CO5	3	3	3	3	2	2	2	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	MEDICAL ELECTRONICS	Semester	VI
Course Code	MVJ20EC644	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3: 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Explain physiological parameters such as electrical, non-electrical and the recording methods.
- Learn the methods used for recording and measuring the biological signals
- Illustrate the various Medical Imaging devices used in the hospitals.
- Explain the telemetry systems and know the safety aspects required in medical equipment.
- Understand the various Therapeutic Devices and know about recent trends in medical system.

Module-1	RBT Level L1, L2, L3 & L6	8Hrs.

Prerequisites: *Basics of Transducer*

Fundamentals of Physiology and Transducer:

Types of Bioelectric Potentials: Introduction to different types of bioelectric potentials, Action and resting potentials, Propagation of action potentials.

Biological Systems: Nervous system and its fundamentals, Basic components of a biomedical system, Cardiovascular systems, Respiratory systems

Electrodes and Transducers in Medical systems: Different type of electrodes, sensors used in biomedicine. Physiological signals and transducers, Piezoelectric Transducers, ultrasonic transducers, Temperature measurement, Fibre optic temperature sensors. Selection criteria for transducer and electrodes.

Laboratory Sessions/ Experimental learning:

1. Practical applications of electrodes in medical field.

Applications: Ultrasonic scanning devices, Measures skin and body temperature, Measures Respiratory rate**Video link / Additional online information :**

1. https://nptel.ac.in/courses/102/104/102104043/ 2. https://www.youtube.com/watch?v=QiwxdcckPGc 3. https://www.youtube.com/watch?v=LOjK2wB_qcg&feature=youtu.be 4. https://youtu.be/7TabKYSbdH4			
Module-2	RBT Level L1, L2, L3 & L6	8Hrs.	
Electrical and Non-Electrical Parameter Measurement: **Electro Physiological Measurement**: Biological amplifiers, ECG,EEG, EMG, PCG, typical waveforms and signal characteristics **Non Electrical Parameter Measurement**: Measurement of blood pressure, Ultra sound blood flow meter, Blood flow cardiac output, Heart rate, heart sound, measurement of gas volume, flow rate of CO2 and O2 in exhaust air, pH of blood **Laboratory Sessions/ Experimental learning**: 1. Measure the "PQRST ECG" signal in both normal and abnormal conditions. **Applications**: Psychology and Neuroscience, Brain Computer Interfaces (BCI) **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/108/108108167/ 2. https://www.youtube.com/watch?v=7cvgDIdtw8M 3. https://www.youtube.com/watch?v=mK6sPBbChqc			
Module-3	RBT Level L1, L2, L3 & L6	8Hrs.	
Amplifiers used in Medical Electronics: Amplifiers, preamplifiers, differential amplifiers, chopper amplifiers, Isolation amplifier **Medical Imaging**: X-ray machine, Computer tomography, Magnetic resonance imaging system, Positron emission tomography and endoscopy. **Laboratory Sessions/ Experimental learning**: 1. Graphical results of all Medical Images. **Applications**:Diagnose disease, blood clots, tumours, bone fractures ,inflammation or infection in an organ ,degenerative diseases ,strokes **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=N0Dwh3avx9A 2. https://www.youtube.com/watch?v=5_k6GVMwQ8w			

3. https://www.youtube.com/watch?v=1ftsuzhJ-vk			
Module-4		RBT Level L1, L2, L3	8Hrs.
Telemetry: Introduction to telemetry systems, Different types of biotelemetry systems, Retinal Imaging, Imaging application in Biometric systems. **Safety in Medical Environment:** Electrical safety in medical environment, shock hazards, leakage current, Instruments for checking safety parameters of biomedical equipment **Laboratory Sessions/ Experimental learning:** 1. Practical applications of telemetry in medical systems. **Applications:**In the branch of Ophthalmology **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=0UPoSdBFD48 2. https://www.youtube.com/watch?v=8SPHA_1tTw4			
Module-5		RBT Level L1, L2, L3	8Hrs.
Assisting and Therapeutic Devices: Cardiac pacemakers, Defibrillators, Ventilators, Surgical diathermy, Heart lung machine, Laser in surgery and medicine. **Recent Trends in medical System:** Insulin Pumps, Radio pill, Endo microscopy, Brain machine interface, Lab on a chip, ICCU patient monitoring system, Wearable Antennas. **Robotic Devices:** Nano Robots, Robotic surgery, Orthopedic prostheses fixation. **Laboratory Sessions/ Experimental learning:** 1. Functions of ICCU patient Monitoring Systems. **Applications:** Diagnosis of the gastrointestinal tract. Applications of BCI are neuroergonomics, medical, smart environment, education and self-regulation, games and entertainment, neuro marketing and advertisement **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=SMXBR_YFocs 2. https://www.youtube.com/watch?v=qUD865w2Drw 3. https://www.youtube.com/watch?v=KAvQsRL-jeo			
Course outcomes:			
CO1	Analyse the operation and characteristics of Electronic devices and use of them in applications.		

CO2	Evaluate the performance of electronic circuits.
CO3	Demonstrate the electronic systems and analyse their applicability
CO4	Analyse requirement of electronic devices and systems.
CO5	Design a simple prototype for a certain application.

Text Books:	
1.	R.S. Khandpur, "Hand book of Bio Medical Instrumentation" (2nd edition)- ISBN-13: 9789339205430.
2.	Mandeep Singh, "Introduction to Biomedical Instrumentation", ISBN-13: 9788120350236
Reference Books:	
1.	S.K. Guha, "Principles of Medical Electronics and biomedical Instrumentation" - ISBN-13: 978-8173712579.
2.	J.G.Webster(Wiley India), "Medical instrumentation Application and Design", ISBN-13: 978-0471676003.
3.	Joseph D. Bronzino, "The Biomedical Engineering Handbook", Third Edition, CRC Press-2006.
4.	John D. Enderle and Joseph D. Bronzino, "Introduction to Biomedical Engineering", Third Edition, Elsevier Inc.-2012.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.
iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	1	-	-	1	-	-	1
CO2	3	3	2	2	2	1	-	-	1	-	-	1
CO3	3	3	2	2	3	1	-	-	1	-	-	1
CO4	3	3	2	2	3	1	-	-	1	-	-	2
CO5	3	3	2	2	2	1	-	-	1	-	-	3

High-3, Medium-2, Low-1

Course Title	MICROWAVE & ANTENNA LAB	Semester	VI
Course Code	MVJ20ECL66	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Understand the Mode Characteristics of Reflex Klystron Oscillator.
- Study the Performance and Extract S-parameters of various Microwave components.
- Study the Radiation Pattern and Find the Field Intensity of a given Antenna/ Array.
- Understand Modelling of different planar microstrip patch antennas.

LABORATORY SESSIONS:

PART A: Hardware Experiments

Sl No	Experiment Name	RBT Level	Hours
1.	Measurement of frequency, guide wavelength, power, VSWR and attenuation in Microwave test bench.	L3	3
2.	Measurement of directivity and gain of microstrip Yagi antennas.	L3	3
3.	Determination of Coupling and isolation characteristics of microstrip directional coupler.	L3	2
4.	Determination of Resonance characteristics of microstrip ring resonator and computation of dielectric constant of the substrate.	L3	3
5.	Power division and isolation of microstrip power divider.	L3	2
6.	Study of Circulator. Extraction of S-Parameters.	L3	2

7.	Study of Isolator. Extraction of S-Parameters.	L3	2
8.	Study the I-V characteristics of Gunn diode.	L3	2
PART B: Lab experiments in CST Microwave Studio			
9.	Modelling of different planar microstrip patch antennas (square patch, circular patch, triangular patch etc.). Investigation of parametric requirements for simulation.	L3	2
10.	Simulation of planar microstrip square (or circular, or triangular etc.) patch (or monopole) antenna, and plotting the return loss bandwidth.	L3	3
11.	Simulation of planar microstrip square (or circular, or triangular, or complementary etc.) patch (or monopole) antenna, and investigating the gain and radiation patterns.	L3	3
12.	Design of planar microstrip square (or circular, or triangular etc.) patch (or monopole) antenna, incorporation of fractal design and plotting the return loss bandwidth, investigation of surface current patterns.	L3	3

Course outcomes:	
CO1	Analyse the Mode Characteristics of Reflex Klystron Oscillator.
CO2	Demonstrate the performance and extract S-Parameters of various Microwave Components.
CO3	Plot the Radiation Pattern and find the field Intensity of a given Antenna/ Array.
CO4	Analyse Coupling and isolation characteristics of microstrip directional coupler
CO5	Measure various parameters of planar microstrip patch antennas using CST Microwave Studio

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	-	-	2	-	-	1
CO2	3	3	3	2	-	1	-	-	2	-	-	1
CO3	3	3	3	2	-	1	-	-	2	-	-	1
CO4	3	3	3	2	-	1	-	-	2	-	-	1
CO5	3	3	3	2	-	1	-	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	COMPUTER COMMUNICATION NETWORKS LAB	Semester	VI
Course Code	MVJ20ECL67	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0: 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Model a network and understand the protocols at various OSI reference levels.
- Design a suitable network and simulate using a Network simulator tool.
- Study the networking concepts and protocols using C/C++ programming.
- Analyse the networks for different configurations and observe the results.

LABORATORY SESSIONS:

Sl No	Experiment Name	RBT Level	Hours
Simulation experiments using NetSim or any other equivalent tool			
1	Implement a point to point network with four nodes and duplex links between them. Analyze the network performance by setting the queue size and varying the bandwidth.	L3	3
2	Implement a four node point to point network with links n0-n1, n1-n2 and n2-n3. Apply TCP agent between n1-n2 and UDP between n1-n3. Apply relevant applications over TCP and UDP agents changing the parameter and determine the number of packets sent by TCP/UDP.	L4	3
3	Implement Ethernet LAN using n (6-10) nodes. Compare the throughput by changing the error rate and data rate.	L4	3
4	Implement ESS with transmission nodes in Wireless LAN and obtain the performance parameters.	L3	3
5	Implementation of Link state routing algorithm.	L3	3
Implement the following in C/C++ in Linux platform			
6	Write a program for a HLDC frame to perform the following. i) Bit stuffing ii) Character stuffing.	L3	4

7	Write a program for distance vector algorithm to find suitable path for transmission. For the given data, use CRC-CCITT polynomial to obtain CRC code. Verify the program for the cases. a. Without error, b. With error	L3	4
8	Implementation of Sliding Window Protocol.	L4	3
9	Write a program for congestion control using leaky bucket algorithm.	L4	4

Course outcomes:	
CO1	Implement Netsim tool for learning and practicing of network algorithms.
CO2	Apply the knowledge of C programming for network operation.
CO3	Evaluate the network with different configurations to measure the performance parameters.
CO4	Analyse the data link layer and routing protocols using C programming
CO5	Implement congestion control and avoidance protocol in wired and wireless networks.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	3	-	-	-	2	-	-	1
CO2	3	3	3	2	3	-	-	-	2	-	-	1
CO3	3	3	3	3	3	-	-	-	2	-	-	1
CO4	3	3	3	3	3	-	-	-	2	-	-	1
CO5	3	3	2	2	3	-	-	-	2	-	-	1

High-3, Medium-2, Low-1

B.E, VII Semester, Electronics & Communication Engineering

Course Title	VLSI SYSTEM DESIGN	Semester	VII
Course Code	MVJ20EC71	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to: • Understand the characteristics of CMOS circuit construction. • Introduce the concepts and techniques of modern integrated circuit design and testing (CMOS VLSI). • Design CMOS combinational and sequential logic at the transistor level, with mask layout. • Describe the general steps required for processing of CMOS integrated circuits. • Study functional units including adders, multipliers, ROMs, SRAMs.		
Module-1	RBT Level L1, L2, L3	10Hrs.
Prerequisites: *Basics of transistor* **Introduction to MOS Technology**: Semiconductor materials, enhancement mode MOS transistor, depletion mode MOS transistor, NMOS fabrication, CMOS fabrication, comparison of NMOS, CMOS, BICMOS, GaAs technologies. **Introduction to ASICs** : Field Programmable gate array, Full custom, Semi-custom , ASIC Design flow. **Laboratory Sessions/ Experimental learning:** 1. Design and demonstrate the MOS transistor connected as a diode using any CAD tool. **Applications:** Design of Diode **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=faiEVOOCe-s&t=2519s 2. https://www.youtube.com/watch?v=FRihw0Gpi0Y		

3. https://www.youtube.com/watch?v=oSrUsM0hoPs		
Module-2	RBT Level L1, L2, L3	10Hrs.

Basic Electrical Properties of MOS Circuits: Drain-to-Source current vs. voltage relationships, aspects of MOS transistor threshold voltage, MOS transistor transconductance and output conductance, the pass transistor, the NMOS inverter, determination of pull up to pull down ratio of NMOS transistor driven by another NMOS transistor, alternate forms of pull up, the CMOS inverter, MOS transistor circuit model, latch up in CMOS circuits.

Laboratory Sessions / Experimental learning:

1. Simulation of CMOS Inverter characteristics with different values of Inverter Ratio (Kr) using LTspice / pspice software.

Applications: Design of nMOS and CMOS inverter circuit.

Video link / Additional online information:

1. https://www.youtube.com/watch?v=eqnMAaYU4OY
2. https://www.youtube.com/watch?v=zNqmohJHDwc

Module-3	RBT Level L1, L2, L3, L4	10Hrs.

MOS Circuit Design Process: MOS layers, stick diagrams, design rules and layout, 2ìm, 1.2ìm CMOS rules. Layout diagrams, symbolic diagrams. Basic circuit concepts: Sheet resistance, area capacitance of layers, delay model, wiring capacitances, choice of layers. Scaling of MOS circuits: Scaling models, scaling function for device parameters and limitation of scaling.

Laboratory Sessions/ Experimental learning:

1. Draw layout of inverter using Cadence Tool

Applications: Design of CMOS inverter circuit with different scaling functions.

Video link / Additional online information:

1. https://nptel.ac.in/courses/117106093/
2. https://nptel.ac.in/courses/117106092/
3. https://nptel.ac.in/courses/117101058/

Module-4	RBT Level L1, L2, L3, L4	10Hrs.
Sub System Design and Layout: Architectural issues, switch logic, gate logic, examples of structural design (Combinational logic) and some clocked sequential circuits. Memory register and aspects of system timing, Some commonly used storage/memory elements, Subsystem design process, General arrangement of 4-bit arithmetic processor, regularity, Design of an ALU subsystem. **Laboratory Sessions/ Experimental learning:** 1. Design Manchester Carry-chain using CMOS transistors using any CAD tool **Applications:** Designing of PLA and PLD **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117106093/ 2. https://nptel.ac.in/courses/117106092/ 3. https://nptel.ac.in/courses/117101058/		
Module-5	RBT Level L1, L2, L3, L4	10Hrs.
Test and Testability: System partitioning, layout and testability, reset/ initialization, design for testability, testing combinational logic, testing sequential logic, practical design for test (DFT) guidelines, scan design techniques, built-in-self-test (BIST). CMOS design projects: Incrementer/ Decrementer, comparator for two n-bit numbers. **Laboratory Sessions/ Experimental learning:** 1. Perform a survey on Prime Time CAD tool from any open source software for timing Analysis. **Applications:** Testing of Imperfections in chip fabrication. **Video link / Additional online information:** 1. https://youtu.be/V-GL-oQSa14 (Fault design & Testability) 2. https://youtu.be/P7AQJn7K8Os(Combinational Circuit Test Pattern Generation-ATPG) 3. https://youtu.be/NGoRLtDkPwU (Sequential Circuit Testing and Scan Chains &BIST)		

Course outcomes:

CO1	Demonstrate understanding of MOS transistor theory, CMOS fabrication flow and technology scaling.

CO2	Utilize the knowledge of physical design aspects to draw the basic gates using stick and layout diagrams.
CO3	Demonstrate ability to design Combinational, sequential and dynamic logic circuits as per the requirements.
CO4	Interpret Memory elements along with timing considerations.
CO5	Summarize testing and testability issues in VLSI Design.

Text Books:

1.	Sung Mo Kang & Yosuf Leblebici, "CMOS Digital Integrated Circuits: Analysis and Design" - Third Edition, Tata McGraw-Hill.
2.	Neil H. E. Weste, and David Money Harris, "CMOS VLSI Design- A Circuits and Systems Perspective"- 4th Edition, Pearson Education.
3.	Adel Sedra and K. C. Smith, "Microelectronics Circuits Theory and Applications", 6th or 7th Edition, Oxford University Press, International Version, 2009.

Reference Books:

1.	Douglas A Pucknell & Kamran Eshragian, "Basic VLSI Design", PHI 3rd Edition, (original Edition – 1994).
2.	https://link.springer.com/chapter/10.1007%2F978-981-33-4642-0_2

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	-	1
CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	3	3	2	2	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	IOT & WIRELESS SENSOR NETWORK	Semester	VII
Course Code	MVJ20EC72	CIE	50
Total No. of Contact Hours	50	SEE	50
No. of Contact Hours/week	4 (L : T : P :: 3 : 2 : 0)	Total	100
Credits	4	Exam. Duration	3Hrs

Course objective is to:

- Provide knowledge about IoT and M2M architecture.
- Understand various layers of IoT and their functionality.
- Describe Cloud computing and design principles of IoT
- Understand the architecture and design principles of WSNs.
- Provide knowledge about MAC and routing protocols in WSN

Module-1	RBT Level L1, L2, L3	10Hrs.

Prerequisites: *Knowledge on Computer Networks*

Introduction to IoT: Genesis, Digitization, Impact- Connected Roadways, Buildings, IoT Challenges, Network Architecture and Design, Drivers Behind New Network Architectures, Security, Constrained Devices and Networks Comparing IoT Architectures, M2M architecture, IoT world forum standard, IoT Reference Model, Simplified IoT Architecture.

Laboratory Sessions/ Experimental learning:

1. Comparative study of Oracle, IBM and Cisco Architectures of IoT

Applications: Smart Cities, Home Automation System

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/105/106105166/
2. https://www.analyticsvidhya.com/blog/2016/08/10-youtube-videos-explaining-the-real-world-applications-of-internet-of-things-iot/

Module-2	RBT Level L1, L2, L3	10Hrs.

IoT Layers and functionality : IoT Network Architecture and Design Core IoT Functional Stack, Layer1(Sensors and Actuators) , Layer 2(Communications Sublayer), Access

network sublayer, Gateways and backhaul sublayer, Network transport sublayer, IoT Network management. Layer 3(Applications and Analytics), Analytics vs Control, Data vs Network Analytics IoT Data Management and Compute Stack. **Laboratory Sessions/ Experimental learning:** 1. Implement an IoT architecture to design an application of your own. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/108/108108147/ 2. https://onlinecourses.nptel.ac.in/noc20_cs69/unit?unit=17&lesson=18		
Module-3	RBT Level L1, L2, L3 & L6	10Hrs.
Data Collection, Storage and Computing using a Cloud Platform: Introduction, Cloud computing paradigm for data collection, storage and computing, Cloud service models, IoT Cloud - based data collection, storage and computing services using Nimbits, The Hierarchy of Edge, Fog, and Cloud. **Prototyping and Designing Software for IoT Applications:** Introduction, Prototyping Embedded device software, Programming Embedded Device, Arduino Platform using IDE, Reading data from sensors and devices, Devices, Gateways, Internet and Web/Cloud services software development. **Laboratory Sessions/ Experimental learning:** 1. Weather monitoring using Blynk/ThingSpeak through cloud 2. Design a people counter using Node MCU 3. Christmas light show with Arduino **Applications:** Google Cloud, SAAS, PAAS, Sensor applications **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105167/ 2. https://onlinecourses.swayam2.ac.in/aic20_sp04/preview		
Module-4	RBT Level L1, L2, L3,L4	10Hrs.
Overview of Wireless Sensor Networks: Challenges for Wireless Sensor Networks, Enabling Technologies for Wireless Sensor Networks. **Architectures:** Single-Node Architecture, Hardware Components, Energy Consumption of Sensor Nodes, Operating Systems and Execution Environments, Network Architecture,		

Sensor Network Scenarios, Optimization Goals and Figures of Merit, Design principles for WSNs, Service interfaces of WSNs Gateway Concepts. **Laboratory Sessions/ Experimental learning:** 1. Do a case study on total energy conservation opportunities in Solar Power **Applications:** Health care monitoring, Area monitoring, Industrial monitoring, Threat detection. **Video link / Additional online information :** 1. https://nptel.ac.in/courses/106/105/106105166/ 2. https://nptel.ac.in/courses/106/105/106105160/			
Module-5		RBT Level L1, L2, L3,L4	10Hrs.
Communication Protocols: Physical Layer and Transceiver Design Considerations, MAC Protocols for Wireless Sensor Networks, Low Duty Cycle Protocols and Wakeup Concepts - S-MAC , The Mediation Device Protocol, Wakeup Radio Concepts, Contention based protocols(CSMA,PAMAS), Schedule based protocols (LEACH) Address and Name Management in WSNs, Assignment of MAC Addresses, Routing Protocols- Energy-Efficient Routing, Geographic Routing, Hierarchical networks by clustering. **Laboratory Sessions/ Experimental learning:** 1. Design an energy efficient system for a WSN using the routing protocols using NetSim or NS2 **Applications:** Environmental/Earth sensing, Air pollution monitoring, Forest fire detection, Landslide detection, Water quality monitoring **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105160/ 2. https://nptel.ac.in/courses/106/105/106105195/			
Course outcomes: After studying this course, students will be able to:			
CO1	Analyze different IOT Architecture and select them for a particular application.		
CO2	Evaluate the sensor data generated and map it to IOT protocol stack.		
CO3	Implement and execute programs using development tools.		
CO4	Develop an energy efficient system for WSN.		
CO5	Create a real life application involving Wireless Sensor Networks using IoT concepts.		

Text Books:	
1.	Cisco, IOT Fundamentals – Networking Technologies, Protocols, Use Cases for IOT, Pearson Education; First edition (16 August 2017). ISBN-10: 9386873745, ISBN-13: 978-9386873743
2.	Raj Kamal,"Internet of Things-Architecture and design principles", McGraw Hill Education.
3.	Holger Karl & Andreas Willig, "Protocols And Architectures for Wireless Sensor Networks" , John Wiley, 2005.
Reference Books:	
1.	Kazem Sohraby, Daniel Minoli, & Taieb Znati, "Wireless Sensor NetworksTechnology, Protocols, And Applications", John Wiley, 2007.
2.	Anna Hac, "Wireless Sensor Network Designs", John Wiley, 2003.
3.	Arshdeep Bahga and Vijay Madisetti, 'Internet of Things – A Hands on Approach', Orient Blackswan Private Limited - New Delhi; First edition (2015), ISBN-10: 8173719543, ISBN-13: 978-8173719547

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	2	-	-	2	-	-	1
CO2	3	3	3	2	2	2	-	-	2	-	-	1
CO3	3	3	3	3	2	2	-	-	2	-	-	1
CO4	3	3	3	3	2	2	-	-	2	-	-	1
CO5	3	3	3	3	2	2	-	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	OPTICAL COMMUNICATION	Semester	VII
Course Code	MVJ20EC731	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Learn the basic principles of optical fiber communication with different modes of light propagation.
- Study of optical sources, detectors and receivers.
- Understand the transmission characteristics and losses in optical fiber and study optical components.
- Know the concept of WDM and system design.
- Learn the network standards in optical fiber and understand the network architectures along with its functionalities.

Module-1	RBT Level L1, L2	8Hrs.

Optical fiber Communications: Historical development, General system, Advantages of optical fiber communication, Optical fiber wave guides: Ray theory transmission, Modes in planar guide, Phase and group velocity, Cylindrical fiber: Modes, Step index fibers, Graded index fibers, Single mode fibers, Cutoff wavelength, Mode field diameter, effective refractive index, Fiber Materials, Photonic crystal fibers.

Laboratory Sessions/ Experimental learning:

1. Measurement of numerical aperture of an optical fiber.

Applications: Networking, Telecommunication

Video link / Additional online information :

1. https://youtu.be/9seDKvbaoHU
2. https://youtu.be/BGUhTDWkwx8

Module-2	RBT Level L1, L2,L3	8Hrs.

Pre-requisite: Knowledge of Semiconductor Devices

Optical sources: Light Emitting diodes: LED Structures, Light Source Materials, Quantum Efficiency and LED Power, Modulation. Laser Diodes: Modes and Threshold conditions, Rate equation, External Quantum Efficiency, Resonant Frequencies.

Photo detectors: Physical principles of Photodiodes, Photo detector noise, Detector response time.

Optical Receiver: Optical Receiver Operation: Error sources, Front End Amplifiers, Receiver sensitivity, Quantum Limit.

Applications: Optical memories, OMEMS, Basic Principle Holography,Principle Of Hologram Recording

Laboratory Sessions/ Experimental learning:

1. To Investigate the Transmission (Intermodal dispersion) Characteristics of Multi-mode Optical Fiber.

Applications: Networking, Telecommunication, Military and Space Applications

Video link / Additional online information :

1. https://youtu.be/15WulWvjWEg

Module-3	RBT Level L1, L2, L3	8Hrs.

Transmission characteristics of optical fiber: Attenuation, Material absorption losses, Linear scattering losses, Nonlinear scattering losses, Fiber bend loss, Dispersion, Chromatic dispersion, Intermodal dispersion: Multimode step index fiber.

Optical Fiber Connectors: Fiber Splicing, Splicing Techniques, Splicing Single-Mode Fibers, Optical Fiber Connectors, Connector Types, Single-Mode Fiber Connectors, Connector Return Loss.

Optical amplifiers: Basic application and Types, Semiconductor optical amplifiers, Erbium Doped Fiber Amplifiers, Raman Amplifiers, Wideband Optical Amplifiers.

Laboratory Sessions/ Experimental learning:

1. Measurement of propagation loss, bending loss of an optical fiber.

Applications: Networking, Telecommunication ,Automotive Industry

Video link / Additional online information:

1. https://youtu.be/BGUhTDWkwx8

Module-4	RBT Level L1, L2	8Hrs.

WDM Concepts and Components: Overview of WDM: Operational Principles of WDM,WDM standards, Passive Optical couplers ,Mach-Zehnder Interferometer Multiplexers, Isolators and Circulators, Fiber grating filters, Dielectric Thin-Film Filters, Diffraction Gratings.

Optical System Design: Point-to- Point Links, System Considerations, Link Power Budget, Rise Time Budget .Short-Wavelength Band, Attenuation-Limited Distances for Single-Mode Links.

Laboratory Sessions/ Experimental learning:

1. Determine the wavelength of light from a monochromatic source using Interferometer and calculate the refractive index of a thin film.

Applications: Networking, Telecommunication

Video link / Additional online information:

1. https://youtu.be/t8a25L58-m8
2. https://vlab.amrita.edu/index.php?sub=1&brch=189

Module-5	RBT Level L1, L2	8Hrs.

Optical Networks: Optical network evolution and concepts: Optical networking terminology, Optical network node and switching elements, Wavelength division multiplexed networks, Public telecommunication network overview. Optical network transmission modes, layers and protocols: Synchronous networks, Asynchronous transfer mode, OSI reference model, Optical transport network, Internet protocol, Wavelength routing networks: Routing and wavelength assignment, Optical switching networks: Optical circuit switched networks, packet switched networks, Multiprotocol Label Switching, Optical burst switching networks.

Laboratory Sessions/ Experimental learning:

1. Analog and Digital (with TDM) communication link using optical fiber.

Applications: Networking, Telecommunication

Video link / Additional online information:

1. http://ofcvlab.vesit.ves.ac.in/page2/honeycomb.html

2.	https://www.youtube.com/embed/f5EmFoXlYyQ

Course outcomes:	
CO1	Classify and working of optical fiber with different modes of signal propagation.
CO2	Analyze the characteristics of optical sources and detectors.
CO3	Describe the transmission characteristics and losses in optical fiber communication and identify various amplifiers..
CO4	Understand the concept of WDM and analyse the various aspects of system design.
CO5	Illustrate the networking aspects of optical fiber and describe various standards associated with it.

Text Books:	
1.	Gerd Keiser , Optical Fiber Communication, 5th Edition, McGraw Hill Education(India) Private Limited, 2015. ISBN:1-25-900687-5.
2.	John M Senior, Optical Fiber Communications, Principles and Practice, 3rd Edition, Pearson Education, 2010, ISBN:978-81-317-3266-3
Reference Books:	
1.	Joseph C Palais, Fiber Optic Communication , Pearson Education, 2005, ISBN:0130085103
2.	Ramaswami, Sivarajan and Sasaki "Optical Networks", Morgan Kaufmann, 2009.
3.	Ed Robert Kelsall, Ian Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley, 2007.
4.	John F. Read, 'Industrial Applications of Lasers', Academic Press, 1978.

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- Activities/Experimentations related to courses (8 Marks)
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CO-PO Mapping												
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CO1	3	3	3	1	-	1	-	-	-	-	-	1
CO2	3	3	3	1	-	1	-	-	-	-	-	1
CO3	3	3	3	1	-	1	-	-	-	-	-	1
CO4	3	3	3	1	-	1	-	-	-	-	-	1
CO5	3	3	3	1	-	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	WIRELESS & CELLULAR COMMUNICATION	Semester	VII
Course Code	MVJ20EC732	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand mobile radio communication principles and to study the recent trends adopted in cellular systems and wireless standards.
- Familiarize students to radio signal propagation mechanisms and to the characteristics of mobile radio channels, which both are needed in the designing of modern wireless communication systems and networks.
- Study the concepts of cellular communication system, architecture, functioning, various standards
- Learn the concepts of signal propagation in cellular environment
- Study the different multiple access techniques for Wireless Communication

Module-1	RBT Level L1, L2, L3	8Hrs.

Introduction to Cellular Mobile Systems: The Cellular concept, System design, Capacity improvement in cellular systems, Co-channel interference reduction. Intelligent cell concept and applications, technical Challenges.

Laboratory Sessions/ Experimental learning:

1. Understand how pulse shaping is realized using MATLAB® functions

Applications:

- Transmission of music, news, road conditions, weather reports, and other broadcast information are received via digital audio broadcasting (DAB) with 1.5Mbit/s.
- A universal mobile telecommunications system (UMTS) phone might be available offering voice and data connectivity with 384kbit/s.

Video link / Additional online information:

1. https://www.coursera.org/lecture/wireless-communications/1-1-cellular-communication-KpitQ

<table>
<tr><td colspan="3">2. https://nptel.ac.in/courses/117/102/117102062/</td></tr>
<tr><td>Module-2</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Mobile radio propagation: Reflection, Diffraction, Fading, Multipath Propagation, Channel modeling, Diversity Schemes and Combining Techniques. The cellular fundamentals: cellular communication and frequency reuse, general architecture of a cellular system, channel assignment strategies, hand-off in a cellular system. Interference and cellular system capacity: co-channel interference and adjacent channel interference, power control.
Laboratory Sessions/ Experimental learning:
1. Compute the power of the noise and the original signal. Find signal to noise ratio (SNR), compare it with the desired value and see if they are the same using MATLAB
Applications:
• International broadcasting, long distance aircraft and ship communication, citizen band (CB) radios. Diffraction and reflection give rise to propagation beyond the horizon. Propagation at large distance, propagates well within buildings.
Video link / Additional online information:
1. https://freevideolectures.com/course/2329/wireless-communication/14
2. https://nptel.ac.in/courses/108/108/108108148/</td></tr>
<tr><td>Module-3</td><td>RBT Level
L1, L2, L3</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Signal propagation in mobile communication: Design parameters at the base station, Practical link budget design using path loss models. propagation path loss, outdoor propagation models (Okumura model & Hata model), indoor propagation models, power delay profile, channel parameters (delay spread, doppler spread, coherence bandwidth, coherence time, Smart antenna systems, Beam forming. MIMO Systems. RAKE receiver.
Laboratory Sessions/ Experimental learning:
1. Performance of Baseband QAM/QPSK Under AWGN Channel
Applications:
• Antennas mounted on these structures pump out wireless communications signals to devices in the field via electromagnetic waves.</td></tr>
</table>

• Wireless signal propagation is the movement of these radio waves (which move at the speed of light) to and from these sites and devices. **Video link / Additional online information:** 1. https://freevideolectures.com/course/2329/wireless-communication 2. https://web.stanford.edu/class/ee359/lectures.html 3. https://nptel.ac.in/courses/117/105/117105084/		
Module-4	RBT Level L1, L2, L3	8Hrs.
Multiuser Systems: CDMA- Principle, Network design, Link capacity, Power control, WCDMA-Network planning, MC-CDMA, OFDM, Cellular mobile communication beyond 3G. Wireless Personal Area Networks (Bluetooth, UWB and ZigBee), Wireless Local Area Networks (IEEE 802.11, network architecture, medium access methods, WLAN standards), Wireless Metropolitan Area Networks (WiMAX), Ad-hoc Wireless Networks. **Laboratory Sessions/ Experimental learning:** 1. Develop a detector and calculate BER with MATLAB Simulation **Applications**: Radio and TV Broad casting **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/104/108104157/ 2. https://nptel.ac.in/courses/106/105/106105173/ 3. https://nptel.ac.in/courses/111/102/111102130/		
Module-5	RBT Level L1, L2, L3	8Hrs.
5G Radio Access Technologies: Access Design Principles for Multi-user Communications – Multi-carrier with Filtering – Non orthogonal Schemes for Efficient Multiple Access – Radio Access for Dense Deployments – Radio Access for V2X Communication – Radio Access for Massive Machine-type Communication. **Laboratory Sessions/ Experimental learning:** 1. Implementation of channel estimation for multipath environment **Applications**: Television remote control, Wi-Fi, Cell phones, wireless power transfer, computer interface devices **Video link / Additional online information:**		

1. https://www.technologyreview.com/collection/wireless-technology-innovations-lead-the-way-to-a-smartly-connected-future/ 2. https://in.mathworks.com/videos/5g-new-radio-fundamentals-understanding-the-next-generation-of-wireless-technology-1561301737915.html 3. https://nptel.ac.in/courses/117/104/117104099/

Course outcomes:	
CO1	Discuss the cellular system design and technical challenges.
CO2	Analyze the Mobile radio propagation, fading, diversity concepts and the channel modelling.
CO3	Evaluate design parameters involved in the base station.
CO4	Discriminate Multiuser Systems, CDMA, WCDMA network planning and OFDM Concepts.
CO5	Describe the concepts of 5G Radio Access Technologies

Text Books:	
1.	T.S Rapaport, "Wireless Communications" 2 nd edition, Pearson Education, Noida, India.
2.	A.F.Molisch, Wireless Communications, Wiley, 2005.
Reference Books:	
1.	A.Goldsmith, Wireless Communications, Cambridge University Press, 2005.
2.	Andrea Goldsmith, "Wireless Communications", Cambridge University Press, 2005.
3.	Jonathan Rodriquez, "Fundamentals of 5G Mobile Networks", Wiley, 2015

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)

SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	-	-	-	1
CO2	3	3	3	2	2	1	-	-	-	-	-	1
CO3	3	3	3	2	2	1	-	-	-	-	-	1
CO4	3	3	3	2	2	1	-	-	-	-	-	1
CO5	3	3	3	2	2	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	ROBOTICS & AUTOMATION	Semester	VII
Course Code	MVJ20EC733	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Study the history, concept development and key components of robotics technologies.
- Know the concept of interfacing actuators and other components
- Understand basic mathematics manipulations of spatial coordinate representation and transformation.
- Learn basic robot forward and inverse kinematic problems
- Analyze basic robotic dynamics, path planning and control problems

Module-1	RBT Level L1, L2, L3 ,L4	8Hrs.

Basic concepts in robotics: Definition, anatomy of robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics, Industrial Applications of Robots. Drives for robots: Electric, hydraulic and pneumatic. Sensors: Internal-External, Contact-noncontact, position, velocity, force, torque, proximity and range.

Laboratory Sessions/ Experimental learning:

1. Interface various sensors with Microcontroller.

Applications: Machine Tending,Picking, Packing and Palletizing, painting, all Industrial applications

Video link / Additional online information:

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/

<table>
<tr><td>Module-2</td><td>RBT Level
L1, L2, L3 , L4</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Robot drivers, Sensors and Vision: Introduction to techniques, Image acquisition and processing, Different types of grippers- Mechanical, Magnetics ,vacuum, Adhesive, Gripper force Analysis and Gripper Design , overview of actuators, Power and torque, Acceleration and velocity Specifications and characteristics of Stepper motors, AC motors, DC motors and servomotors.
Laboratory Sessions/ Experimental learning:
1. Interface motors using various Motor drivers.
Applications:Industrial application, agriculture robots, surgical robots
Video link / Additional online information:
1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/</td></tr>
<tr><td>Module-3</td><td>RBT Level
L1, L2, L3 ,L4</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Robot Kinematics and Dynamics: Direct and inverse kinematics for industrial robots for position and orientation, Redundancy, Manipulator, direct and inverse velocity.Link inertia tensor and manipulator inertia tensor, Newton –Eller formulation for RP and RP manipulators, Trajectory planning.
Laboratory Sessions/ Experimental learning:
1. Interface servo motors to form gripper.
Applications: Pick and Place, Excavators, Robotic ARM.
Video link / Additional online information:
1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/</td></tr>
<tr><td>Module-4</td><td>RBT Level
L1, L2, L3 ,L4</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Robot Kinematics: Dynamics and Programming methods, Robot language classification, Robot language structure, Kinematics and Path Planning: Solution of inverse kinematics problem, multiple solution jacobian work envelop, hill climbing techniques, robot programming languages elements and its functions. Simple programs on Sensing distance and direction, Line Following Algorithms, Feedback Systems.</td></tr>
</table>

Laboratory Sessions/ Experimental learning: 1. Design algorithm for Maze solving robot. **Applications:** Defence, Surveillance, Autonomous Vehicle. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/

Module-5	RBT Level L1, L2, L3 , L4	8Hrs.
Design and Applications: Developing and building a robot, Models of flexible links and joints, Robotic arm – Components and structure, Types of joints and workspace, Design models for mechanic arms and lifting systems Mutiple robots, machine interface, robots in manufacturing and non- manufacturing applications, robot cell design, selection of robot. Laboratory Sessions/ Experimental learning: 1. Case Study on Robots in material handling and assembly. Human Robot Interaction **Applications:** Humanoid, Robotic Arms. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/		

Course outcomes:	
CO1	Analyze the concept development and key components of robotics technologies
CO2	Select the components for interfacing actuators
CO3	Implement basic mathematics manipulations of spatial coordinate representation and Transformation.
CO4	Solve basic robot forward and inverse kinematic problems
CO5	Design robots which are capable to solve basic robotic dynamics, path planning and control problems
Text Books:	
1.	Introduction to Robotics By S.K.Saha , Tata McGraw Hill

2.	Robotics Control ,Sensing ,Vision and Intelligence by K.S. Fu, R.C .Gonzalez, C.S.G.Lee , Tata McGraw HillJ. Hirchhorn: Kinematics and Dynamics of Machinery, McGraw Hill book co.
Reference Books:	
1.	Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india.
2.	Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata McGraw Hill
3.	Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari

CIE Assessment:

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- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
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CO3	3	3	3	2	1	1	-	-	1	-	-	1
CO4	3	3	3	2	1	1	-	-	1	-	-	1
CO5	3	3	3	2	1	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	SYSTEM ON CHIP ARCHITECTURE	Semester	VII
Course Code	MVJ20EC734	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand the needs of SoC architecture & design.
- Analyze various elements in SoC design.
- Study the overview of SoC memory system.
- Outline the reconfiguration mechanism of SoC.
- Learn the algorithms used in SoC system design

Module-1	RBT Level L1, L2	8Hrs.

Prerequisites: *Moore's law, Basics of embedded system and embedded C programming, Motivation for SoC.*

Introduction to the System Approach: Need for SoC, System Architecture, and Components of the system, Hardware & Software, Processor Architectures, Memory and Addressing, System level interconnection, an approach for SoC Design, System Architecture and Complexity.

Laboratory Sessions/Experimental learning:

1. Case study on Comparison on System-on-Board, System-on-Chip and System-in-Package.

Applications: Embedded System, mobile device.

Video link / Additional online information:

1. http://www.nptelvideos.com/lecture.php?id=7838
2. https://www.youtube.com/watch?v=PRQXzjTrCJY

Module-2	RBT Level L1, L2, L3	8Hrs.

Processors: Introduction, Processor Selection for SoC, Basic concepts in Processor Architecture, Basic concepts in Processor Micro Architecture, Basic elements in Instruction handling.

Buffers: Minimizing Pipeline Delays, Branches, More Robust Processors, Vector Processors and Vector Instructions extensions, VLIW Processors, Superscalar Processors.

Laboratory Sessions/Experimental learning :

1. Design a model to generate a square wave using suitable programming language with appropriate delay.
2. Design a model for generating a Interrupt using different addressing modes by selecting suitable programming language.

Applications : Supercomputers

Video link / Additional online information:

1. https://youtu.be/4VRtujwa_b8
2. https://nptel.ac.in/courses/124107010/

Module-3	RBT Level L1, L2, L3	8Hrs.

Memory Design for SoC: Overview of SoC external memory, Internal Memory, Size, Scratchpads and Cache memory, Cache Organization, Cache data, Write Policies, Strategies for line replacement at miss time, Types of Cache, Split – I, and D – Caches, Multilevel Caches, Virtual to real translation , SoC Memory System, Models of Simple Processor, memory interaction.

Laboratory Sessions/Experimental learning :

1. Case study on on-chip peripherals of MSP430

Applications: Cloud, Data-centres.

Video link / Additional online information:

1. https://youtu.be/cjNORC_00_A
2 https://www.youtube.com/watch?v=A_bWZLIs0Tw

Module-4	RBT Level L1, L2, L3	8Hrs.

Interconnect: Inter Connect Architectures, Bus: Basic Architectures, SoC Standard Buses, Analytic Bus Models, Using the Bus model, Effects of Bus transactions and contention time. SoC Customization: An overview, Customizing Instruction Processor, Reconfiguration Technologies, Mapping design onto Reconfigurable devices, Instance Specific design, Customizable Soft Processor.

Laboratory Sessions/Experimental learning :

1 Design a model to save and store data in SD card with MSP430 microcontroller.

Applications : Data-Centre interconnects, PC peripherals

Video link / Additional online information:

1 https://youtu.be/PvZ5GXR9Ri8

Module-5	RBT Level L1, L2, L3	8Hrs.

Application Studies / Case Studies: SoC Design approach, AES algorithms, Design and evaluation, Image compression – JPEG compression.

Laboratory Sessions/Experimental learning :

1. Implement an algorithm for JPEG compression using MATLAB.

Applications: Wireless security, processor security, encryption

Video link / Additional online information:

1. https://nptel.ac.in/courses/105104183/

Course outcomes:	
CO1	Interpret the need of SoC system design.
CO2	Outline the SoC Architecture design and basic concepts of processor.
CO3	Design memory organization in SoC system .
CO4	Utilize the reconfiguration mechanism of SoC in reconfigurable devices.
CO5	Apply various algorithm for SoC system design.

Text Books:	
1.	Michael J. Flynn and Wayne Luk, "Computer System Design System-on-Chip", Wiley India Pvt.Ltd.

2.	Ricardo Reis, "Design of System on a Chip: Devices and Components", 1st Edition, 2004, Springer
Reference Books:	
1.	Prakash Rashinkar, Peter Paterson and Leena Singh L, "System on Chip Verification n – Methodologies and Techniques", 2001, Kluwer Academic Publishers
2.	Web Source: What is a System on Chip (SoC)? - AnySilicon

CIE Assessment:

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- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	1	-	-	-	-	-	1
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CO3	3	3	3	2	1	1	-	-	-	-	-	1
CO4	3	3	3	2	1	1	-	-	-	-	-	1
CO5	3	3	3	2	1	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	AUTOMOTIVE EMBEDDED SYSTEMS	Semester	VII
Course Code	MVJ20EC741	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Expose the students to the fundamentals and building of Electronic Engine Control systems.
- Teach on functional components and circuits for vehicles.
- Discuss on programmable controllers for vehicle management systems.
- Teach logics of automation & commercial techniques for vehicle communication.
- Introduce the embedded systems concepts for E-vehicle system development.

Module-1	RBT Level L1,L2,L3,L4	8Hrs.

BASIC OF ELECTRONIC ENGINE CONTROL SYSTEMS: Overview of Automotive systems, fuel economy, air-fuel ratio, emission limits and vehicle performance; Automotive microcontrollers- Electronic control Unit- Hardware & software selection and requirements for Automotive applications – open source ECU- RTOS - Concept for Engine management-Standards; Introduction to AUTOSAR and Introduction to Society SAE- Functional safety ISO 26262- Simulation and modeling of automotive system components.

Laboratory Sessions/Experimental Learning:

1. Display and analyze the basic components of automotive system.

Applications: Vehicle Control , Power Train

Video link/ Additional online information:

1. https://www.youtube.com/watch?v=AZAvaZF1TcE

Module-2	RBT Level L1,L2,L3,L4	8Hrs.

SENSORS AND ACTUATORS FOR AUTOMOTIVE: Review of sensors- sensors interface to the ECU, conventional sensors and actuators, Modern sensor and actuators - LIDAR

sensor- smart sensors- MEMS/NEMS sensors and actuators for automotive applications. **Laboratory Sessions/Experimental Learning:** . 1. Interfacing Sensors like RTD, LVDT, Load Cell etc **Applications:** Electric Vehicle **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=Y18LabELpx4		
Module-3	RBT Level L1,L2,L3,L4	8Hrs.
VEHICLE MANAGEMENT SYSTEMS: Electronic Engine Control-engine mapping, air/fuel ratio spark timing control strategy, fuel control, electronic ignition- Adaptive cruise control - speed control-anti-locking braking system-electronic suspension - electronic steering , Automatic wiper control- body control system ; Vehicle system schematic for interfacing with EMS, ECU. Energy Management system for electric vehicles- Battery management system, power management system-electrically assisted power steering system- Adaptive lighting system- Safety and Collision Avoidance. **Laboratory Sessions/Experimental Learning:** 1. To Control the speed of the motor using Electronics Controller. 2. To Change the direction of the Steering through Electronic Management Systems. **Applications:** Automotive Industry, Real time tracking & Control **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=1LwNV10XTtQ		
Module-4	RBT Level L1,L2,L3,L4	8Hrs.
ONBOARD DIAGONSTICS AND TELEMATICS: On board diagnosis of vehicles -System diagnostic standards and regulation requirements Vehicle communication protocols Bluetooth, CAN, LIN, FLEXRAY, MOST, KWP2000 and recent trends in vehicle communications- Navigation- Connected Cars technology – Tracking- Security for data communication- dashboard display and Virtual Instrumentation, multimedia electronics- Role of IOT in Automotive systems. **Laboratory Sessions/Experimental Learning:** 1. Case study on CAN BUS protocol in automobile industry		

Applications: Vehicle –Vehicle Communication **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=LZQB9In4_0Y			
Module-5		**RBT Level** **L1,L2,L3,L4**	**8Hrs.**
ELECTRIC VEHICLES: Electric vehicles –Components- Plug in Electrical vehicle-Charging station – Aggregators- Fuel cells/Solar powered vehicles- Autonomous vehicles. **Laboratory Sessions/Experimental Learning:** 1. Case studies on Autonomous Cars. **Applications:** Autonomous vehicles **Video link/ Additional online information:** 1. https://www.youtube.com/watch?v=wypbLRe9xUg			

Course outcomes:	
CO1	Know the significance of the role of embedded system for automotive applications.
CO2	Understand the need, selection of sensors and actuators and interfacing with ECU
CO3	Applying the Embedded concepts for vehicle management and control systems.
CO4	Understand various Vehicle Communication Protocols and role of IoT in
CO5	Understand the need of Electrical vehicle and able to apply the embedded system technology for various aspects of EVs.

Text Books:	
1.	William B. Ribbens ,"Understanding Automotive Electronics", Elseiver,2012
2.	Ali Emedi, Mehrded ehsani, John M Miller , "Vehicular Electric power system- land, Sea, Air and Space Vehicles" Marcel Decker, 2004..
Reference Books:	

1.	L.Vlacic , M .Parent , F.Harahima, "Intelligent Vehicl Technologies", SAE International, 2001.
2.	Jack Erjavec,Jeff Arias,"Alternate Fuel Technology-Electric ,Hybrid& Fuel Cell Vehicles",Cengage ,2012
3.	Electronic Engine Control technology – Ronald K Jurgen Chilton's guide to Fuel Injection – Ford.
4.	Automotive Electricals / Electronics System and Components, Tom Denton, 3 rd Edition, 2004.
5.	Uwe Kiencke, Lars Nielsen, "Automotive Control Systems: For Engine, Driveline, and Vehicle", Springer; 1 edition, March 30, 2000 .
6.	Automotive Electricals Electronics System and Components, Robert Bosch Gmbh, 4 th Edition, 2004.
7.	Automotive Hand Book, Robert Bosch, Bently Publishers, 1997.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

iv. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

v. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

vi. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2		1	-	-	-	-	-	-	-
CO2	3	3	2	1	1	-	-	-	-	-	-	-
CO3	3	2	2	1	1	-	-	-	-	-	-	-
CO4	3	3	2		-	-	-	-	-	-	-	-
CO5	3	3	2		-	1	-	1	1	-	-	-

High-3, Medium-2, Low-1

Course Title	SATELLITE & RADAR COMMUNICATION	Semester	VII
Course Code	MVJ20EC742	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Provide a conceptual knowledge of communication through satellites.
- Study the concept of navigation - both inertial and by navigation satellites.
- Understand typical challenges of satellite-based systems.
- Learn the basic principle of radar equation.
- Motivate to learn modern radar and navigational techniques.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Digital Communication Systems

Introduction to Satellite Communication: Orbital aspects of Satellite Communication: Introduction to geo-synchronous and geo-stationary satellites, Kepler's laws, Locating the satellite with respect to the earth, Sub-satellite point, Look angles, Mechanics of launching a synchronous satellite.

Laboratory Sessions/ Experimental learning:

1. To study the details regarding satellite communication toolbox in Matlab.

Applications: DTH, or satellite television, services (such as the DirecTV and DISH Network services

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105131/#
2. https://youtu.be/n70zjMvm8L0
3. https://youtu.be/oYRMYSIVj1o

Module-2	RBT Level L1, L2, L3	8Hrs.

Satellite sub-systems: Attitude and Orbit control systems, Telemetry, Tracking and command control system, Power supply system, Space craft antennas, Multiple access

techniques, comparison of FDMA, TDMA, and CDMA. Earth station equipment, tracking systems. **Satellite Link Design**: Basic transmission theory, System noise temperature and G/T Ratio, Noise figure and noise temperature, Calculation of system noise temperature, G/T ratio for earth stations, Link budgets - Uplink and downlink budget calculations, Error control for digital satellite links, Prediction of rain attenuation and propagation impairment counter measures. **Laboratory Sessions/ Experimental learning:** 1. Study and analyze the parameters of RF-link satellite simulation using Matlab **Applications:** Mobile Communication, Error detection and correction **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://www.youtube.com/watch?v=FTHt-c8hWKw			
Module-3		RBT Level L1, L2, L3	8Hrs.
Communication Satellites: Introduction, Related Applications, Frequency Bands, Payloads, Satellite Vs. Terrestrial Networks, Satellite Telephony, Satellite Television, Satellite radio, Regional satellite Systems, National Satellite Systems. **Remote Sensing Satellites:** Classification of remote sensing systems, orbits, Payloads, Types of images: Classification, Interpretation, Applications. **Weather Forecasting Satellites:** Fundamentals: Images, Orbits, Payloads, And Applications. **Navigation Satellites**: Development of Satellite Navigation Systems, GPS system, Applications. **Laboratory Sessions/ Experimental learning:** 1. A Case Study of Using Remote Sensing Data and GIS for Land Management **Applications**: Communication, Weather forecasting, Remote sensing, Navigation **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105131/# 2. https://nptel.ac.in/courses/121/107/121107009/ 3. https://onlinecourses.nptel.ac.in/noc19_ce45/preview			

Module-4	RBT Level L1, L2, L3	8Hrs.
Introduction to Radar: Radar block diagram and operation, Radar frequencies, Applications of radar, Prediction of range performance, Minimum detectable signal, Receiver noise, Probability density function, SNR, Integration of radar pulses, Radar cross-section of targets, PRF and range ambiguities, Transmitter power, System losses. **Electronically steered Phased Array Antenna in Radar:** Phase shifters, Frequency scan arrays, Array elements, Feeds for arrays, Computer Control of Phased-Array Radar. **Laboratory Sessions/ Experimental learning:** 1. Implement the radar range equations for remote sensing. **Applications:** Ground surveillance, missile control, fire control, air traffic control (ATC), moving target indication (MTI). **Video link / Additional online information:** 1. https://onlinecourses.nptel.ac.in/noc19_ee58/preview 2. https://nptel.ac.in/courses/108/105/108105154/		
Module-5	RBT Level L1, L2, L3	8Hrs.
Radar Technology and Applications: Doppler Effect, CW radar, FM CW radar, Multiple frequency CW radar, MTI radar, Delay line canceller, Range gated MTI radar, Blind speeds, Staggered PRF, Limitations to the performance of MTI radar, Non-coherent MTI radar. Tracking radar: sequential lobing, conical scan, Monopulse: amplitude comparison and phase comparison methods, Radar antennas. Radar displays. **Laboratory Sessions/ Experimental learning:** 1. Study the implementation and importance of MTI radar with Power amplifier. **Applications:** Ground surveillance, weapons location, and vehicle search **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105154/ 2. https://youtu.be/XFapyIIzX_8 3. https://freevideolectures.com/course/5299/introduction-radar-systems/42		

Course outcomes:	
CO1	Apply the basics of digital transmission related to satellite communication
CO2	Comprehend the design of satellite subsystems
CO3	Evaluate spacecraft subsystem performance and trades
CO4	Model the characteristics of radar echoes from different types oftargets and clutter.
CO5	Calculate and simulate receiver noise and losses.

Text Books:	
1.	T. Pratt, C.W. Boastian and Jeremy Allnutt, “Satellite Communication”, 2013, 2nd edition, John Wiley and Sons, Bangalore, India.
2.	Merril. I. Skolnik, “Introduction to Radar Systems”, 2/e, MGH, 1981.
Reference Books:	
1.	Dennis Roddy, Satellite Communications, 4th Edition, McGraw- Hill International edition, 2006
2.	Timothy Pratt, Charles Bostian, Jeremy Allnutt, Satellite Communications, 2nd Edition, Wiley India Pvt. Ltd , 2017, ISBN: 978-81-265-0833-4

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CO3	3	3	3	2	-	-	-	-	-	-	-	-
CO4	3	3	3	2	1	-	-	-	-	-	-	-
CO5	3	3	3	-	2	-	-	-	-	-	-	-

High-3, Medium-2, Low-1

Course Title	ARTIFICIAL INTELLIGENCE & DATA SCIENCE	Semester	VII
Course Code	MVJ20EC743	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Identify the problems where AI is required and the different methods available.
- Compare and contrast different AI techniques available.
- Understand and explain learning algorithms.
- Obtain a Comprehensive knowledge of various tools and techniques for Data transformation and visualization.
- Learn the probability and probabilistic models of data science

Module-1	RBT Level L1, L2, L3	8Hrs.

***Prerequisites:** Machine Learning*

Artificial Intelligence: What is Artificial Intelligence? AI Technique, Level of the Model, Problem Spaces, and Search: Defining the Problem as a State Space Search, Production Systems, Problem Characteristics, Production System Characteristics and issues in the Design of Search Programs. Heuristic Search Techniques: Generate-and Test, Hill Climbing, Best-first Search, Problem Reduction, Constraint Satisfaction, Means-ends.

Laboratory Sessions/ Experimental learning:

1. Write a program to solve 8 queens problem using PROLOG

Applications: Astronomy, Health care, Finance, Gaming, Data security

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/102/106102220/
   https://www.simplilearn.com/artificial-intelligence-introduction-for-beginners-training-course

Module-2	RBT Level L1, L2, L3	8Hrs.
Analysis, Knowledge Representation: Representations and Mappings, Approaches to Knowledge Representation, Using Predicate Logic: Representing Simple Facts in Logic, Representing Instance and ISA Relationships, Computable Functions and Predicates, Resolution, Natural Deduction. Using Rules: Procedural Versus Declarative Knowledge, Logic Programming, Forward Versus Backward Reasoning. **Laboratory Sessions/ Experimental learning:** 1. Program to replace an integer from the list using PROLOG **Applications:** Computer database **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/105/106105077/ https://www.youtube.com/watch?v=xUIqkAmfi8A		
Module-3	RBT Level L3,L4	8Hrs.
Reasoning: Symbolic Reasoning Under Uncertainty, Statistical Reasoning, Weak Slot and Filler, Structure, Semantic nets, Frames, Strong Slot and Filler Structure, Conceptual Dependency, Scripts, CYC. **Natural Language Processing:** Natural Language Processing, Syntactic processing, semantic analysis, Parallel and Distributed AI, Psychological modeling- parallelism and distributed in reasoning systems, Learning, Connectionist Models, Hopfield networks, neural networks. Expert Systems. **Laboratory Sessions/ Experimental learning:** 1. Solve Robot (traversal) problem using means End Analysis using PROLOG **Applications:** Search Autocorrect and Autocomplete, Language Translator, Social Media Monitoring. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/106/101/106101007/ 2. https://www.youtube.com/watch?v=WHCo4m2VOws&vl=en https://www.youtube.com/watch?v=dw6kp0jfi5w		

Module-4	RBT Level L3,L4,L5	8Hrs.

Prerequisites: Mathematical and Statistical concepts, Programming skills like C or C++

Data Visualization: Introduction, Causality and Experiments - Data Pre-processing: Knowing data, Data cleaning, Data reduction, Data transformation, Data discretization - Visualization and Graphing: Visualizing Categorical Distributions, Visualizing Numerical Distributions, Overlaid Graphs, plots, and summary statistics of Exploratory Data Analysis (EDA). Exploring Univariate Data - Histograms -Stem-and Leaf Quantile Based Plots - Continuous Distributions - Quantile Plots- QQ Plot- Box Plots

Laboratory Sessions/ Experimental learning: R as CALCULATOR APPLICATION

1. Using with and without R objects on console
2. Using mathematical functions on console
3. Write an R script, to create R objects for calculator application and save in a specified location in disk.

Applications: Fraud and Risk Detection, Website Recommendations, Advanced Image Recognition, Airline Route Planning

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106179/
2 .https://nptel.ac.in/courses/106/107/106107220/

Module-5	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Probability theory

Big Data Analytics: Hadoop Distributed File System Basics, Running Example Programs and Benchmarks, Hadoop Map Reduce Framework, Map Reduce Programming

Applications: Customer Relationship management, Health care, Education, Retail, Banking, Financial services, Insurance, Manufacturing, Telecom, Public Sector

Laboratory Sessions/ Experimental learning:

1. Word Count Map Reduce program to understand Map Reduce Paradigm Installing and configuring Hadoop

Applications: Communication, Healthcare

Video link / Additional online information:

1.	https://nptel.ac.in/courses/106/104/106104189/ 2. https://www.digimat.in/nptel/courses/video/106104189/L06.html

Course outcomes:	
CO1	Identify the AI based problems
CO2	Apply techniques to solve the AI problems.
CO3	Demonstrate learning and various learning techniques
CO4	Apply pre-processing techniques to convert raw data so as to enable further analysis
CO5	Analyze the probability density function of transformations of random variables and use these techniques to generate data from various distributions

Text Books:	
1.	E. Rich , K. Knight & S. B. Nair - Artificial Intelligence, 3/e, McGraw Hill.
2.	Artificial Intelligence: A Modern Approach, Stuart Rusell, Peter Norving, Pearson Education 2nd Edition.
3.	Jiawei Han, Micheline Kamber, Jian Pei, Data Mining Concepts and Techniques, Third edition, Elsevier Publisher, 2006
Reference Books:	
1.	Dan W. Patterson, Introduction to Artificial Intelligence and Expert Systems – Prentice Hal of India
2.	N.P. Padhy "Artificial Intelligence and Intelligent Systems" , Oxford University Press-2015
3.	Adi Adhikari and John De Nero, Computational and Inferential Thinking: The Foundations of Data Science, First edition, 2019
4.	Douglas Eadline,"Hadoop 2 Quick-Start Guide: Learn the Essentials of Big Data Computing in the Apache Hadoop 2 Ecosystem", 1stEdition, Pearson Education, 2016. ISBN-13: 978-9332570351
5.	Anil Maheshwari, "Data Analytics", 1st Edition, McGraw Hill Education, 2017. ISBN-13: 978-9352604180

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	1	-	-	1
CO2	3	3	3	2	2	1	-	-	1	-	-	1
CO3	3	3	3	2	2	1	-	-	1	-	-	1
CO4	3	3	3	2	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	CRYPTOGRAPHY & CYBER SECURITY	Semester	VII
Course Code	MVJ20EC744	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Outline the basic principles of Cyber security and its applications
- Familiarize with Cryptography and very essential algorithms
- Use the theorems needed for cryptographic operations and compare & contrast different types of cryptography
- State the concepts & uses of Digital signature and web security
- Demonstrate the need and summarize the concept of Secure Electronic Transactions & Intrusion detection system.

Module-1	RBT Level L1, L2, L3, L6	8Hrs.

Introduction: Services, Mechanisms, Mechanism Attacks, The OSI Security Architecture, A Model for Network Security, Cyber Attacks, Defence Strategies and Techniques, Guiding Principles

Mathematical Background of Cryptography: Integer Arithmetic, Modular Arithmetic, Matrices, The Greatest Comma Divisor, Useful Algebraic Structures, Chinese Remainder Theorem

Applications: Time Stamping, Electronic Money, Secure Network Communication

Laboratory Sessions/ Experimental learning:

1. Breaking the Shift Cipher

Video link / Additional online information :

1. https://nptel.ac.in/courses/117103063/
2. https://nptel.ac.in/courses/117107095/
3. http://nptelvideos.com/video.php?id=2441
4. http://www.nptelvideos.com/video.php?id=429

Module-2	RBT Level L1, L2, L3,L6	8Hrs.
Basics of Cryptography: Preliminaries, Elementary Substitution Ciphers, Elementary Transport Ciphers, Other Cipher Properties. **Symmetric Ciphers**: Symmetric Ciphers model, Substitution Techniques, Transposition Techniques, Simplified DES, Data encryption Standard (DES), The strength of DES, Differential and Linear Cryptanalysis, Block Cipher Design Principles and modes of operation, Evaluation Criteria for Advanced Encryption standard, The AES Cipher. **Laboratory Sessions/ Experimental learning**: 1. Breaking the Mono-alphabetic Substitution Cipher **Applications**: wireless security, processor security, file encryption. **Video link / Additional online information**: 1. https://nptel.ac.in/courses/117106087/ 2. https://www.youtube.com/watch?v=ANHTfY9feZg 3. https://nptel.ac.in/courses/108102095/		
Module-3	RBT Level L1, L2, L3, L6	8Hrs.
Principles of public key Cryptosystem, The RSA algorithms, Key management, Diffie – Hellman key exchange, Elliptic Curve Arithmetic, Authentication functions, Hash functions. Digital Signatures, Authentication protocols, Digital signature standard. Web security consideration, Secure Socket Layer, Transport layer security, secure electronic transaction. **Laboratory Sessions/ Experimental learning**: 1. Diffie-Hellman Key Establishment **Applications**: Random number generator, permutation generator **Video link / Additional online information**: 1. https://www.youtube.com/watch?v=m4sjTt7rhow 2. https://nptel.ac.in/courses/117101106/ 3. https://nptel.ac.in/courses/108108114/		

Module-4	RBT Level L1, L2, L3	8Hrs.

Intruders, Intrusion Detection, Password Management, Malicious software programs – Viruses and related Threats, Virus Countermeasures Firewall Design Principles, Trusted Systems

Laboratory Sessions/ Experimental learning:

1. Digital Signatures Scheme
2. Cryptographic Hash Functions and Applications(HMAC)

Applications: Cyber-attacks, Cybercrime, Cyber security.

Video link / Additional online information :

1. https://nptel.ac.in/courses/108105113/
2. https://nptel.ac.in/courses/117106086/

Module-5	RBT Level L1, L2, L3	8Hrs.

Transport Level Security: Web Security Considerations, Secure Sockets Layer, Transport Layer Security, HTTPS, Secure Shell (SSH)

Laboratory Sessions/ Experimental learning:

1. Cryptographic Hash Functions and Applications.
2. Diffie-Hellman Key Establishment

Applications: Encryption, message authentication and integrity, and replay attack protection

Video link / Additional online information:

1. https://nptel.ac.in/courses/117102052/

Course outcomes:	
CO1	Analyse the importance of security attacks, service mechanism, basic network security model and its applications.
CO2	Design and develop simple cryptography algorithms and Explain basic structure of DES and AES
CO3	Apply the concepts of Primes, Testing, Factorization, Chinese remainder theorem and RSA Cryptosystem.

CO4	Illustrate the concept public key cryptography & apply digital signatures in email. Processing and Explain usages of email-security, IP security and web security.
CO5	Describe different techniques used in key exchange protocols.

Text Books:

1.	Cryptography and Network Security- Behrouz A Forouzan, Debdeep Mukhopadhyay,Mc-GrawHill, 3rd Edition, 2015
2.	Cryptography and Network Security- William Stallings, Pearson Education, 7th Edition.

Reference Books:

1.	Cryptography, Network Security and Cyber Laws – Bernard Menezes, Cengage Learning, 2010 edition.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	1	-	-	1
CO2	3	3	3	2	1	1	-	-	1	-	-	1
CO3	3	3	3	2	1	1	-	-	1	-	-	1
CO4	3	3	3	2	1	1	-	-	1	-	-	1
CO5	3	3	3	2	1	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	VLSI SYSTEM DESIGN LAB	Semester	VII
Course Code	MVJ20ECL76	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Explore the CAD tool and understand the flow of the Full Custom IC design cycle.
- Learn DRC, LVS and Parasitic Extraction of the various designs.
- Design and simulate the various basic CMOS analog circuits and use them in higher circuits like data converters using design abstraction concepts.
- Design and simulate the various basic CMOS digital circuits and use them in higher circuits like adders and shift registers using design abstraction concepts.

Laboratory Sessions			
Sl No	Experiment Name	RBT Level	Hours
ASIC Digital Design			
1	Write Verilog Code for **inverter** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.	L3	3
2	Write Verilog Code for **buffer** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.	L3	3
3	Write Verilog Code for **Transmission Gate** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.	L3	3
4	Write Verilog Code for **Basic/universal gates** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given	L3	3

	constraints. Do the initial timing verification with gate level simulation.		
5	Write Verilog Code for **Flip flops -RS, D, JK, MS, T** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.	L3	3
6	Write Verilog Code for **Serial & Parallel adder** and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.	L3	2
7	Write Verilog Code for 4-bit counter [Synchronous and Asynchronous counter] and Test Bench for verification, observe the waveform and synthesize the code with technological library with given constraints. Do the initial timing verification with gate level simulation.	L3	2
Analog Design			
8	Design an Inverter with given specifications, completing the design flow mentioned below: • Draw the schematic and verify the following i) DC Analysis ii) Transient Analysis • Draw the Layout and verify the DRC, ERC • Check for LVS Verify & Optimize for Time, Power and Area to the given constraint	L5	3
9	Design the Common source amplifier with given specifications, completing the design flow mentioned below: • Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis • Draw the Layout and verify the DRC, ERC • Check for LVS	L5	2

	• RC extraction		
10	Design the Common Drain amplifier with given specifications, completing the design flow mentioned below: • Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis • Draw the Layout and verify the DRC, ERC • Check for LVS • RC extraction	L5	2
11	Design a Single Stage differential amplifier, with given specifications, completing the design flow mentioned below: • Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii) AC Analysis • Draw the Layout and verify the DRC, ERC • Check for LVS • RC extraction	L5	2
12	Design an **Operational-amp** with given specification using given differential amplifier Common source and Common Drain amplifier in library and completing the design flow mentioned below: • Draw the schematic and verify the following i) Transient Analysis ii) DC Analysis iii). AC Analysis • Draw the Layout and verify the DRC, ERC • Check for LVS • RC extraction	L5	2

Course outcomes:	
CO1	Write test bench to simulate various digital circuits.
CO2	Interpret concepts of DC Analysis, AC Analysis and Transient Analysis in analog circuits.
CO3	Design and simulate basic CMOS circuits like inverter, common source amplifier and differential amplifiers.

CO4	Design higher level circuits like operational amplifier and analog/digital converters to meet desired parameters.
CO5	Use transistors to design gates and further using gates realize shift registers and adders to meet desired parameters.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	50 marks

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	2	2	2	-	-	-	2	-	-	1
CO2	3	3	2	2	2	-	-	-	2	-	-	1
CO3	3	3	2	2	2	-	-	-	2	-	-	1
CO4	3	3	2	2	2	-	-	-	2	-	-	1
CO5	3	3	2	2	2	-	-	-	2	-	-	1

High-3, Medium-2, Low-1

Course Title	IOT LAB	Semester	VII
Course Code	MVJ20ECL77	CIE	50
Total No. of Contact Hours	30	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 0 : 2 : 2)	Total	100
Credits	2	Exam. Duration	3Hrs

Course objective is to:

- Gain knowledge on IoT ecosystem and Arduino board.
- Establish Wifi IOT module with Arduino uno.
- Interface IR, Temperature, humidity sensors to Arduino board.
- Implement protocols to move sensor data to cloud.

Laboratory Sessions

Sl No	Experiment Name	RBT Level	Hours
1	Write a program for interface Arduino Uno with DHT Sensor to print Humidity and Temperature.	L3	3
2	Write a program for interface Arduino Uno with Smoke Sensor to print digital and analog output.	L3	3
3	Write a program for interface Arduino Uno with LM-35 Sensor for analog output result.	L3	3
4	Write a program for interface Arduino Uno with LDR (Light Dependent Resistor) Sensor.	L4	3
5	Write a program for interface Arduino Uno with Magnetic Sensor.	L3	3
6	Write a program for sending the data of Serial communication between Gateway and Arduino.	L4	3
7	Write a program for establishing Wifi IOT module with Arduino uno.	L5	4
8	Write a program for Communication between gateways to an end node.	L3	4

9	Write a program for Send data on Thingspeak with end node and also display those data on lcd.	L5	4

Course outcomes:	
CO1	Experience the use and outcome of different sensors
CO2	Interface Arduino Uno with LDR,LM-35,DHT sensor
CO3	Understand the communication between gateway to an end node
CO4	Create program for establishing Wifi IOT module with Arduino uno
CO5	Implement a program to move sensor data to cloud.

Scheme of Evaluation	
Regular Lab work and Writing Lab records	(20+15) = 35 marks
Lab test and Viva-voce at the end of the semester	(10+5) = 15 marks
Total	**50 marks**

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12
CO1	3	3	3	2	2	1	-	-	2	-	-	2
CO2	3	3	3	2	2	1	-	-	2	-	-	2
CO3	3	3	3	2	2	1	-	-	2	-	-	2
CO4	3	3	3	2	2	1	-	-	2	-	-	2
CO5	3	3	3	2	2	1	-	-	2	-	-	2

High-3, Medium-2, Low-1

Course Title	PROJECT PHASE – 1	Semester	VII
Course Code	MVJ20ECP78	CIE	50
Total No. of Contact Hours	-	SEE	-
No. of Contact Hours/week	- (L : T : P :: 0 : 0 : 4)	Total	50
Credits	2	Exam. Duration	-

Course Objective:

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To expand intellectual capacity, credibility, judgment, intuition.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - I: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

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

CO1	Describe the project and be able to defend it.
CO2	Learn to use modern tools and techniques.
CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation :

Internal Marks: The Internal marks (50 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	2	1	1	2	1	1	2
CO2	2	2	2	3	3	2	1	1	2	1	2	2
CO3	2	2	2	3	3	2	1	1	2	1	2	2
CO4	2	2	2	3	3	2	1	1	2	1	2	2
CO5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

B.E, VIII Semester, Electronics & Communication Engineering

Course Title	PROJECT PHASE – 2	Semester	VIII
Course Code	MVJ20ECP81	CIE	50
Total No. of Contact Hours	-	SEE	50
No. of Contact Hours/week	(L : T : P :: 0 : 0 : 14)	Total	100
Credits	8	Exam. Duration	3 Hours

Course Objective:

- To support independent learning.
- To develop interactive, communication, organization, time management, and presentation skills.
- To impart flexibility and adaptability.
- To inspire independent and team working.
- To expand intellectual capacity, credibility, judgment, intuition.
- To adhere to punctuality, setting and meeting deadlines.
- To instill responsibilities to oneself and others.
- To train students to present the topic of project work in a seminar without any fear, face audience confidently, enhance communication skill, involve in group discussion to present and exchange ideas.

Project Work Phase - II: Each student of the project batch shall involve in carrying out the project work jointly in constant consultation with internal guide, co-guide, and external guide and prepare the project report as per the norms avoiding plagiarism.

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

CO1	Describe the project and be able to defend it. Develop critical thinking and problem solving skills.
CO2	Learn to use modern tools and techniques. Communicate effectively and to present ideas clearly and coherently both in written and oral forms.

CO3	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO4	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO5	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.

Scheme of Evaluation :

Internal Marks: The Internal marks (50 marks) evaluation shall be based on Phase wise completion of the project work, Project report, Presentation and Demonstration of the actual/model/prototype of the project.

Semester End Examination: SEE marks for the project (50 marks) shall be based on Project report, Presentation and Demonstration of the actual/model/prototype of the project, as per the norms by the examiners appointed

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	2	1	1	2	1	1	2
CO2	2	2	2	3	3	2	1	1	2	1	2	2
CO3	2	2	2	3	3	2	1	1	2	1	2	2
CO4	2	2	2	3	3	2	1	1	2	1	2	2
CO5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	INTERNSHIP	Semester	VIII
Course Code	MVJ20ECI82	CIE	50
Total No. of Contact Hours	Industrial Oriented	SEE	50
No. of Contact Hours/week	-	Total	100
Credits	3	Exam. Duration	3 Hours

Course Objective: • To get the field exposure and experience • To apply the theoretical concept in field application • To prepare the comparison statement of difference activities	
Internship: This shall be carried out by students in industry set-up related to the construction/ materials testing laboratories/research organizations/project management consulting firms/QS and QA organizations/ planning and design offices/Professional organizations and other avenues related to the Electronics and Communication engineering domain in consultation and approval of internship guide/HOD /internship committees of the institutions.	
Course outcomes: At the end of the course the student will be able to:	
CO1	Develop skills to work in a team to achieve common goal. Develop skills of project management and finance.
CO2	Develop skills of self-learning, evaluate their learning and take appropriate actions to improve it.
CO3	Prepare them for life-long learning to face the challenges and support the technological changes to meet the societal needs.
Scheme of Evaluation : Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation of the activities undertaken during the internship, to a panel comprising internship guide, a senior faculty from the department and head of the department. Each	

student should submit the internship report at the end of semester with internship certificate.

Semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of internship supervisor, a senior faculty from the department and head of the department.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	2	1	1	2	1	1	2
CO2	2	2	2	3	3	2	1	1	2	1	2	2
CO3	2	2	2	3	3	2	1	1	2	1	2	2
CO4	2	2	2	3	3	2	1	1	2	1	2	2
CO5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	SEMINAR	Semester	VIII
Course Code	MVJ20ECS83	CIE	50
Total No. of Contact Hours	-	SEE	50
No. of Contact Hours/week	(L : T : P :: 0 : 0 : 4)	Total	100
Credits	1	Exam. Duration	3 Hours

Course Objective:

- To inculcate self-learning, face audience confidently, enhance communication skill, involve in group discussion and present and exchange ideas.

Seminar: Each student, under the guidance of a Faculty, is required to choose, preferably, a recent topic of his/her interest relevant to the course of specialization. Carryout literature survey; organize the Course topics in a systematic order.

- Conduct literature survey in the domain area to find appropriate topic.
- Prepare the synopsis report with own sentences in a standard format.
- Learn to use MS word, MS power point, MS equation and Drawing tools or any such facilities in the preparation of report and presentation.
- Present the seminar topic orally and/or through power point slides.
- Communicate effectively to answer the queries and involve in debate/discussion.
- The participants shall take part in discussion to foster friendly and stimulating environment in which the students are motivated to reach high standards and become self-confident.

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

CO1	Develop knowledge in the field of Electronics and Communication Engineering and other disciplines through independent learning and collaborative study.
CO2	Identify and discuss the current, real-time issues and challenges in engineering & technology. Develop written and oral communication skills.
CO3	Explore concepts in larger diverse social and academic contexts.
CO4	Apply principles of ethics and respect in interaction with others.

CO5	Develop the skills to enable life-long learning.

Scheme of Evaluation :

Internal Marks: The Internal marks (50 marks) evaluation shall be based on midterm and final presentation, to a panel comprising seminar guide, a senior faculty from the department and head of the department. Each student should submit the Seminar report at the end of semester Semester End Examination: Viva-Voce examination shall be conducted by a panel of examiners consisting of seminar supervisor, a senior faculty from the department and head of the department.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	2	3	3	2	1	1	2	1	1	2
CO2	2	2	2	3	3	2	1	1	2	1	2	2
CO3	2	2	2	3	3	2	1	1	2	1	2	2
CO4	2	2	2	3	3	2	1	1	2	1	2	2
CO5	2	2	2	3	3	2	1	1	2	1	2	2

High-3, Medium-2, Low-1

Course Title	CERTIFICATION	Semester	VIII
Course Code	MVJ20ECC84	CIE	-
Total No. of Contact Hours	-	SEE	-
No. of Contact Hours/week	-	Total	-
Credits	2	Exam. Duration	3 Hours

Course Objective:

- To inculcate self-learning, enhance the skill in different field of Engineering

Certification: Each student, under the guidance of a Faculty, is required to undergo online certification course minimum of 30 hours (number of courses is not limited) preferably, a recent topic of his/her interest. Each student should submit the Course details and Qualification Certificates at the end of semester.

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

CO1	Develop knowledge in different fields of Engineering
CO2	Develop the skills to enable life-long learning.

Open electives offered by Department of ECE:

Course Title	DIGITAL IMAGE PROCESSING	Semester	VI
Course Code	MVJ20EC651	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Learn the fundamentals of digital image processing
- Understand the image transforms and other image enhancement techniques used in digital image processing.
- Study the image restoration techniques and methods used in digital image processing
- Understand region-based segmentation and segmentation using morphological watersheds.
- Know the color fundamentals and various morphological image processing techniques.

Module-1	RBT Level L1, L2, L3, L4	8Hrs.

Prerequisites: Discrete Fourier Transform, MATLAB Basics

Introduction to Digital Image Processing: What is Digital Image Processing? Origin of Digital Image Processing, Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Elements of Visual Perception, Image Sensing and Acquisition, Image Sampling and Quantization, Some Basic Relationships Between Pixels, Linear and Nonlinear Operations.

Applications of Image Processing: Medical imaging, Robot vision, Character recognition, Remote Sensing.

Laboratory Sessions/ Experimental learning:

1. Implementation and analysis of image sampling methods including uniform, grid, jittered and best candidate algorithms using MATLAB

Applications: Medical imaging, Robot vision, Character recognition, Remote Sensing.

Video link / Additional online information : 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm		
Module-2	RBT Level L1, L2, L3, L4	8Hrs.
Spatial Domain: Some Basic Intensity Transformation Functions, Histogram Processing, Fundamentals of Spatial Filtering, Smoothing Spatial Filters, Sharpening Spatial Filters **Frequency Domain:** Preliminary Concepts, The Discrete Fourier Transform (DFT) of Two Variables, Properties of the 2-D DFT, Filtering in the Frequency Domain, Image, Smoothing and Image Sharpening Using Frequency Domain Filters, Selective Filtering. **Laboratory Sessions/ Experimental learning:** 1. Implementation and analysis of image smoothing and sharpening algorithms using MATLAB. **Applications:** Image Enhancement, Image Analysis **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm		
Module-3	RBT Level L1, L2, L3,L4	8Hrs.
Restoration: Noise models, Restoration in the Presence of Noise Only using Spatial Filtering and Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Minimum Mean Square Error(Wiener) Filtering, Constrained Least Squares Filtering. **Laboratory Sessions/ Experimental learning:** 1. Test the restoration with the Inverse Filter for deblurring and denoising. Identify the problem with the Inverse Filter and discuss the solution for the same. **Applications:** Image Enhancement, Image Analysis, Error detection and correction **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105079/ 2. https://www.tutorialspoint.com/dip/index.htm		

Module-4	RBT Level L1, L2, L3, L4	8Hrs.

Segmentation: Point, Line, and Edge Detection, Thresholding, Region-Based Segmentation, Segmentation Using Morphological Watersheds.

Representation and Description: Representation, Boundary descriptors.

Laboratory Sessions/ Experimental learning:

2. Develop and implement a matlab code for Image segmentation using thresholding technique.

Applications: Object tracking, Pattern recognition

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://www.tutorialspoint.com/dip/index.htm

Module-5	RBT Level L1, L2, L3, L4	8Hrs.

Color Image Processing: Color Fundamentals, Color Models, Pseudocolor Image Processing.

Morphological Image Processing: Preliminaries, Erosion and Dilation, Opening and Closing, The Hit-or-Miss Transforms, Some Basic Morphological Algorithms. Four morphological principles, Skeletons and object marking.

Laboratory Sessions/ Experimental learning:

1. Implementation and analysis of multimodal image fusion using MATLAB.

Applications: Color conversion, Object marking

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105079/
2. https://www.tutorialspoint.com/dip/index.htm

Course outcomes:	
CO1	Analyze image processing algorithms used for sampling and quantization.
CO2	Apply and analyze image processing techniques in both the spatial and frequency (Fourier) domains.
CO3	Implement and analyse various image restoration algorithms

CO4	Design image analysis techniques for image segmentation and evaluate the methodologies for segmentation.
CO5	Conduct independent study and analyze various Morphological Image Processing techniques.
Text Books:	
1.	Rafel C Gonzalez and Richard E. Woods , “Digital Image Processing”-, PHI 3rdEdition 2010.
2.	Milan Sonka, Vaclav Hlavac, Roger Boyle, –”Image Processing, Analysis, and Machine Vision||”, Cengage Learning, 2013, ISBN: 978-81-315-1883-0
Reference Books:	
1.	S.Jayaraman, S Esakkirajan, T.Veerakumar, “Digital Image Processing”, Tata McGraw Hill, 2011
4.	S.Jayaraman, S.Esakkirajan, T.Veerakumar, “Digital Image Processing”- Tata McGraw Hill 2014.
5.	A. K. Jain, “Fundamentals of Digital Image Processing”- Pearson 2004.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	2	1	-	-	1	-	-	1
CO2	3	3	3	2	2	1	-	-	1	-	-	1
CO3	3	3	3	2	2	1	-	-	1	-	-	1
CO4	3	3	3	2	2	1	-	-	1	-	-	1
CO5	3	3	3	2	2	1	-	-	1	-	-	1

High-3, Medium-2, Low-1

Course Title	PRINCIPLES OF COMMUNICATION	Semester	VI
Course Code	MVJ20EC652	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to: • Understand and analyze the concepts of Analog Modulation schemes viz; AM, FM. • Learn the concepts of digitization of signals viz; sampling, quantizing and encoding. • Realize the basic concepts of various digital modulation techniques. • Study the principles behind information theory and coding. • Understand the basics of spread spectrum modulation.		
Module-1	RBT Level L1, L2, L3	8Hrs.
Prerequisites: *Modulation, Need for Modulation and types of Modulation.* **Analog Modulation:** Amplitude Modulation - AM, DSBSC, SSBSC, VSB - PSD, modulators and demodulators, Angle modulation - PM and FM - PSD, modulators and demodulators - Super heterodyne receivers. **Laboratory Sessions/ Experimental learning:** 1. Introduction to Matlab 2. Generation of AM signal using Matlab **Applications:** Broadcast transmissions, Air band radio, Quadrature amplitude modulation **Video link / Additional online information :** 1. https://nptel.ac.in/courses/117/105/117105143/ 2. https://youtu.be/00ZbuhPruJw 3. https://youtu.be/rt08yTGv_z4		

Module-2	RBT Level L1, L2,L3	8Hrs.

Pulse Modulation: Low pass sampling theorem, Quantization, PAM, Line coding, PCM, DPCM, DM, and ADPCM and ADM, Channel Vocoder, Time Division Multiplexing, Frequency Division Multiplexing.

Laboratory Sessions/ Experimental learning:

1. Delta modulation using Matlab

Applications: Speech recognition systems, pattern recognition systems, digital audio in computers, CDs, digital telephony, telephone and radio communications, television systems.

Video link / Additional online information :

1. https://nptel.ac.in/courses/117/105/117105077/
2. https://nptel.ac.in/courses/117/101/117101051/
3. https://youtu.be/s6vlXP3mYXk
4. https://youtu.be/HlGJ6xxbz8s

Module-3	RBT Level L1, L2, L3	8Hrs.

Digital Modulation And Transmission: Phase shift keying, BPSK, DPSK, QPSK, Principles of M-ary signaling M-ary PSK & QAM, Comparison, ISI Pulse shaping, Duo binary encoding, Cosine filters, Eye pattern, equalizers.

Laboratory Sessions/ Experimental learning:

1. Eye diagram using Matlab
2. Generation of BPSK Using LabVIEW

Applications: LAN, CDMA, WiMAX, wireless communication, mobile communication, Satellite Communication, Bluetooth, RFID.

Video link / Additional online information:

1. https://nptel.ac.in/courses/117/105/117105077/
2. https://nptel.ac.in/courses/117/101/117101051/

Module-4	RBT Level L1, L2, L3	8Hrs.
Information Theory and Coding: Measure of information, Entropy, Source coding theorem – Shannon Fanon coding, Huffman Coding, LZ Coding, Channel capacity, Shannon-Hartley law – Shannon's limit, Error control codes, Cyclic codes, Syndrome calculation, Convolution Coding, Sequential and Viterbi decoding. **Laboratory Sessions/ Experimental learning:** 1. Huffman coding using Matlab **Applications:** Data Compression, audio/video transmission, data transmission and file transfer **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/102/108102117/ 2. https://nptel.ac.in/courses/117/104/117104129/		
Module-5	RBT Level L1, L2, L3	8Hrs.
Spread Spectrum Multiple Access Techniques: PN sequences, properties, m-sequence, DSSS – Processing gain, Jamming, FHSS, Synchronization and tracking, Multiple Access FDMA, TDMA, CDMA. **Laboratory Sessions/ Experimental learning:** 1. Direct Sequence Spread spectrum Signal Generation & Detection using Matlab **Applications:** CDMA, Wi-Fi, WPAN, etc., **Video link / Additional online information:** 1. https://nptel.ac.in/courses/117/105/117105077/ 2. https://nptel.ac.in/courses/117/101/117101051/ 3. https://nptel.ac.in/courses/117/105/117105136/ 4. https://youtu.be/Ojmv3I4kDn4		

Course outcomes:	
CO1	Examine the concepts of AM and FM modulation and demodulation.
CO2	Apply the concepts of sampling, quantization and encoding for digitization of signals.

CO3	Evaluate the performance of a baseband and pass band digital communication system in terms of error rate and spectral efficiency.
CO4	Analyze source and error control coding.
CO5	Illustrate the digital communication system with spread spectrum modulation.

Text Books:	
1.	H Taub, D L Schilling, G Saha, "Principles of Communication Systems" 3/e, TMH 2007
2.	Simon Haykins, "An Introduction to Analog and Digital Communication", John Wiley, 2003.
Reference Books:	
1.	Simon Haykin, "Digital Communication Systems", John Wiley & sons, First Edition, 2014, ISBN 978-0-471-64735-5.
4.	B.P.Lathi, "Modern Digital and Analog Communication systems", 3rd edition, Oxford University Press, 2007
5.	H P Hsu, Schaum Outline Series – "Analog and Digital Communications" TMH 2006
6.	B.Sklar, "Digital Communications Fundamentals and Applications" 2/e Pearson Education 2007
7.	K Giridhar, "Information Theory And Coding", 4th Edition, Pooja Publication, Bangalore, 2001.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	1	1	-	-	-	-	-	1
CO2	3	3	3	2	1	1	-	-	-	-	-	1
CO3	3	3	3	2	1	1	-	-	-	-	-	1
CO4	3	3	3	2	1	1	-	-	-	-	-	1
CO5	3	3	3	2	1	1	-	-	-	-	-	1

High-3, Medium-2, Low-1

Course Title	SENSOR TECHNOLOGY	Semester	VI
Course Code	MVJ20EC653	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Understand various technologies associated in manufacturing of sensors.
- Provide better familiarity with different sensors and their applications in real life.
- Acquire knowledge about types of sensors used in modern digital systems.
- Evaluate the technological and physical limitations of a specific sensor.
- Propose a suitable sensor for a given measurement situation.

Module-1	RBT Level L1,L2,L3	8Hrs.

Prerequisite: *Basic Electronics, Knowledge on physical quantities*

Sensors Fundamentals and Characteristics: General Concepts and Terminology, Sensor Classification, Static Characteristics, Dynamic Characteristics, Materials for Sensors, Microsensor Technology.

Laboratory Sessions/ Experimental learning:

1. Study on applications of sensors

Applications: Biological, Chemical, Electric, magnetic, or electromagnetic wave, Heat, temperature, Mechanical displacement or wave, Radioactivity, radiation and other.

Video link / Additional online information:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/courses/108/108/108108147/

Module-2	RBT Level L1,L2,L3	8Hrs.
Primary sensors: Temperature sensors, Pressure sensors, Flow-velocity and flow-rate sensors, Level sensors, Force and torque sensors, Acceleration and inclination sensors and Velocity sensors. **Resistive Sensors:** Resistive Temperature Detectors (RTDs),Thermistors, Magneto resistors, Light-Dependent Resistors (LDRs), Resistive Hygrometers, Resistive Gas sensors. **Laboratory Sessions/ Experimental learning:** 1. Strain measurement with Bridge circuit **Applications:** Patient monitoring in medical applications, Manufacturing and industrial equipment and motorsport applications. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ 2. https://nptel.ac.in/courses/108/106/108106165/		
Module-3	RBT Level L1,L2,L3	8Hrs.
Reactance Variation and Electromagnetic Sensors: Capacitive sensors: Variable capacitor and Differential capacitor, Inductive sensors:Variable reluctance sensors, Eddy current sensors, Linear Variable Differential Transformers (LVDTs), Electromagnetic sensors: Sensors based on Faraday's Law and Hall effect sensors. **Laboratory Sessions/ Experimental learning:** 1. Develop a displacement measurement system with inductive sensors (LVDT) **Applications:** Smart phones, Industrial automation, Communication, automobile and aerospace. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/		
Module-4	RBT Level L1,L2,L3	8Hrs.
Self-Generating sensors: Thermoelectric sensors, Piezoelectric sensors, Pyroelectric sensors, Photovoltaic sensors, Electrochemical sensors, Proximity sensors. **Laboratory Sessions/ Experimental learning:**		

1. Develop a sensor system for force measurement using piezoelectric sensors **Applications**: Temperature controlled devices: refrigeration and air conditioning, Alarm clocks, Medical devices, PIN pads, photonics and pharmaceutical compositions, Robotics. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/			
Module-5		RBT Level L1,L2,L3	8Hrs.
Digital sensors: Position encoders,Resonant sensors: SAW sensors, Vibrating wire strain gages, Vibrating cylinder sensors, Digital flow meters **Other sensing methods**: Charge-Coupled sensors – Fundamentals & types of CCD, Fiber-Optic sensors, Ultrasonic-based sensors, Gyroscope sensors, optical sensors, IR sensors. **Laboratory Sessions/ Experimental learning**: 1. Measure strain, temperature and pressure using LabVIEW. **Applications**: Industries, digital cameras, photocopiers. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/108/105/108105064/ 2. https://nptel.ac.in/courses/112/103/112103174/			

Course outcomes:	
CO1	Understand the concept of sensors and its characteristics.
CO2	Explain the working principles of primary and resistive sensors.
CO3	Understand the inductive, capacitive and Electromagnetic sensors and its applications
CO4	Identify alternative methods to measure common quantities such as temperature, pressure, force and acceleration.
CO5	Select appropriate sensors used for various applications
Text Books:	
1.	Ramon Pallas & John G.Webster, "Sensors and signal conditioning", John Wiley & Sons., 2^{nd} Ed.,2001.

2.	J. Fraden, "Handbook of Modern Sensors: Physical, Designs, and Applications", AIP Press, Springer, 3rd Ed.,2004.
Reference Books:	
1.	D. Patranabis, "Sensors and Transducers", PHI Publication, 2nd Ed.,2004 New Delhi.
2.	Webster John G, "Instrumentation and sensors Handbook", CRC Press, 1st Ed., 1999.
3.	Shawhney A.K., "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons, 1994.

CIE Assessment:

CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests

- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
- Activities/Experimentations related to courses (8 Marks)

SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	1	-	2	-	-	-	-	2	1
CO2	3	2	2	1	1	2	-	-	-	-	2	1
CO3	3	2	2	1	1	2	-	-	-	-	2	1
CO4	3	2	2	1	1	2	-	-	-	-	2	1
CO5	3	2	2	1	2	2	-	-	-	-	2	1

High-3, Medium-2, Low-1

Course Title	INTRODUCTION TO MATLAB & SIMULINK	Semester	VI
Course Code	MVJ20EC654	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- To provide a foundation in programming for engineering problem solving using the MATLAB software package.
- To acquaint the student with some of the terminology in this very new field and relate it to the basic engineering process of design.
- To provide an introduction to the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
- To develop the skills to analyse and break down an engineering program and solve it algorithmically using MATLAB

Module-1	RBT Level L1, L2, L3 ,L4, L5	8Hrs.

Introduction to Matlab, Creating Variables, Some Useful MATLAB Functions Data Types creating simple and multiple data set in single plot, Matrix generation, Array operations and Linear equations

Introduction to programming in MATLAB, Visualization and Programming ,Control flow and operators

Laboratory Sessions/ Experimental learning:

1. Write MATLAB commands to analyze arithmetic, logical and Boolean operations.
2. Write MATLAB commands to analyze vector operations and magic matrixes.
3. Write a MATLAB program to demonstrate if and else if statement for comparing Two numbers.

Video link / Additional online information :

1. https://in.mathworks.com/videos/writing-a-matlab-program-69023.html
2. https://youtu.be/ygGF3RR1NyM
3. https://www.halvorsen.blog/documents/programming/matlab/matlab_basics.php

Module-2	RBT Level L1, L2, L3 ,L4,L5	8Hrs.
Solving Equations, Curve Fitting, and Numerical Techniques :Linear Algebra, Polynomials, Optimization, Differentiation/Integration, Differential Equations **Advanced Methods**: Probability and Statistics, Data Structures, Images, File I/O **Video link / Additional online information:** 1. https://www.youtube.com/watch?v=14H4UFoxZjs 2. https://www.youtube.com/watch?v=fqS873TnMDs		
Module-3	RBT Level L1, L2, L3,L4 & L6	8Hrs.
Various functions and toolboxes: Documentation, Misc. Useful Functions, Graphical User Interfaces, Simulink, Symbolic Toolbox **Applications**: App Designing using GUI, Image processing **Video link / Additional online information:** 1. https://in.mathworks.com/matlabcentral/fileexchange/44634-design-of-graphical-user-interface-application-with-matlab 2. https://in.mathworks.com/videos/app-designer-overview-1510748719083.html		
Module-4	RBT Level L1, L2, L3,L4 & L6	8Hrs.
Prerequisites: *Types of filters* **Introduction to SIMULINK**: Multiple plots creating models, blocks, Systems and sub-systems, Simulating Dynamic System, Solving a model, solvers, MATLAB SIMULINK integration, S-function); MATLAB Toolboxes training (Signal Processing, Neural Network, FUZZY logic, Control System, Communication, Power System toolboxes); **Laboratory Sessions/ Experimental learning:** 1. Create a spreadsheet file with some data (or use an existing spreadsheet with data if you have) and import the data into MATLAB. 2. Matlab 2D and 3D Plot **Video link / Additional online information :** 1. https://www.youtube.com/watch?v=iOmqgewj5XI 2. https://in.mathworks.com/learn/tutorials/simulink-onramp.html 3. https://www.halvorsen.blog/documents/teaching/courses/matlab/matlab3.php		

4. https://www.youtube.com/watch?v=EW544PfgBrs		
Module-5	RBT Level L1, L2, L3	8Hrs.

Applications of Matlab: Diode Characteristics, Fourier Analysis, Signal Processing, Deep learning, Image processing

Laboratory Sessions/ Experimental learning:

1. Image Enhancement Using Intensity Transformations,
2. Morphological and Other Set Operations
3. Two-Dimensional Fast Fourier Transform

Video link / Additional online information:

1. https://in.mathworks.com/videos/image-processing-and-computer-vision-in-matlab-and-simulink-96760.html
2. https://in.mathworks.com/videos/introduction-to-deep-learning-and-applications-in-image-processing-1606855547622.html

Course outcomes:	
CO1	Students should be able to apply computer methods for solving a wide range of engineering problems.
CO2	Students should be able to use computer engineering software to solve and present problem solutions in a technical format.
CO3	Students should be able to utilize computer skills to enhance learning and performance in other engineering and science courses.
CO4	Understand how signals, images, and data are represented and manipulated in MATLAB
CO5	Students should be able understand the various programming constructs and how they can be used to solve a computational problem.

Text Books:	
1.	Proakis & Monalakis, "Digital signal processing – Principles Algorithms & Applications", 4th Edition, Pearson education, New Delhi, 2007. ISBN: 81-317-1000-9.

2.	Li Tan, Jean Jiang, "Digital Signal processing – Fundamentals and Applications", Academic Press, 2013, ISBN: 978-0-12-415893.
Reference Books:	
1.	S. Salivahanan, C. Gnanpriya, Digital Signal processing , McGraw Hill

CIE Assessment:
CIE is based on quizzes, tests, assignments/seminars and any other form of evaluation. Generally, there will be: Three Internal Assessment (IA) tests during the semester (30 marks each), the final IA marks to be awarded will be the average of three tests - Quizzes/mini tests (4 marks) - Mini Project / Case Studies (8 Marks) - Activities/Experimentations related to courses (8 Marks)
SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	2	1	1	2
CO2	3	3	3	2	-	-	-	-	2	1	1	2
CO3	3	3	3	3	-	-	-	-	2	1	1	2
CO4	3	3	3	3	-	-	-	-	2	1	1	2
CO5	3	3	2	-	3	-	-	-	3	1	3	3

High-3, Medium-2, Low-1

Course Title	REAL TIME OPERATING SYSTEMS	Semester	VII
Course Code	MVJ20EC751	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Acquire knowledge about concepts related to OS for Embedded Systems.
- Gain knowledge about different types of scheduling algorithms suitable for embedded real time systems.
- Introduce the principles of Inter process communication and multitasking applications.
- Explain the architecture of Linux Kernel and RTOS applications to Linux.
- Discuss Real-Time Programming in Linux and µC linux.

Module-1	RBT Level L1, L2, L3	8Hrs.

Prerequisites: Basic Concepts of Operating systems and basics of task management and task scheduling.

Real Time Systems: Introduction, issues in real time computing, Structure of a real time system, task classes, performance measures for real time systems, task assignment and scheduling algorithms, mode changes, Fault tolerant scheduling, Real Time Models.

Laboratory Sessions/ Experimental learning:

1. Create an application that creates two tasks that wait on a timer whilst the main task loops.
2. Create an application that creates tasks and scheduling tasks.

Applications: Kiel RTOS for ARM (Keil RTX - ARM)

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/105/106105036/
2. https://nptel.ac.in/courses/106/105/106105172/

Module-2	RBT Level L1, L2, L3	8Hrs.

μC/OS- II RTOS Concepts: Foreground/Background process, Resources, Tasks, Multitasking, Priorities, Schedulers, Kernel, Exclusion, Inter task communication, Interrupts, Clock ticks, μC/OS- II Kernel structure , μC/OS- II Initialisation, Starting μC/OS- II.

Laboratory Sessions/ Experimental learning:

1. Write an Keil RTOS code that demonstrates the multitasking priority.
2. Write an Keil RTOS code that assigns priority and sets the time slice period to illustrate time slicing.

Applications:

1. Email Spam and Malware Filtering
2. File Managers and Resource management systems

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106198/
2. http://www.nptelvideos.in/2012/11/real-time-systems.html

Module-3	RBT Level L1, L2, L3	8Hrs.

μC/OS- II RTOS Functions: Task Management, Time management, Semaphore management, Mutual exclusion semaphore, Event Management, Message management, Memory management, porting μC/OS- II – comparison and study of various RTOS like QNX- VX Works-Psos.

Laboratory Sessions/ Experimental learning:

1. Write an Keil RTOS code to manage tasks to handle semaphore to overcome mutual exclusion.
2. Demonstrate Porting of μC/OS- II in Embedded processor.

Applications: Traffic light controller system

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/105/106105215/

2. https://nptel.ac.in/courses/106/105/106105172/		
Module-4	RBT Level L1, L2, L3	8Hrs.

Embedded Linux: Embedded Linux, Features - Embedded Linux Distributions - Architecture of Embedded Linux - Linux Kernel Architecture – User Space -Root File System - Linux Start-Up Sequence - GNU Cross Platform Tool chain -Porting Traditional RTOS Applications to Linux.

Laboratory Sessions/ Experimental learning:

1. Write an application that display two different messages in LCD display in two lines.

Applications: Smart Mobile Phone operating system development process demonstration.

Video link / Additional online information:

1. http://1.https//nptel.ac.in/courses/11706087/
2. https://nptel.ac.in/courses/106/106/106106198/

Module-5	RBT Level L1, L2, L3	8Hrs.

Real time Linux: Linux and Real-Time, Real-Time Programming in Linux, Hard Real-Time Linux - Building and Debugging, Building the Kernel, Integrated Development Environment, Kernel Debuggers, Embedded Drivers, Boardsupport packages, Introduction to µC linux.

Laboratory Sessions/ Experimental learning:

1. Creating and UART driver for USB bus.

Applications: Demonstration of ABS system in automobiles

Video link / Additional online information:

1. https://nptel.ac.in/courses/117102059/
2. http://www.nptelvideos.in/2012/11/real-time-systems.html
3. https://www.youtube.com/watch?v=HlU5cYqGLZE

Course outcomes:	
CO1	Summarize fundamental principles for programming of real time systems with time and resource limitations.

CO2	Develop RTOS based embedded real time applications.
CO3	Analyze the functions of real time operating systems .
CO4	Utilize RTOS software tool chain for Embedded Applications.
CO5	Develop real time kernals and Embedded Drivers.

Text Books:	
1.	Krishna C.M., Kang G. Shin, "Real Time Systems", Tata McGraw-Hill Edition, 2010.
2.	Philip A.Laplante, "Real Time Systems Design and Analysis-An Engineers Handbook", II Edition-IEEE Press, IEEE Computer Society Press, 2001.
Reference Books:	
1.	Jean J Labrosse, "MicroC/OS-II The Real Time Kernel" II Edition, CMP Books, 2002.
2.	P.Raghavan, Amol Lad, Sriram Neelakandan, "Embedded Linux System Design and Development",Auerbach Publications, Taylor& Francis Group, 2006.
3.	Christopher Hallinan, "Embedded Linux Primer, A Practical, Real-World Approach", II Edition PearsonEducation, Inc., 2011.

CIE Assessment:

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- Quizzes/mini tests (4 marks)
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iii. One question must be set from each unit. The duration of examination is 3 hours.

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CO4	3	3	3	2	1	1	-	-	1	-	2	1
CO5	3	3	3	2	1	1	-	-	1	-	2	1

High-3, Medium-2, Low-1

Course Title	INDUSTRIAL IOT	Semester	VII
Course Code	MVJ20EC752	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3 Hours

Course objective is to:

- Learn the basic issues, policy and challenges in the Internet.
- Bring the IoT perspective in thinking and building solutions
- Acquire an idea of some of the application areas where Internet of Things can be applied.
- Understand the cloud and internet environment.
- Analyse the various modes of communications with Internet.

Module-1	RBT Level L1,L2, L3	8Hrs.

Prerequisites : Basic Knowledge about C or C++

Introduction to IoT: IoT Vs. IIoT, History of IIoT, Components of IIoT: Sensors, Interface, Networks, People &Process, Hype cycle, IoT Market, Trends& future Real life examples, Key terms: IoT Platform, Interfaces, API, clouds, Data Management Analytics, Mining &Manipulation; Role of IIoT in Manufacturing Processes Use of IIoT in plant maintenance practices, Sustainability through Business excellence tools Challenges & Benefits in implementing IIoT

Video link / Additional online information (related to module if any):

1. http://www.theinternetofthings.eu/what-is-the-internet-of-things.
2. https://www.engineersgarage.com/article_page/sensors-different-types-of-sensors/
3. https://www.educba.com/applications-of-sensors/

Module-2	RBT Level L2, L3	8Hrs.

Architectures: Overview of IoT components ,Various Architectures of IoT and IIoT, Advantages & disadvantages, Industrial Internet, Reference Architecture; IIoT System

components: Sensors, Gateways, Routers, Modem, Cloud brokers, servers and its integration, WSN, WSN network design for IoT. **Applications:** IoT Protocol Applications **Video link / Additional online information (related to module if any):** 1. https://inductiveautomation.com/resources/article/what-is-scada 2. https://iotbytes.wordpress.com/application-protocols-for-iot/ 3. https://data-flair.training/blogs/iot-protocols/ 4. https://www.avsystem.com/blog/iot-protocols-and-standards/		
Module-3	**RBT Level** L2, L3,L4	8Hrs.
Sensor and Interfacing: Introduction to sensors, Transducers, Classification, Roles of sensors in IIoT , Various types of sensors , Design of sensors, sensor architecture, special requirements for IIoT sensors, Role of actuators, types of actuators. Hardwire the sensors with different protocols such as HART, MODBUS-Serial & Parallel, Ethernet, BACNet , Current, M2M etc **Video link / Additional online information (related to module if any):** 1. https://www.digiteum.com/rfid-technology-internet-of-things 2. https://www.uio.no/studier/emner/matnat/ifi/INF5910CPS/h10/undervisningsmateriale/RFID-IoT.pdf		
Module-4	**RBT Level** L3,L4,L6	8Hrs.
Protocols and Cloud: Need of protocols, Types of Protocols, Wi-Fi, Wi-Fi direct, Zigbee, Z wave, Bacnet, BLE, Modbus, SPI , I2C, IIoT protocols –COAP, MQTT,6lowpan, lwm2m, AMPQ IIoT cloud platforms : Overview of cloud platforms, predix, thingworks, azure etc. Data analytics, cloud services, Business models: Saas, Paas, Iaas. **Video link / Additional online information (related to module if any):** 1. https://www.simform.com/home-automation-using-internet-of-things/ 2. https://iot5.net/iot-applications/smart-home-iot-applications/ 3. https://maker.pro/raspberry-pi/tutorial/how-to-connect-and-interface-raspberry-pi-with-arduino# 4. https://create.arduino.cc/projecthub/ruchir1674/how-to-interface-arduino-with-raspberrypi-504b06		

Module-5	RBT Level L4,L5,L6	8Hrs.
IoT Analytics and Applications: IoT Analytics, Role of Analytics in IoT, Data visualization Techniques, Introduction to R Programming, Statistical Methods. Internet of Things Applications: Smart Metering, e-Health Body Area Networks, City Automation, Automotive Applications, Home Automation, Smart Cards, Plant Automation, Real life examples of IIoT in Manufacturing Sector **Video link / Additional online information (related to module if any):** 1. https://www.water-io.com/iot-vs-wot 2. https://www.talend.com/resources/iot-cloud-architecture/		

Course outcomes:	
CO1	Describe IoT and IIoT
CO2	Analyse various IoT Layers and their relative importance
CO3	Design and develop the real life IoT applications using off the shelf hardware software
CO4	Realize the importance of Data Analytics in IoT
CO5	Apply the concepts of Design Thinking

Text Books:	
1.	Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications 2.Bernd Scholz-Reiter, Florian
2.	Cisco, IOT Fundamentals – Networking Technologies, Protocols, Use Cases for IOT, Pearson Education; First edition (16 August 2017). ISBN-10: 9386873745, ISBN-13: 978-9386873743
3.	Raj Kamal,"Internet of Things-Architecture and design principles", McGraw Hill Education.

Reference Books:	
1.	Honbo Zhou, "The Internet of Things in the Cloud:A Middleware Perspective" -C Press-2012
2.	Dieter Uckelmann, Mark Harrison, "Architecting the Internet of Things", Springer201
3.	Arshdeep Bahga, Vijay Madisetti, "Internet of Things (A Hands-On-Approach)", V 2014.

4.	Olivier Hersent, David Boswarthick, Omar Elloumi, “The Internet of Things – applications and Protocols”, Wiley, 2012.
5.	Luigi Atzori, Antonio Lera, Giacomo Morabito, “The Internet of Things: A Survey”, Journal on Networks, Elsevier Publications, October, 2010.

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SEE Assessment:
i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus. ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions. iii. One question must be set from each unit. The duration of examination is 3 hours.

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CO3	3	3	3	2	1	1	-	-	1	-	1	1
CO4	3	3	3	2	1	1	-	-	1	-	1	1
CO5	3	3	3	2	1	1	-	-	1	-	1	1

High-3, Medium-2, Low-1

Course Title	MACHINE LEARNING DESIGN & APPLICATION	Semester	VII
Course Code	MVJ20EC753	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Define machine learning and understand the basic theory underlying machine learning.
- Differentiate supervised, unsupervised and reinforcement learning
- Understand the basic concepts of learning and decision trees.
- Understand neural networks and Bayesian techniques for problems appear in machine learning
- Understand the instant based learning and reinforced learning
- Perform statistical analysis of machine learning techniques.

Module-1	RBT Level L1, L2, L3	8Hrs.

Introduction, Concept learning: Machine Learning Design, Applications of Machine learning, Learning Problems – Well posed learning problems, Designing a Learning system, Concept Learning, Perspective and Issues in Machine Learning.

Laboratory Sessions/ Experimental learning:

1. Implement and demonstrate the FIND-Algorithm for finding the most specific hypothesis based on a given set of training data samples. Read the training data from a .CSV file.

Applications: Data training samples, Speech Recognition algorithm.

Video link / Additional online information :

1. https://nptel.ac.in/courses/106/106/106106139/
2. https://www.digimat.in/nptel/courses/video/106105152/L01.html

Module-2	RBT Level L1, L2, L3	8Hrs.

Decision Tree Learning and Artificial Neural Networks: Decision Tree Representation, Hypothesis Space Search, Inductive bias in decision tree, issues in Decision tree. Neural Network Representation, Perceptrons, Multilayer Networks and Back Propagation Algorithms, Support Vector Machines.

Laboratory Sessions/ Experimental learning:

1. Write a program to demonstrate the working of the decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

Applications:

1. Email Spam and Malware Filtering
2. ID3 algorithm
3. Self-driving cars

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/106/106106198/
2. https://www.youtube.com/watch?v=fPLxFXiS9fU

Module-3	RBT Level L1, L2, L3 & L6	8Hrs.

Bayesian and Computational Learning: Evaluating Hypotheses: Estimating Hypotheses Accuracy, Basics of sampling Theory, Comparing Learning Algorithms. Bayes theorem demonstration and concept learning, Bayes Optimal Classifier, Naive Bayes classifier, Bayesian belief networks, EM algorithm.

Computational Learning Theory: Sample Complexity for Finite Hypothesis spaces, Sample Complexity for Infinite Hypothesis spaces.

Laboratory Sessions/ Experimental learning:

1. Build an Artificial Neural Network by implementing the Back propagation algorithm and test the same using appropriate data sets.

Applications:

1. Artificial Neural Network.
2. Virtual Personal Assistant.
3. Online Fraud Detection.

Video link / Additional online information:

1. https://nptel.ac.in/courses/106/105/106105215/		
Module-4	RBT Level L1, L2, L3	8Hrs.

Instance Based Learning and Learning set of rules: Demonstrate K- Nearest Neighbour Learning, Locally Weighted Regression, Radial Basis Functions, Case-Based Reasoning.

Reinforcement Learning: Introduction, Evaluate Learning Task, Q Learning

Laboratory Sessions/ Experimental learning:

1. Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same dataset for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering.

Applications: Market segmentation, Document clustering

Video link / Additional online information :

1. http://1.https//nptel.ac.in/courses/11706087/
2. https://nptel.ac.in/courses/106/106/106106198/

Module-5	RBT Level L1, L2, L3 & L6	8Hrs.

Analytical Learning: Perfect Domain Theories, Explanation Based Learning, Inductive-Analytical Approaches, FOCL Algorithm.

Real life applications of Machine learning: Develop an algorithm and flowchart for, Traffic prediction, Image recognition and Self-driving cars.

Laboratory Sessions/ Experimental learning:

1. Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

Applications:

1. Regression algorithm.
2. Tower of Hanoi.

Video link / Additional online information:

1. https://nptel.ac.in/courses/117102059/

Course outcomes:	
CO1	Choose the learning techniques and investigate concept learning.
CO2	Identify the characteristics of decision tree and solve problems associated with

CO3	Apply effectively neural networks for appropriate applications.
CO4	Apply Bayesian techniques and derive effectively learning rules
CO5	Evaluate hypothesis and investigate instant based learning and reinforced learning.

Text Books:	
1.	Tom M. Mitchell, "Machine Learning", McGraw-Hill Education (INDIAN EDITION), 2013.
Reference Books:	
1.	Ethem Alpaydin, "Introduction to Machine Learning", 2nd Ed., PHI Learning Pvt. Ltd., 2013.
2.	T. Hastie, R. Tibshirani, J. H. Friedman, "The Elements of Statistical Learning", Springer; 1st edition, 2001.

CIE Assessment:

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- Quizzes/mini tests (4 marks)
- Mini Project / Case Studies (8 Marks)
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SEE Assessment:

i. Question paper for the SEE consists two parts i.e. Part A and Part B. Part A is compulsory and consists of objective type or short answer type questions of 1 or 2 marks each for total of 20 marks covering the whole syllabus.

ii. Part B also covers the entire syllabus consisting of five questions having choices and may contain sub-divisions, each carrying 16 marks. Students have to answer five full questions.

iii. One question must be set from each unit. The duration of examination is 3 hours.

CO-PO Mapping												
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CO3	3	3	3	3	3	1	-	-	2	1	2	1
CO4	3	3	3	3	3	1	1	-	2	1	2	2
CO5	3	3	3	3	2	2	2	-	3	2	3	3

High-3, Medium-2, Low-1

Course Title	ROBOTICS & AUTOMATION	Semester	VII
Course Code	MVJ20EC754	CIE	50
Total No. of Contact Hours	40	SEE	50
No. of Contact Hours/week	3 (L : T : P :: 3 : 0 : 0)	Total	100
Credits	3	Exam. Duration	3Hrs

Course objective is to:

- Study the history, concept development and key components of robotics technologies.
- Know the concept of interfacing actuators and other components
- Understand basic mathematics manipulations of spatial coordinate representation and transformation.
- Learn basic robot forward and inverse kinematic problems
- Analyze basic robotic dynamics, path planning and control problems

Module-1	RBT Level L1, L2, L3 ,L4	8Hrs.

Basic concepts in robotics: Definition, anatomy of robot, basic structure of robot, Specifications and Classification of robot, Safety Measures in robotics, Industrial Applications of Robots. Drives for robots: Electric, hydraulic and pneumatic. Sensors: Internal-External, Contact-noncontact, position, velocity, force, torque, proximity and range.

Laboratory Sessions/ Experimental learning:

1. Interface various sensors with Microcontroller.

Applications: Machine Tending,Picking, Packing and Palletizing, painting,all Industrial applications

Video link / Additional online information:

1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/

<table>
<tr><td>Module-2</td><td>RBT Level
L1, L2, L3 , L4</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Robot drivers, Sensors and Vision :Vision Introduction to techniques, Image acquisition and processing, Different types of grippers- Mechanical, Magnetics ,vacuum, Adhesive, Gripper force Analysis & Gripper Design , overview of actuators, Power and torque, Acceleration and velocity Specifications and characteristics of Stepper motors, AC motors, DC motors and servomotors.
Laboratory Sessions/ Experimental learning:
1. Interface motors using various Motor drivers.
Applications: Industrial application, agriculture robots, surgical robots
Video link / Additional online information:
1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/</td></tr>
<tr><td>Module-3</td><td>RBT Level
L1, L2, L3 ,L4</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Robot Kinematics and Dynamics: Direct and inverse kinematics for industrial robots for position and orientation, Redundancy, Manipulator, direct and inverse velocity. Lagrangian formulation, Link inertia tensor and manipulator inertia tensor, Newton –Eller formulation for RP and RP manipulators, Trajectory planning.
Laboratory Sessions/ Experimental learning:
1. Interface servo motors to form gripper.
Applications: Pick and Place, Excavators, Robotic ARM.
Video link / Additional online information:
1. https://nptel.ac.in/courses/112/105/112105249/
2. https://nptel.ac.in/courses/112/101/112101098/</td></tr>
<tr><td>Module-4</td><td>RBT Level
L1, L2, L3 ,L4</td><td>8Hrs.</td></tr>
<tr><td colspan="3">Robot Kinematics: Dynamics and Programming methods, Robot language classification, Robot language structure, KINEMATICS AND PATH PLANNING: Solution of inverse kinematics problem – multiple solution jacobian work envelop, hill climbing techniques, robot programming languages elements and its functions. Simple programs on Sensing distance and direction, Line Following Algorithms, Feedback Systems.</td></tr>
</table>

Laboratory Sessions/ Experimental learning: 1. Design algorithm for Maze solving robot. **Applications:** Defence, Survillience, Autonomous Vehicle. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/		
Module-5	RBT Level L1, L2, L3 , L4	8Hrs.
Developing and building a robot, Models of flexible links and joints, Robotic arm, Components and structure, Types of joints and workspace, Design models for mechanic arms and lifting systems Multiple robots, machine interface, robots in manufacturing and non- manufacturing applications, robot cell design, selection of robot. Laboratory Sessions/ Experimental learning: 1. Robots in material handling and assembly. Human Robot Interaction **Applications:** Humanoid, Robotic Arms. **Video link / Additional online information:** 1. https://nptel.ac.in/courses/112/105/112105249/ 2. https://nptel.ac.in/courses/112/101/112101098/		

Course outcomes:	
CO1	Analyze the concept development and key components of robotics technologies
CO2	Select the components for interfacing actuators
CO3	Implement basic mathematics manipulations of spatial coordinate representation and Transformation.
CO4	Solve basic robot forward and inverse kinematic problems
CO5	Design robots which are capable to solve basic robotic dynamics, path planning and control problems

Text Books:	
1.	Introduction to Robotics By S.K.Saha , Tata McGraw Hill
2.	Robotics Control ,Sensing ,Vision and Intelligence by K.S. Fu, R.C .Gonzalez, C.S.G.Lee ,Tata McGraw HillJ. Hirchhorn: Kinematics and Dynamics of Machinery, McGraw Hill book co.
Reference Books:	
1.	Robert J. Schilling , Fundamentals of Robotics- Analysis and Control, Prentics Hall india.
2.	Robotics Technology and Flexible Automation by S.R.Deb, S. Deb, Tata McGraw Hill
3.	Robot Motion and Control (Recent Developments) by M.Thoma& M. Morari

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High-3, Medium-2, Low-1