Eighth Meeting of the Senate

September 12th, 2020

Minutes of the Meeting

Indian Institute of Information Technology Vadodara

The eighth meeting of the Senate of Indian Institute of Information Technology Vadodara was held on September 12th, 2020 at 3.30.00 pm through Video Conference mode. This mode was resorted to as a special case arising out of Covid2019 pandemic. The members joined through Video Conferencing with an aim to minimum travel especially for people who are above 50.

The following members were present:

1. Prof. Sarat Kumar Patra, Director IIIT Vadodara, Chairperson
2. Prof. Surendra Prasad, IIT Delhi, Member (on online mode).
3. Prof Gautam Barua, Director IIIT Guwahati (on online mode).
4. Prof. G Sivakumar, IIT Bombay, Member (on online mode).
5. Dr. K. Kesavasamy, TCS, Member (on online mode).
6. Dr. Pratik Shah, IIIT Vadodara, PIC Academics (on online mode).
7. Dr. Dhirendra Sinha, IIIT Vadodara, HoD Sciences and Humanities
8. Dr. Jignesh Bhatt, IIIT Vadodara, HoD Electronics and Communication
9. Dr. Ashish Phophalia, IIIT Vadodara, HoD Computer Science and IT
10. Col Ravi Chugh (Retd), Registrar and Secretary to Senate

Item No	Agenda
SEN:8-1	APPROVE THE MINUTES OF THE SEVENTH MEETING OF THE SENATE HELD ON MAY 2, 2020.
SEN:8-2	RATIFY/ APPROVE THE DECISIONS TAKEN ON THE AGENDA ITEMS CIRCULATED AND APPROVED ON JUNE 9 AND JUNE 29.
SEN:8-3	TO APPROVE THE RESULT OF M.TECH. IN CSE GRADUATING BATCH AND THE LIST OF GRADUATING STUDENTS FOR GRADUATION BATCH 2020 (ADMISSION BATCH 2018-19) OF M.TECH. (CSE).
SEN:8-4	TO APPROVE THE LIST OF MEDAL WINNERS FOR B.TECH. AND M. TECH. GRADUATING BATCH 2020.

SEN:8-5	TO CONSIDER AND APPROVE THE RESULTS OF B.TECH. CSE AND IT 2ND, 4TH AND 6TH SEMESTERS AND M.TECH. CSE 2ND SEMESTER.
SEN:8-6	TO APPROVE THE AUTUMN 2020-21 ACADEMIC CALENDAR FOR M.TECH. IN CSE AND ECE PROGRAMMES FOR ADMISSION BATCH 2020-21.
SEN:8-7	TO DISCUSS AND APPROVE THE CURRICULUM OF M.TECH. IN COMPUTER SCIENCE AND ENGINEERING AND M.TECH. IN ELECTRONICS AND COMMUNICATION ENGINEERING.
SEN:8-8	PHD THESIS EVALUATION. MODIFICATION TO THE PHD ORDINANCE.
SEN:8-9	TO CONSIDER INVITING FOREIGN FACULTY FOR TEACHING COURSES IN ONLINE MODE AND REMUNERATION.
SEN:8-10	PROPOSAL ON CONDUCTING ONLINE-CONVOCATION FOR GRADUATING BATCH 2020
SEN:8-11	TO APPROVE THE POLICY ON EVALUATION OF SWAYAM COURSES
SEN:8-12	TO APPROVE POLICY ON TRANSFERRING CREDITS AND EVALUATION FOR IIT GANDHINAGAR COURSES
SEN:8-13	ANY OTHER ITEM WITH THE PERMISSION OF THE CHAIR. **SEN: 8-T1** APROVAL OF RESULTS OF B.TECH (BACKLOG CASES) **SEN: 8-T2** APPROVE THE RESULTS OF PHD STUDENTS **SEN: 8-T3** APPROVE THE ADDITIONAL LIST OF GRADUATING STUDENTS B.TECH BATCH 2020-21

Prof. SK Patra, Chairperson welcomed the members of the Senate. He welcomed Prof Gautam Barua, Director IIIT Guwahati as a member of the Senate. The Chairperson, thanked Prof. PanduRangan Chandrasekaran for his contribution to IIIT Vadodara as member of Senate.

He also welcomed Dr Ashish Phophalia, HoD Computer Science and Dr Pratik Shah PIC Academics. This was necessitated due to reshuffling of roles within the Institute.

The Chairperson informed that all members were present for the meeting.

SEN:8-1 APPROVE THE MINUTES OF THE SEVENTH MEETING OF THE SENATE HELD ON 2ND MAY 2020.

The Minutes of the "Seventh meeting of the Senate" held on 2nd May 2020 was circulated to all members. The minutes corrected after incorporating the suggestions from the esteemed members of the Senate have been thereafter approved by the Chairperson.

Decision: *The Senate approved and adopted the minutes of the Seventh meeting of the Senate held on 2nd May 2020.*

SEN:8-2 RATIFY/ APPROVE THE DECISIONS TAKEN ON THE AGENDA ITEMS CIRCULATED AND APPROVED ON JUNE 9 AND JUNE 29.

SEN:C8-1 PROPOSAL TO REVISE GRADING AND ASSESSMENT POLICY FOR WINTER 2019-20 SEMESTER (JAN 2020-JUNE 2020) CONSIDERING THE COVID-19 PANDEMIC.

SEN:C8-2 PROPOSAL FOR REVISED TEACHING METHODOLOGY AND ACADEMIC CALENDAR FOR AUTUMN 2020-21 SEMESTER FOR ALL RETURNING STUDENTS OF B.TECH (3RD, 5TH AND 7TH SEMESTER).

SEN:C8-3 TO APPROVE THE RESULT OF 8TH SEMESTER EXAMINATION (ACADEMIC YEAR 2019-20) AND THE LIST OF GRADUATING STUDENTS FOR GRADUATION BATCH 2020 (ADMISSION BATCH 2016-17) OF B.TECH (CSE) AND B.TECH (IT).

The adopted minutes with the email communications are attached as **Annexure-I & Annexure-II** for reference.

Decision: *The Senate noted that Agenda SEN:C8-1 and SEN:C8-2 were already approved on 9th June 2020 by circulation and Agenda SEN:C8-3 was also approved on 29th June 2020.*

SEN:8-3 TO APPROVE THE RESULT OF M.TECH. IN CSE GRADUATING BATCH AND THE LIST OF GRADUATING STUDENTS FOR GRADUATION BATCH 2020 (ADMISSION BATCH 2018-19) OF M.TECH. (CSE)

The results of winter 2019-20 semester for the M.Tech in CSE is placed in **Annexure-III**. The note on the graduation requirement verification is also placed in **Annexure-III.**

Decision: *The Senate noted the contents and approved the results and the graduation list of Admission Batch 2018-19.*

SEN:8-4 TO APPROVE THE LIST OF MEDAL WINNERS FOR B.TECH. AND M. TECH. GRADUATING BATCH 2020.

The list of medal winners of B.Tech and M.Tech programs for graduating batch 2020 is attached as **Annexure-IV.**

Decision: *The Senate approved the names of the medal winners. However, they noted that the criteria of Chairperson's Gold Medal and Institute Medals are on similar lines and as a result the winner of Chairperson's Gold Medal also gets the Rank -1 Institute Medal. They suggested that Chairpersons Gold Medal criteria can be relooked and it can be considered with extended parameters along with academics.*

SEN:8-5 TO CONSIDER AND APPROVE THE RESULTS OF B.TECH. CSE AND IT 2ND, 4TH AND 6TH SEMESTERS AND M.TECH. CSE 2ND SEMESTER.

The summary of the results of Winter 2019-20 for B.Tech. in CSE and IT of 2nd, 4th and 6th semesters along with the list of students under academic probation is placed in **Annexure-V**.

The summary of the results of Winter 2019-20 for M.Tech. in CSE of 2nd semester is placed in **Annexure-VI.**

Decision: *The Senate noted the contents and approved the results.*

SEN:8-6 TO APPROVE THE AUTUMN 2020-21 ACADEMIC CALENDAR FOR M.TECH. IN CSE AND ECE PROGRAMMES FOR ADMISSION BATCH 2020-21.

The institute admits students to its M.Tech. programmes from CCMT. For this year as per the CCMT schedule, the final National Spot Round will conclude on 7th of September, 2020. The students are thereafter required to proceed with the registration and document verification at the allotted institutes (in person/ online depending on the situation). The registration window is for a week, i.e. up to 14th of September, 2020.

Based on the above, the following academic plan is proposed for the M.Tech admission batch 2020-21 (attached as **Annexure-VII**):

Autumn 2020-21 (M.Tech. 2020-21)							
		Acad/Non-Acad (1/0)					
Week	Dates	M	T	W	Th	F	Remarks
0	7-11 Sept	R	R	R	R	R	Document Verification and Registration Week
1	14-18 Sept	1	1	1	1	1	Commencement of Classes 14th September, 2020
2	21-25 Sept	1	1	1	1	1	
3	28 Sept - 2 Oct	1	1	1	1	H	2nd Oct - Mahatma Gandhi's Birthday
4	5-9 Oct	1	1	1	1	1	
5	12-16 Oct	1	1	1	1	1	
6	19-23 Oct	1	1	1	1	1	
7	26-30 Oct	1	1	1	1	H	30th Oct - Id, 27th October to be treated as a Friday
8	2-6 Nov	1	1	1	1	1	
9	9-13 Nov	1	1	1	1	1	
10	16-20 Nov	1	1	E	E	E	18-21 Midterm exam Wednesday-Saturday (Synchronized with the end semester examination of running semester for returning students)
11	23-27 Nov	1	1	1	1	1	
12	30 Nov - 4 Dec	H	1	1	1	1	30th Nov - Guru Nanak Jayanti
13	7-11 Dec	1	1	1	1	1	
14	14-18 Dec	1	1	1	1	1	Course Evaluation Week
15	21-26 Dec	E	E	E	E	H	**21-26 December End Term Examination (Including Saturday)**
	Total Days	**13**	**14**	**13**	**13**	**11**	
*27th October to be treated as a Friday, E-Exam, H-Holiday							

The academic calendar based on the above is presented below:

Autumn 2020-21: Academic Calendar - M.Tech 2020-21			
Sr. No.	Event	Date(s)	Day(s)
1	Registration	7-11 September, 2020	Monday-Friday
2	Commencement of Classes	14th September, 2020	Monday

3	Mid-Semester Examination	18-21 November, 2020	Wednesday-Saturday
5	Course Feedback	14-18 December, 2020	Monday-Friday
6	End-Semester Examination	21-26 December, 2020	Monday-Saturday
7	Last Date of Submission of Grades to Registrar's Office	8th January, 2021	Friday
8	Result Coordination Committee Meeting	18th January, 2021	Friday
9	Announcement of Results	February, 2021	
10	Winter 2020-21 (Registration and Commencement of Classes for Returning Students)	4 January 2021	Monday

The Senate suggested adopting Spot Round admission round to fill up unfilled seats in M.Tech. Institute will formulate process for Spot Admission in M.Tech for Academic Year 2021-22 and beyond.

Decision: *The Senate noted the contents and approved the Academic Calendar.*

SEN:8-7 TO DISCUSS AND APPROVE THE CURRICULUM OF M.TECH. IN COMPUTER SCIENCE AND ENGINEERING AND M.TECH. IN ELECTRONICS AND COMMUNICATION ENGINEERING.

In the sixth meeting of the senate (SEN:6-8), the M.Tech. in ECE program was in principle approved. The curriculum for the same was required to be presented to the senate for its approval in the subsequent meeting. However, due to the disruption in the academic schedule created by the pandemic, the priority was shifted towards planning for the closure of Winter 2019-20 and subsequently begin the Autumn 2020-21 semester. In the seventh meeting of the senate, major decisions related to the academic activities were taken considering the same.

The institute organized a one day workshop for 'M. Tech. Curriculum Development and Revision' on Saturday, 1st Feb 2020. During the workshop, the broad guidelines for curriculum for M.Tech. in ECE were drafted. In addition, some revisions in the M.Tech. in CSE curriculum were incorporated. Based on the discussions and suggestions, revised M.Tech. Curricula for both the programs are prepared and attached in **Annexure-VIII** as reference.

The Salient features of the proposed curriculum are as follows:

Master of Technology Program

The Institute offers two 2-years Master of Technology (M. Tech.) programs under Thesis/Project mode in the following two branches:

1. Computer Science and Engineering (CSE)
2. Electronics and Communication Engineering (ECE)

(I) **The academic program will be offered in 2 modes. These include**

1. Thesis Mode (TM)
2. Project Mode (PM)

A student can opt for any one of the modes. The TM is primarily for the students interested to pursue a research oriented career. They are expected to work on research problems and contribute to the field with research work in specific areas. However, in PM, a student works on industry oriented problems and contributes to develop new technologies / proof of concepts.

(II) Course Categories and Range of Credits for M. Tech. Program

M Tech program offered by the institute is designed with the following credit guidelines presented in table below

Course Categories*	Thesis Mode		Project Mode	
	Min Credit	Max Credit	Min Credit	Max Credit
Program Core	12	16	12	16
Program Elective	14	20	14	20
Thesis / Project	22	24	22	24
Total Credits	54-60		54-60	

**Types of courses to be offered as Program Core and / or Program Elective in terms of Lecture-Tutorial-Practical: Credits (L-T-P: C) are*

Program Core: *3-0-0: 3, 0-1-2: 2, 2-0-0: 2, 1-0-2: 2, 3-0-2: 4, 3-1-0: 4*

Program Elective: *3-0-0: 3, 1-0-0: 1, 1-0-2: 2, 0-1-2: 2, 1-0-2: 2*

Comprehensive Viva: *0-0-0: 2*

Research / Project Work: *0-0-3: 2, 0-0-6: 4*

Note: *Courses with (1-x-x) or (0-x-x) will not be evaluated through mid- and end-semester examinations*

(III) Graduation Requirements

A student to be eligible to receive M Tech degree should meet the following criteria:

[A] Thesis Mode:

1. Completed all registered courses with minimum DD/Pass Grade.
2. Should have secured CPI ≥ 6.00 (on 10.00 point scale).
3. Should have acquired minimum 34 credits in 'Graded Courses' out of which there must be at least
   - 14 credits from Program Core,
   - 14 credits from Program Electives and
   - 4 credits from HS Electives.
4. Should have secured minimum 22 credits from 'Thesis' and 2 credits of Comprehensive viva.

[B] Project Mode

1. Completed all registered courses with minimum DD/Pass Grade.
2. Should have secured CPI ≥ 6.00 (on 10.00 point scale).
3. Should have acquired minimum 37 credits in 'Graded Courses' out of which there must be at least
   - 14 credits from Program Core,
   - 16 credits from Program Electives and
   - 4 credits from HS Electives.
4. Should have secured minimum 22 credits from 'Project'.

Decision: *The Senate noted the contents and approved the following:*

1. The Senate did not accept the proposal of thesis mode/ Project mode as two different modes. The revised M.Tech CSE curriculum is enclosed at ***Annexure*** **XVI**. *The curriculum has been suitably modified.*

2. The Comprehensive exam be replaced with stage evaluations which could be organized periodically and can be termed as Project Part – I, Project Part –II etc.

3. As no admissions were received in M.Tech ECE, it was suggested that the programme may be modified with some specialization such as ICT. The curriculum to be proposed and presented to the Senate in due course.

SEN: 8.8 PHD THESIS EVALUATION. MODIFICATION TO THE PHD ORDINANCE.

The PhD ordinance of the institute currently does not contain the process of the thesis submission and evaluation. The detail process along with associated forms is enclosed as **Annexure-IX**.

Decision: *The Senate noted the contents and approved the proposal.*

SEN:8-9 TO CONSIDER INVITING FOREIGN FACULTY FOR TEACHING COURSES IN ONLINE MODE AND REMUNERATION THERE TO.

The institute is taking services of visiting faculty to meet its teaching requirements at UG and PG level courses. In order to include faculty members from foreign Universities/ Institutes for online teaching, a committee was set up by the director on 22nd July 2020. The committee was to recommend the remuneration amount for the visiting faculty who are regular faculty of a foreign University/ Institute (full time teaching faculty at foreign universities).

Decision: *The Senate noted that Institute had already hired one faculty from Czech Republic. However, they suggested to go slow on this as it has its own merits and demerits. Institute confirmed hiring services of only one to two experts in a semester. These courses will be taught in online mode and implemented for elective courses only.*

SEN:8-10 PROPOSAL ON CONDUCTING ONLINE-CONVOCATION FOR GRADUATING BATCH 2020.

The institute is planning to consider hosting its third convocation. Considering the COVID19 situation it is proposed to host the online. POSSIBLE DATES 04-07 NOV 2020/ 21 NOV 2020. CONVOCATION WAS USUALLY HELD ON SECOND SATURDAY. THIS YEAR THE SECOND SATURDAY, 14TH NOV 2020 IS DIWALI.

Decision: *The Senate approved the proposal of online convocation.*

SEN:8-11 TO APPROVE THE POLICY ON EVALUATION OF SWAYAM COURSES.

A draft policy on evaluation of SWAYAM courses is placed in **Annexure-XI**.

Decision: *The Senate approved the policy on evaluation of SWAYAM courses.*

SEN:8-12 TO APPROVE POLICY ON TRANSFERRING CREDITS AND EVALUATION FOR IIT GANDHINAGAR COURSES.

A draft policy on transferring credits and evaluation for IIT Gandhinagar courses is placed in **Annexure-XII.**

Decision: *The Senate approved the policy on transferring credits and evaluation for IIT Gandhinagar courses.*

SEN:8-13 ANY OTHER ITEM WITH THE PERMISSION OF THE CHAIR.

Secretary informed the Chairperson that there are three Agenda which are received from Academic Section and need immediate attention as they are related with results and graduation list. He requested that if these could be taken as a Table Item. With the approval of the Chair, following Items was taken as a table Items:

SEN: 8-T1 APROVAL OF RESULTS OF B.TECH (BACKLOG CASES)

To approve the results of undermentioned students who have passed their examinations with backlog courses:

Ser No	Admission Batch	No of Students	Name of Students
1.	2017-18 CSE	1	Exempted under Section 8 (1) (e) and Section 8 (1) (j) of RTI Act 2005
2.	2016-17 CSE	5	
3.	2016-17 IT	1	
4.	2015-16 IT	1	
5.	2014-15 IT	1	
	Total	**9**	

The details are enclosed in **Annexure XIII**.

Decision: *The Senate approved the results.*

SEN: 8-T2 APPROVE THE RESULTS OF PHD STUDENTS

The results of PhD students of Admission Batch 2016-17 to 2018-19 is enclosed as **Annexure XIV**.

Decision: *The Senate approved the results.*

SEN: 8-T3 APPROVE THE ADDITIONAL LIST OF GRADUATING STUDENTS B.TECH BATCH 2020

The summary of graduating B.Tech Batch 2020 is as under:

Ser No	Admission Batch	No of Students	Remarks
1.	2016-17 CSE	61	Exempted under Section 8 (1) (e) and Section 8 (1) (j) of RTI Act 2005
2.	2016-17 IT	20	
3.	2015-16 IT	1	
4.	2014-15 IT	1	

	Total	83	Seventy five (75) students list was approved vide circulation Agenda SEN: C8-3 dated 22 June 2020. Eight (08) students added now in Graduation List Total 83 students in the graduation list for B.Tech.

The details are enclosed in **Annexure XV**.

Decision: *The Senate approved the graduation list of 83 graduates in B.Tech.*

Indian Institute of Information Technology Vadodara

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AGENDA APPROVAL OF SENATE THROUGH CIRCULATION

AGENDA

Circulation Item No	Agenda
SEN:C8-1	Proposal to Revise Grading and Assessment Policy for Winter 2019-20 semester (Jan 2020-June 2020) considering the COVID-19 Pandemic.
SEN:C8-2	Proposal for revised teaching methodology and Academic Calendar for Autumn 2020-21 semester for all Returning Students of B.Tech programmes (3rd, 5th and 7th semester).

SEN: C8-1 PROPOSAL TO REVISE GRADING AND ASSESSMENT POLICY FOR WINTER 2019-20 SEMESTER (Jan 2020-June 2020) CONSIDERING THE COVID-19 PANDEMIC.

1. The institute adopted to online teaching in the month of March following Covid19 pandemic and students asked to go home. It is a milestone for the institute that the institute has been able to conclude the winter 2019-20 semester teaching by 30th April 2020 for all UG and PG programs. The Senate in its 7th meeting held on 02nd May 2020 had formalized assessment policy for the semester. The salient features are enumerated below.

2. **Examination and Evaluation Policy for Winter 2019-20 (January 2020 to June 2020 session)**. Every graded course theory has following evaluation components:

   (a) Two in-semester examinations (together constituting at least 30%)
   (b) One end-semester examination (constituting at least 45%)
   (c) Continuous evaluation in the form of quizzes, assignments and projects assigned by the course teacher (remaining component).

3. Due to the effect of pandemic, the institute could not hold the second in-semester examination and the end-semester examination. The Senate in its 7th meeting held on 02 May 2020 approved the following evaluation process for the current semester

(a) Conduct of Online viva-voce of B.Tech 4th Year students.

(b) Conduct of remote examination of 3rd Year B.Tech and 1st Year M.Tech students in the month of May 2020 and associated directions for conduct of examination.

(c) In-principle approval for conduct of remote examination for 1st and 2nd Year (2^{nd} and 4^{th} semester final examination respectively) students to be held in June 2020.

(d) Revision of Assessment Policy as under:

"The faculty members will compensate for second in-semester examination evaluation by either taking multiple quizzes or weighing the first in-semester exam and end semester exam proportionately. The course instructor should take approval from the Director about the same and inform students immediately."

(e) To conduct supplementary exams only once in a year and that too in summer i.e. in vacation before the commencement of autumn semester.

(f) The Senate ratified the decision taken of removing summer internship (COURSE CODE-.PC-303/PC-304) from graduation requirement for the students of B Tech 2017 batch in light of Covid-19 pandemic. However, after noting that some students are still interested to continue with internship in their own interest, the Senate suggested some projects under faculty guidance be given to students who are not involved in internship to use their time fruitfully. This can be done if feasible by discussing with faculty and students.

4. **Under Graduate Programmes (4th Year B.Tech. in CSE and IT)**. Following has been completed as part of the evaluation process:

(a) The fourth year students (8th semester) have only the B.Tech project in the final semester. B Tech Project evaluation has been completed. The in-campus seminar presentation was replaced by online presentation. Following this their result has been compiled and will be declared and presented to Senate in due course.

(b) There has been no change in the evaluation policy.

(c) The institute has ensured that the students of the graduating batch will receive their results and degree in time.

5. **Under Graduate Programmes (3^{rd} Year (6th semester), 2^{nd} Year (4th semester) and 1^{st} Year (2nd semester) B.Tech in CSE and IT)**

(a) The second in-semester examination evaluation will be compensated by either a quiz or weighing the first in-semester exam and end semester exam proportionately.

(b) The end semester examination will be held in remote examination mode. The students will be required to upload their scanned answer sheet.

(c) There will be no deviation in the evaluation policy from the regular evaluation policy of the institute.

(d) However, taking a considerate view of the pandemic situation, mental stress in students, evaluation of courses in multiple Institute of National Importance, the following is being proposed for consideration of the Senate:

(i) No 'F' grade to be awarded. The minimum grade awarded will be "DD" equivalent to 4/10 points.

(ii) Students can register for grade improvement in which he/she is awarded 'DD' grade (The minimum passing grade).

(iii) As a special provision, at the end of current semester (Winter 2019-20 semester), no student will be terminated from the respective academic programs for not meeting the required performance criteria as prescribed in the ordinance (Rule BTR 14.3: ***Discontinued from Institute on account of poor academic performance at the end of the second and fourth semester***, refers".

Note: - The remote end-semester examination for 3rd Year (6th semester) B.Tech students has concluded on 31st May 2020. The students being engaged in summer internships, the examinations were held on Saturdays and Sundays. The end semester examination of 1st year and 2nd year students has been scheduled in the second half of June 2020.

6. **Post Graduate Programmes (M Tech)**

(a) 2nd Year M.Tech (4th semester): The 2nd Year M.Tech students have to submit and defend their thesis which is part of their one year of thesis work. The activity will be taken up in the month of June. There is no change in the evaluation guidelines. However, the Institute is considering online presentation subject to conditions at the time of evaluation.

(b) 1st Year M.Tech (2nd semester): There is no major deviation from the existing policy except that second in-semester exams will be compensated proportionately. The end semester examination has been held in remote mode. The examination has concluded on 31st May 2020. There will be no change in the evaluation policy from the regular evaluation policy of the institute. In line with B Tech evaluation policy following is proposed

(i) No 'F' grade will be awarded. The minimum grade awarded will be "DD" equivalent to 4/10 points.

(ii) Students will be permitted to reappear courses with DD grade for grade improvement.

(d) **Doctoral students:** There are no changes in the evaluation guidelines for the PhD students. Their research progress seminar will be evaluated as per the regular evaluation guidelines. If required the presentation will be carried out through video conferencing technology. However, the institute is considering the extension in timelines for the evaluation schedule.

7. The above proposal is in line with some of the National level institutes like IIT Kanpur and IIT Gandhinagar.

8. **Summary**. The following is the summary:

(a) **B.Tech Programme**.

Ser No	4th Year	3rd Year	2nd and 1st Year B.Tech
(i)	No Change; Results will be declared as per schedule.	Remote Exams conducted successfully.	Remote Exams to be conducted from 15th June 2020.
(ii)	Presentation has been completed in remote mode and evaluation completed.	No major deviation from the existing policy. Exception: Second in-semester exams will be compensated proportionately from first in-semester exam and end-semester examination performance.	
(iii)		Due to pandemic situation the following is being proposed for the Senate approval: (aa) No 'F' grade will be awarded. Minimum grade to be awarded DD. (ab) Students can reappear end semester examination for grade improvement in which he/she secures 'DD' grade. (ac) As a special provision, at the end of Winter 2019-20 semester, no student will be terminated from the respective academic programs for not meeting the required CPI criteria as prescribed in the ordinance.	

(b) **M.Tech Programme.**

Ser No	2nd Year	1st Year
(i)	No major deviation from the existing policy except the institute is considering evaluation of the dissertation one month late in July 2020.	No major deviation from the existing policy except that second in-semester exams will be compensated proportionately. No 'F' grade will be awarded. The minimum grade awarded will be "DD". Remote Exams conducted successfully.

(c) **Doctoral Students**. No major deviation from the existing policy except that the institute is considering providing some extension in timelines for the evaluation.

9. It is further proposed that in case there are clear directions from MHRD on non-conducting the end semester examination then the evaluation policy will be suitably modified based on Government directives.

10. The current proposed policy is generally in line with the other Institutes of National Importance and considering the local conditions of the Ahmedabad/ Gandhinagar region during the ongoing COVID-19 pandemic conditions.

In view of COVID-19 pandemic, mental health of students and considering the national sentiment prevailing in the country in relation to students, the Senate is requested to approve the proposed modification to the policy for the Academic Year 2019-20 as a special case.

SEN:C8-2 PROPOSAL FOR REVISED TEACHING METHODOLOGY AND ACADEMIC CALENDAR FOR AUTUMN 2020-21 SEMESTER FOR ALL RETURNING STUDENTS OF B.TECH PROGRAMMES (3RD, 5TH AND 7TH SEMESTER).

1. In view of uncertainties associated with the COVID-19 pandemic and the general directions that Institute should reopen with direction of Central and State Government, discussion with stakeholders and parents, the time frame for resumption of academic activities at institutes is not clear. It is unlikely that the Institute can open in July 2020 (for undergraduate students), wherein students can attend classes in physical mode. It also important to note that, institutes will have to observe Ministry of Health and Family Welfare guidelines on health and social distancing in classrooms and Hostel. Considering this it is proposed that all lectures during

the Autumn 2020-21 session will be held online till the point institute is in a position to call students to the campus meeting government guidelines.

2. **It is proposed to commence the classes for returning students of 3rd, 5th and 7th semesters online from 20th July 2020.**

3. The academic calendar and academic planning for the returning students for the Autumn Semester Academic Year 2020-21 are placed in Annexure I and Annexure II respectively. The full academic calendar will be considered by the Senate after the admission dates are finalized by the respective agencies and resumption of campus activities are finalized.

4. The institute is in process of setting up the guidelines for the online mode of teaching-learning activities for Autumn 2020-21. Once finalized, it will be placed for approval of the Senate.

5. The Institute will work on six day per week on need basis if students are permitted to return to campus.

The Senate is requested to approve the proposed academic schedule for Autumn 2020-21.

Annexure I

Indian Institute of Information Technology Vadodara			
Autumn 2020-21			
Academic Schedule - Returning B.Tech. Students			
Sr. No.	**Event**	**Date(s)**	**Day(s)**
1	Commencement of Classes for Returning Students	20 July 2020	
2	Mid-Semester Examination	9-18 September 2020	Wednesday - Friday
3	Semester Break for Students (Break will not be considered if classes are held in remote mode)	21-22 September 2020	Monday - Tuesday
4	Course Feedback	9-13 November 2020	Monday - Friday
5	End-Semester Examination (Returning Students and)	18-27 November 2020	Wednesday - Friday
6	Last Date of Submission of Grades to to Academic Office	7 December 2020	Monday
7	Result Coordination Committee Meeting	14 December 2020	Monday
8	Announcement of Results	December 2020	
9	B.Tech. Student Vacation	28 November – 1 January 2020	
10	Winter 2020-21 (Registration and Commencement of Classes for Returning Students)	4 January 2020	Monday

* Comprehensive schedule with Non-Academic activities will be put once the details of 1st year academic activities are finalized by the respective agencies and resumption of campus activities are finalized.

Annexure II

Autumn 2020-21 (Returning B.Tech. students)							
		Acad/Non-Acad (1/0)					
Week	Dates	M	T	W	Th	F	Remarks
1	20-24 July	1	1	1	1	1	Commencement of classes for all returning students
2	27-31 July	1	1	1	1	1	
3	3-7 Aug	1	1	1	1	1	
4	10-14 Aug	1	1	H	1	1	12th May - Janmashtmi
5	17-21 Aug	1	1	1	1	1	
6	24-28 Aug	1	1	1	1	1	
7	31 Aug - 4 Sept	1	1	1	1	1	
8	7-11 Sept	1	1	E	E	E	9-18 September, Examination period (10 Days including Saturday and Sunday)
9	14-18 Sept	E	E	E	E	E	
10	21-25 Sept	B	B	1	1	1	
11	28 Sept - 2 Oct	1	1	1	1	H	2nd Oct - Mahatma Gandhi's Birthday
12	5-9 Oct	1	1	1	1	1	
13	12-16 Oct	1	1	1	1	1	
14	19-23 Oct	1	1	1	1	1	
15	26-30 Oct	1	1	1	1	H	30th Oct - Id
16	2-6 Nov	1	1	1	1	1	
17	9-13 Nov	1	1	1	1	1	
18	16-20 Nov	M	M	E	E	E	18-27 November, Examination period (10 Days including Saturday and Sunday)
19	23-27 Nov	E	E	E	E	E	
	Total Days	15	15	14	15	13	

***7th September, 2020 Monday will be treated as a Friday.**

H: Holiday

B: Break for students

M: Additional days for make-up classes

E: Examination

Indian Institute of Information Technology Vadodara

Block No. 9, Government Engineering College, Sector 28,

Gandhinagar, Gujarat, India - Contact No. 079- 2397 7511

AGENDA APPROVAL OF SENATE THROUGH CIRCULATION

AGENDA

Circulation Item No	Agenda
SEN:C8-3	To approve the result of 8th semester examination (Academic Year 2019-20) and the list of graduating students for Graduation Batch 2020 (Admission Batch 2016-17) of B.Tech (CSE) and B.Tech (IT).

SEN: C8-3 TO APPROVE THE RESULT OF 8TH SEMESTER EXAMINATION (Academic Year 2019-20) AND THE LIST OF GRADUATING STUDENTS FOR GRADUATION BATCH 2020 (ADMISSION BATCH 2016-17) OF B.TECH (CSE) AND B.TECH (IT).

1. The total number of students in the graduating batch 2020 are 81. Out of them 75 students meet the graduation requirement. Six students do not meet the graduation requirement due to courses with "F" grade etc. The detailed report verified by the Committee is enclosed as **Annexure I.** The result is summarized below:

Summary of Performance of B.Tech Students 2016-17 Admission Batch

B.Tech (Batch)	Program	Highest CPI	Average CPI	Lowest CPI
2016-17	CSE	9.50	7.69	5.60
	IT	8.47	7.23	6.17

Batch	Number of Students	CPI ≥ 9.00	CPI: 6.50 – 8.99	CPI: 5.00 – 6.49	CPI<5.00
2016-17	CSE (56)	06	44	06	00
	IT (19)	00	14	05	00

2. The statistics of students' performance for the batch are as under:

	2016-17 (CSE)	2016-17 (IT)
Max CPI	9.50	8.47
Avg CPI	7.69	7.23
Minimum CPI	5.60	6.17
Maximum SPI (8^{th} sem)	10.00	10.00
Avg SPI (8^{th} sem)	9.34	9.16

Exempted under Section 8 (1) (e) and Section 8 (1) (j) of RTI Act 2005

Summary of performance of M.Tech students is placed below:

M.Tech (Batch)	Program	Highest CPI	Average CPI	Lowest CPI
2018-19	CSE	9.12	8.13	6.55

Batch	Number of Students	CPI ≥ 9.00	CPI: 8.00 – 9.00	CPI: 7.00 – 8.00	CPI≤7.00
2018-19	CSE (13)	02	06	03	02

(A) Summary of student performance:

M.Tech in Computer Science and Engineering.

	2018-19 - CSE
Max CPI	9.12
Avg CPI	8.13
Lowest CPI	6.55

Annex – IV

24.08.2020

Minutes of the Meeting held on 14th August , 2020

Subject: Nomination of Student for Chairperson's Gold Medal for B.Tech. Programs (Batch 2016-17)

As per the guidelines for selection of the recipient of Chairperson's Gold Medal, a meeting of the following members of the committee was held on 14th August, 2020.

Exempted under Section 8 (1) (j) of RTI Act 2005

Guidelines for selecting B.Tech. student:

For the award of the Chairperson's gold medal, the cumulative performance index (CPI) will be considered. The student should have

1. Minimum CPI of 9.00
2. The highest CPI in the batch
3. Not been put on academic probation during the academic program duration
4. Not been put on disciplinary probation during the academic program duration
5. No fail 'F' grade in the transcript.

In case of more than one candidate with the same CPI qualify for the award, all candidates will be awarded the medal.

Recommendation:

The following student has been identified meeting the criteria:

Sr No.	Student ID	Student's Name	CPI	Program
1	201651024	KIRTIKA SINGHAL	9.50	B Tech CSE

It is therefore recommended that Ms. KIRTIKA SINGHAL (Batch 2016-17) to be awarded the Chairperson's gold medal for academic excellence in the Convocation.

24 .08.2020

Minutes of the Meeting held on 14th August , 2020

Subject: Nomination of Student for Institute Gold and Silver Medals for B.Tech. Programs (Batch 2016-17)

As per the guidelines for selection of the recipient of Institute Gold and Silver Medal, a meeting of the following members of the committee was held on 14th August, 2020.

Exempted under Section 8 (1) (j) of RTI Act 2005

Guidelines for selecting B.Tech. student:

For the award of institute gold and silver medals, the cumulative performance index (CPI) will be considered. The student should have

1. Minimum CPI ≥ 8.50
2. The Institute Gold Medal will be awarded to students who have secured first places in their respective program.
3. The Institute Silver Medal will be awarded to the second place holders for each program.

In case of more than one candidate with the same CPI qualify for the award, all candidates will be awarded the medal.

Recommendation:

The following students have been identified meeting the criteria:

Sr. No.	Program	Student ID	Student's Name	CPI	Program	Institute Medal
1	B.Tech CSE	201651024	KIRTIKA SINGHAL	9.50	B Tech CSE	Rank 1
		201651051	VAAIBHAVI SINGH	9.36	B Tech CSE	Rank 2
2	B.Tech IT	No student found meeting the criteria.				

Gold
Silver

It is therefore, recommended that, Ms. KIRTIKA SINGHAL (ID 201651024)(Batch 2016-17) be awarded the Institute gold medal and Ms. VAAIBHAVI SINGH (ID 201651051) (Batch 2016-17) be awarded the Institute silver medal for academic excellence in the Convocation.

24 . 08 . 2020

Minutes of the Meeting held on 14th August , 2020

Subject: Nomination of Student for the Chairperson's Gold Medal for M.Tech Programs (Batch 2018-19)

As per the guidelines for selection of the recipient of the Chairperson's Gold Medal, a meeting of the following members of the committee was held on 14th August, 2020.

Exempted under Section 8 (1) (j) of RTI Act 2005

Guidelines for selecting M.Tech student:

For the award of the chairperson's gold medal, the cumulative performance index (CPI) will be considered. The student should have

1. Minimum CPI of 9.00
2. The highest CPI in the batch
3. Not been put on academic probation during the academic program duration
4. Not been put on disciplinary probation during the academic program duration
5. No fail 'F' grade in the transcript.

In case of more than one candidate with the same CPI qualify for the award, all candidates will be awarded the medal.

Recommendation:

The following student has been identified meeting the criteria:

Sr No.	Student ID	Student's Name	CPI	Program
1	201861002	ARPAN DAM	9.12	M. Tech in CSE

It is therefore recommended that Mr. ARPAN DAM (Batch 2018-19) to be awarded the Chairperson's gold medal (Batch 2018-19) in the Convocation.

24 .08.2020

Minutes of the Meeting held on 14th August , 2020

Subject: Nomination of Students for Institute Gold and Silver Medals for M.Tech. Programs (Batch 2018-19)

As per the guidelines for selection of the recipient of Institute Gold and Silver Medal, a meeting of the following members of the committee was held on 14th August, 2020.

Exempted under Section 8 (1) (j) of RTI Act 2005

Guidelines for selecting M.Tech. student:

For the award of institute gold and silver medals, the cumulative performance index (CPI) will be considered. The student should have

1. Minimum CPI ≥ 8.50
2. The Institute Gold Medal will be awarded to students who have secured first places in their respective program.
3. The Institute Silver Medal will be awarded to the second place holders for each program.

In case of more than one candidate with the same CPI qualify for the award, all candidates will be awarded the medal.

Recommendation:

The following students have been identified meeting the criteria:

Sr. No.	Student ID	Student's Name	CPI	Program	Institute Medal
1	201861002	ARPAN DAM	9.12	M Tech CSE	Rank 1
2	201861010	SHAIKH SAMEER ARIF	9.03	M Tech CSE	Rank 2

Gold
Silvere.

It is therefore recommended that Mr. Arpan Dam (201861002) be awarded the Institute gold medal and Mr. Sharikh Sameer Arif (201861010) to be awarded the Institute silver medal for academic excellence in the Convocation.

ANNEXURE – V

(Exempted under Section 8 (1) (e) and section 8 (1) (j) of RTI Act 2005)

ANNEXURE – VI

(Exempted under Section 8 (1) (e) and section 8 (1) (j) of RTI Act 2005)

Autumn 2020-21 : Academic Calendar - M.Tech. 2020-21			
Sr. No.	**Event**	**Date(s)**	**Day(s)**
1	Registration	7-11 September, 2020	Monday-Friday
2	Commencement of Classes	14th September, 2020	Monday
3	Mid-Semester Examination	18-21 November, 2020	Wednesday-Saturday
5	Course Feedback	14-18 December, 2020	Monday-Friday
6	End-Semester Examination	21-25 December, 2020	Monday-Friday
7	Last Date of Submission of Grades to Registrar's Office	8th January, 2021	Friday
8	Result Coordination Committee Meeting	18th January, 2021	Friday
9	Announcement of Results	February, 2021	
10	Winter 2020-21 (Registration and Commencement of Classes for Returning Students)	4 January 2021	Monday

PIC Academics

PIC - PG courses

HoD CS/IT

Autumn 2020-21 (M.Tech. 2020-21)							
		Acad/Non-Acad (1/0)					
Week	Dates	M	T	W	Th	F	Remarks
0	7-11 Sept	R	R	R	R	R	Document Verification and Registration Week
1	14-18 Sept	1	1	1	1	1	Commencement of Classes 14th September, 2020
2	21-25 Sept	1	1	1	1	1	
3	28 Sept - 2 Oct	1	1	1	1	H	2nd Oct - Mahatma Gandhi's Birthday
4	5-9 Oct	1	1	1	1	1	
5	12-16 Oct	1	1	1	1	1	
6	19-23 Oct	1	1	1	1	1	
7	26-30 Oct	1	1	1	1	H	30th Oct - Id, 29th October to be treated as a Friday
8	2-6 Nov	1	1	1	1	1	
9	9-13 Nov	1	1	1	1	1	
10	16-20 Nov	1	1	E	E	E	18-21 Mid term exam Wednesday-Saturday (Synchronized with the end semester examination of running semester for returning students)
11	23-27 Nov	1	1	1	1	1	
12	30 Nov - 4 Dec	H	1	1	1	1	30th Nov - Guru Nanak Jayanti
13	7-11 Dec	1	1	1	1	1	
14	14-18 Dec	1	1	1	1	1	Course Evaluation Week
15	21-25 Dec	E	E	E	E	E	21-25 December End Term Examination
	Total Days	**13**	**14**	**13**	**13**	**11**	
*27th October to be treated as a Friday							

PIC Academics PIC-PG courses HOD CSE/IT.

Annx - VIII

Curriculum-2020

Master of Technology

in

Computer Science and Engineering

&

Electronics and Communication Engineering

Indian Institute of Information Technology Vadodara

Table of Contents

Master of Technology Program

The Institute offers a 2-years Master of Technology (M. Tech.) program under Thesis/Project mode in the following two branches:

1. Computer Science and Engineering (CSE)
2. Electronics and Communication Engineering (ECE)

The academic program will be offered in two modes. These include

1. Thesis Mode (TM)
2. Project Mode (PM)

A student can opt for any one of the modes. The TM is primarily for the students interested to pursue a research oriented career. They are expected to work on research problems and contribute to the field with research work in specific area(s). However, in PM, a student works on industry oriented problems and contributes to develop new technologies/proof of concepts.

Academic Year (1st July - 30th June)

Each academic year is divided into two semesters of approximately eighteen weeks duration with at least seventy working days for classes in each semester. The two semesters are:

1. Autumn Semester (July-November)
2. Winter Semester (January-April)

In addition, there are two inter-semester breaks:

1. Winter (December)
2. Summer (May-June)

The Senate approves schedules of academic activities for an academic year, inclusive of dates for registration, mid-semester and end-semester examinations, inter-semester breaks etc. The schedule is laid down in the Academic Calendar for the year.

Registration

At the beginning of each semester, until the completion of the program, a student must register for the semester and for the courses that he/she will study during the semester.

Eligibility for Course Registration

A student with no backlog courses (*i.e.* who has passed all the previous courses) will be eligible to register for all courses prescribed in the curriculum for semester. A student who has a backlog course(s) or is on academic probation may be recommended a different set of courses by the Dean of Academic Programs (Dean-AP).

Prerequisite Courses

A student registering for a course must have successfully completed the prerequisite course(s), if any, for that particular course. For hard prerequisites, a minimum grade of 'DD' is required.

Auditing of Courses

Auditing of courses allows students to gain exposure to additional subjects without increasing their overall workload. Registration of courses for Audit is permitted from third semester onwards under the following conditions:

1. A student can audit a maximum of two courses during the entire program.
2. A student has to enter the courses to be audited in the Course Registration Form while registering for the semester. The word 'Audit' would be specially mentioned in the remarks column of the student's course registration form.
3. A student can register a course for audit provided the following two conditions are satisfied: (*i*) the course instructor permits and approves the registration, and (*ii*) the lecture, lab and tutorial time-table strictly permits.
4. An audit course will not be considered as an overload.
5. If the student's performance is satisfactory, a grade of 'P' (Pass) would be awarded. If the performance is not satisfactory, 'F' (Fail) would be awarded.
6. An audit course will not be considered for the calculation of Semester Performance Index (SPI) / Cumulative Performance Index (CPI). However, the course will be reflected in the Semester Grade Report and Transcript as an Audit Course provided a grade of 'P' was obtained, otherwise the course will not appear in the Semester Grade Report and Transcript.

Course Load in Regular Semesters

A student is permitted to register for additional courses over the prescribed courses in the curriculum for a regular semester provided the total number of courses does not exceed 7 and the total credits do not exceed 26. A student is permitted to under-load his/her prescribed academic load in a regular semester by dropping one or more courses provided the number of courses is at least 4 and the registered credits are not less than 12.

Course Assessment

The assessment of students' academic performance includes mid-semester and end-semester examinations along with other continuous evaluation components. The various components of continuous assessment in a course may include home assignments, tutorial assignments, group assignments, quizzes, tests (open or closed book), viva-voce, mini projects, etc. Attendance in lectures/ tutorials/ labs may also be given due weightage in course assessment. The instructor may make attendance in lectures/ tutorials/ labs compulsory (80% or less). The instructor may, in due consultation with the Dean-AP, award 'F' grade to students who do not achieve the prescribed level of attendance in that course.

The distribution of weightage, for the assessment of academic performance of students in a course, through various modes listed above will be communicated by the course instructor at the beginning of the semester with due approval from the Director.

Letter Grade (10-point Scale)

For every course registered by a student, he/she is awarded a letter grade based on his/her combined performance in all the assessments. These letter grades are assigned points on a 10-point scale as described in the table below:

Letter Grade	Points	Remark
AA	10	Outstanding
AB	9	Excellent
BB	8	Very Good
BC	7	Good
CC	6	Average
CD	5	Below Average
DD	4	Poor
F	0	Fail
P	-	Pass
I	-	Incomplete

A student passes the course if he/she gets any grade in the range of 'AA' to 'DD', but fails if he/she gets the grade 'F'. Certain courses are indicated as Pass/Fail courses, and in these courses a grade of 'P' or 'F' is awarded. 'F' grade may also be awarded in case of malpractice in examination/continuous evaluation process. Pass/Fail courses are not considered for calculation of SPI/CPI.

'I' grade will be awarded in a course if the overall performance of the student is satisfactory in the course, but the student either misses the end-semester examination due to illness, accident/death in the family or obtains such an approval from the Dean-AP under exceptional circumstances. A student who misses the end-semester examination must apply for permission with reasoning and proof. An application not so supported will not be considered. Grade 'I' awarded for missing the end-semester examination will be converted into a performance grade (depending on the overall performance of the student in the course) after taking an examination equivalent to the end-semester examination of that particular course. An 'I' grade must be converted into a performance grade by the specified date in the academic calendar for the next semester, otherwise it will be converted into an 'F' grade.

Performance Indices

[A] Semester Performance Index (*SPI*)

The performance of a student in a semester is indicated by the *SPI*. The *SPI* is the weighted average of the grade points obtained in all the courses registered by the student during the semester, calculated to two decimal places.

[B] Cumulative Performance Index (*CPI*)

An up-to-date assessment of the overall performance of a student from the time of entering the Institute is obtained by calculating the student's *CPI*. The *CPI* is a weighted average of the grade points obtained in all the courses registered for credit by the student after entering the Institute. The *CPI* is also calculated to two decimal places.

Calculation of *SPI* and *CPI*

Let the course credits are, U1, U2,....and the numeric values of the corresponding grade awarded in the courses are ,G1, G2….., respectively, the SPI is given by

$$SPI = \frac{U1G1+U2G2+.....}{U1+U2+.....}$$

In the above computation, the courses with 'P' grade are not considered. Similarly, the *CPI* indicates the cumulative academic performance in all the courses taken including those taken in the current semester as

$$CPI = \frac{1}{Total\ Credits} \sum_{i=1}^{4} \left(SPI \times Total\ credits\ of\ the\ i^{th}\ Semester\right)$$

Graduating *CPI* and *Class*

For the purposes of computing the *CPI* at the end of the M. Tech. program, the students' *CPI* will be computed on the basis of the best *CPI* obtained from the courses taken. The grade of M. Tech. Thesis/Project (if graded as prescribed in the curriculum) will be included while computing the final *CPI* of the student. The minimum *CPI* for eligible to graduate the M. Tech. program is 6.00. The Transcript of a graduating student will indicate

1. *Distinction* when $CPI \geq 9.00$,
2. *First Class* when $6.50 \leq CPI < 9.00$ and
3. *Pass* when $6.00 \leq CPI < 6.50$

Repeating a Course

[A] As a Backlog Course

A student must repeat a course taken for credit in which he/she has obtained an 'F' grade. Such a course is regarded as a backlog course. A backlog elective course can be replaced by another elective of the same category. A student can appear for examination (Mid-Semester and End-Semester) components only as a backlog course. The component of continuous evaluation will be carried forward from earlier evaluation. In case a student has obtained 'F' grade in Lab Course, he/she has to repeat the course, i.e., attend all lab sessions and take lab exams.

[B] For Grade Improvement

A student whose *CPI* is less than 5.00 can be permitted to reappear in the courses in which a 'DD' grade was obtained. This is for the purpose of grade improvement in a regular semester only. The grade obtained in the repeated attempt(s) will be considered for the purpose of

calculating the *CPI* for the semesters thereafter. However, the grade obtained in the first and subsequent attempt(s) will be shown in the Transcript.

Award of Degree

The M. Tech. (CSE) and M. Tech. (ECE) degree will be conferred on a student after he/she has fulfilled the graduation requirements stipulated in the curriculum (as approved by the senate).

Award of Medals

The students with highest scholastic performance will be awarded with the Chairperson's Gold Medal and the Institute Medals as per the Institute policy.

Minimum and Maximum Period for Completion of M. Tech. Program

The minimum period to complete the program is two academic years. In any case, a student should fulfil the requirements for her/his degree within a maximum period of three academic years, failing which she/he will be required to leave the Institute. The period of three years excludes any semester in which the student has availed "withdrawn" status.

Conversion from Thesis to Project Mode

In special circumstances when the thesis work performance of a student is weak, he/ she may be permitted to move from Thesis Mode to Project Mode. The thesis credit earned will be converted to project credit. The student will have to complete the elective course (if any, prescribed in the curriculum) in the 4th semester. In addition, the remaining project work credits will be completed in 4th semester.

M. Tech. Program: Course Categories and Distribution of Credits

Definition of Credits

Teaching of the courses shall be reckoned in credits; credits are assigned to the courses based on the following general pattern:

1 hour of Lecture (L) per week	1 Credit
1 hour of Tutorial (T) per week	1 Credit
2 hours of Laboratory (P) per week	1 Credit
3 hours of Laboratory (P) per week	2 Credits
6 hours of Thesis/Project (P) per week	4 Credits

Course Categories and Range of Credits for M. Tech. Program

M. Tech. program offered by the institute is designed with the following credit guidelines presented in table below

Course Categories*	Thesis Mode		Project Mode	
	Min Credit	Max Credit	Min Credit	Max Credit
Program Core	12	16	12	16
Program Elective	14	20	14	20
Thesis / Project	22	24	22	24
Total Credits	**54-60**		**54-60**	

**Types of courses to be offered as Program Core and / or Program Elective in terms of Lecture-Tutorial-Practicals: Credits (L-T-P: C) are*

Program Core: *3-0-0: 3, 0-1-2: 2, 2-0-0: 2, 1-0-2: 2, 3-0-2: 4, 3-1-0: 4*

Program Elective: *3-0-0: 3, 1-0-0: 1, 1-0-2: 2, 0-1-2: 2, 1-0-2: 2*

Comprehensive Viva: *0-0-0: 2*

Research / Project Work: *0-0-3: 2, 0-0-6: 4*

Note: *Courses with (1-x-x) or (0-x-x) will not be evaluated through mid- and end-semester examinations.*

Semester wise credit distribution for each department programs

[A] Computer Science and Engineering

Sem	Course Category	Credits				Mode (TM/PM)
		L	T	P	C	
I	Mathematics	2	0	0	2	TM + PM
	Program Core	x	x	x	9	TM + PM
	Program Elective	x	x	x	4	TM + PM
	Lab Course	0	0	2	1	TM + PM
	Total	**x**	**x**	**x**	**16**	**TM +PM**
II	Program Core	3	0	0	3	T M + PM
	Program Elective	x	x	x	11	T M + PM
	Humanities	x	x	x	2	TM + PM
	Total	**x**	**x**	**x**	**16**	**TM +PM**
III	Comprehensive	0	0	0	2	TM only
	Humanities	x	x	x	2	TM and PM
	Thesis	0	0	15	10	TM only
	Elective	x	x	x	3	PM only
	Project	0	0	12	8	PM only
	Total	**0**	**0**	**15**	**14**	**TM**
		x	**x**	**x**	**13**	**PM**
IV	Thesis	0	0	18	12	TM
	Project	0	0	21	14	PM
	Total	**0**	**0**	**18**	**12**	**TM**
		0	**0**	**21**	**14**	**PM**
Grand Total		**x**	**x**	**x**	**58***	**TM**
		x	**x**	**x**	**59***	**PM**

**The credits given are for guidelines. The total credits may vary in the range 58-60.*

B] Electronics and Communication Engineering

Sem	Course Category	Credits				Mode (TM/PM)
		L	T	P	C	
I	Program Core	x	x	x	9	TM + PM
	Program Elective	x	x	x	5	TM+ PM
	Lab Course	0	x	x	2	TM + PM
	Total	**x**	**x**	**x**	**16**	**TM + PM**
II	Program Core	3	0	0	3	T M+ PM
	Program Elective	x	x	x	10	T M+ PM
	Lab Course	0	0	2	1	T M+ PM
	Humanities	x	x	x	2	T M+ PM
	Total	**x**	**x**	**x**	**16**	**TM + PM**
III	Comprehensive	0	0	0	2	TM only
	Thesis	0	0	15	10	TM only
	Humanities	x	x	x	2	TM +PM
	Program Elective	x	x	x	3	PM only
	Project	0	0	12	8	PM only
	Total	**0**	**0**	**x**	**14**	**TM**
		x	**x**	**x**	**13**	**PM**
IV	Thesis	0	0	18	12	TM
	Project	0	0	21	14	PM
	Total	**0**	**0**	**18**	**12**	**TM**
		0	**0**	**21**	**14**	**PM**
Grand Total		**x**	**x**	**x**	**58***	**TM**
		x	**x**	**x**	**59***	**PM**

**The credits given are for guidelines. The total credits may vary in the range 58-60.*

Graduation Requirements

A student to be eligible to receive M. Tech. degree should meet the following criteria:

Thesis Mode:

1. completed all registered courses with minimum DD/Pass Grade.
2. should have secured CPI ≥ 6.00 (on 10.00 point scale).
3. should have acquired minimum 34 credits in 'Graded Courses' out of which there must be at least
   - 14 credits from Program Core,
   - 14 credits from Program Electives and
   - 4 credits from HS Electives.
4. should have secured minimum 22 credits from 'Thesis' and 2 credits of Comprehensive viva.

Project Mode

1. completed all registered courses with minimum DD/Pass Grade.
2. should have secured CPI ≥ 6.00 (on 10.00 point scale).
3. Should have acquired minimum 37 credits in 'Graded Courses' out of which there must be at least
   - 14 credits from Program Core,
   - 16 credits from Program Electives and
   - 4 credits from HS Electives.
4. should have secured minimum 22 credits from 'Project'.

Computer Science and Engineering

Courses: Semester-I

Thesis / Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
MA601	Essential Mathematics	2	0	0	2
CS603	Advanced Algorithms	3	0	0	3
CS609	Probability, Statistics, Random Process	3	0	0	3
CS611	Computer Systems	3	0	0	3
CS661	Algorithms and DBMS Lab	0	0	2	1
CSXXX	Program Elective*	x	x	x	4
Total		**x**	**x**	**x**	**16**

**List of Program Electives along with Course Code and Credits is provided in Appendix-I*

Courses and Contents

MA601	Essential Mathematics	2-0-0: 2

Objective: Students entering a PG program usually find that their mathematical foundation is inadequate to pursue research for their thesis. It is also a fact that, for them to achieve the required level of mathematical maturity entirely through self-study is difficult. This course is designed with an objective to provide the essential knowledge required to remove this inadequacy. The content of the course is designed keeping in mind the mixed audience coming from computer science and allied engineering disciplines. At the conclusion of this course, students should have a sound understanding of what mathematics is about, and should have acquired a level of mathematical literacy that would enable them to see its relevance in their own domain of knowledge.

Learning Outcomes: Upon successful completion of this course, student will be able to formulate the engineering problems in the language of mathematics

Prerequisite: Nil

Contents:

Module 1: Sets, Relations and Functions: Order, Equivalence and Correspondence; Groups, Rings and Fields: Permutations, Symmetries, Polynomials.

Module 2: Vector Space: Basis, Linear transformat-ions, Norm and Inner-Product, Orthogonality, Metric: continuity, convergence and completeness, Finite Dimensional Vector Space: System of linear equations, Eigen-values, Eigen vectors, Matrix inverse, Least squares and Pseudo inverse, Change of basis and similarity transform.

Module 3: Introduction to Graphs and Connections with Linear Algebra: Random Graphs, Adjacency and Incidence matrices, Graph spectrum, Graph Partitioning and Clustering, Max-Min flow and Graph cuts, Shortest path algorithms.

Text Books:

1. *Introduction to Linear Algebra*, Gilbert Strang, 5th Ed, SIAM, 2016.
2. Kolman, Busby, Ross, *Discrete Mathematical Structures*, Sixth Edition, Pearson, 2008

Reference Books:

1. Lehman, Leighton and Meyer, *Mathematics for Computer Science*, 2017. https://courses.csail.mit.edu/6.042/spring17/mcs.pdf
2. *Linear Algebra*, Kunze Ray, Hoffman Kenneth 2nd Ed, Phi Learning, 2014.
3. *Fundamentals of Matrix Computations*, David S. Watkins, 3rd ed, Wiley.
4. Kepner and Jananthan, *Mathematics of Big Data*, 2018

CS603	Advanced Algorithms	3-0-0: 3

Objective: Advanced Algorithms is an advanced course on designing and analysis of algorithms and is an important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications.

Learning Outcomes: By the end of this course, students should develop the following skills:

1. Understand and apply the algorithms discussed, prove their correctness, and analyze their time complexity in a mathematically rigorous manner.
2. Understand the fundamentals behind the techniques, so that you are able to develop algorithms for new problems where these techniques can be applied.
3. Given a practical application, identify the computational issues and apply suitable algorithms to solve it effectively.

Prerequisite: Fundamental course in algorithms or complexity.

Contents:

Algorithm analysis, order arithmetic: Growth functions, Recurrences and solution of recurrence equations, time and space complexities, average and worst case analysis, lower bounds. Algorithm design techniques: divide and conquer, Greedy Algorithms, Dynamic Algorithm.

AVL Trees, Red-Black Trees, Augmenting Data Structures, Optimal Binary Search Trees, Skip Lists, Self-Adjusting Binary Search Trees (Splay trees/amortized analysis), Binomial Heaps, Fibonacci Heaps, Disjoint Sets (union-find trees), Hashing, Perfect Hashing.

Amortized analysis, Aggregate, Accounting, and Potential methods, String Matching Algorithms: Naive Algorithm; Robin-Karp Algorithm, String matching with Finite Automata, Knuth-Morris-Pratt and Boyer-Moore Algorithms.

Graph Algorithms, Bellman-Ford Algorithm Shortest paths in a DAG, Johnson's Algorithm for sparse graphs, Flow networks and the Ford-Fulkerson Algorithm, Maximum bipartite matching.

Hard problems- Problem classes P, NP, NP-hard and NP-complete, Reducibility, Introduction to Approximation Algorithms and Randomized Algorithms

Text Book:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, "*Introduction to Algorithms*", Prentice Hall India, 2002.

Reference Books:

1. D.E.Knuth, "*The Art of Computer Programming*", Vols. 1 and 3, Addison Wesley, 1998.
2. A.V.Aho, J.E.Hopcroft, J.D.Ullman, "*Design and Analysis of Algorithms*", Addison Wesley, 1976.
3. E.Horowitz, S.Sahni, "*Fundamentals of Computer Algorithms*", Galgotia Publishers, 1984.
4. K.Melhorn, "*Data Structures and Algorithms*", Vols.1 and 2, Springer Verlag, 1984.
5. P.W.Purdom, Jr. and C.A.Brown, "*The Analysis of Algorithms*", Holt Rhinehart and Winston, 1985.

CS609	Probability, Statistics and Random Process	3-0-0: 3

Objective: The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science mainly in signal/images processing, machine learning, artificial intelligence, and data networks.

Learning Outcomes: After studying this course, students will be able to understand and appreciate the key fundamentals of probability and statistical analysis which would be helpful to them in building strong foundations for advanced courses.

Prerequisite: Working knowledge of Linear Algebra and Calculus.

Contents:

INTRODUCTION: Classical, relative frequency and axiomatic definitions of probability, σ-field, measurable space, probability space, addition rule and conditional probability, multiplication rule, total probability, Bayes' theorem and independence.

RANDOM VARIABLES: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, Chebyshev's inequality.

SPECIAL DISTRIBUTIONS: Discrete uniform, binomial, geometric, negative binomial, hypergeometric, Poisson, continuous uniform, exponential, gamma, beta, normal, lognormal, inverse Gaussian, Cauchy, double exponential distributions, reliability and hazard rate, reliability of series and parallel systems.

JOINT DISTRIBUTIONS: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution, representation of multivariate normal distribution.

TRANSFORMATIONS: Functions of random vectors, distributions of order statistics, distributions of sums of random variables.

SAMPLING DISTRIBUTIONS: Mean, median, variance, standard deviation, The law of large numbers, The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

ESTIMATION: Unbiasedness, consistency, minimum mean-squared estimation, the method of moments, the method of maximum likelihood estimation, maximum a posterior probability estimation.

RANDOM PROCESSES: Definition and examples, Stationary processes, wide-sense stationary, strict sense stationary, Ergodicity and ergodic processes, Autocorrelation and autocovariance functions, Power spectral density, various noise processes like additive white Gaussian noise, fractional Gaussian noise, etc., Transmission of random process through linear time-invariant systems, Analysis of communication systems in the presence of noise.

Text Book:

1. A. Papoulis and S. Unnikrishnan Pillai, "*Probability, Random Variables and Stochastic Processes*," Fourth Edition, McGraw Hill.

Reference Books:

1. Steven Kay, "*Intuitive probability and random processes using MATLAB*", Springer.
2. Alberto Leon-Garcia, "*Probability, statistics, and random processes for electrical engineers*," Prentice Hall - Pearson.
3. Sheldon Ross, "*A first course in probability*", Eighth edition, Prentice Hall - Pearson.
4. Sheldon Ross, "*Introduction to Probability and Statistics for Engineers and Scientists*", Academic Press.

CS611	Computer Systems	3-0-0: 3

Objective: The objective of this course is to expose students to the "full span" of the computer network and DBMS. It will give the students a performance perspective towards analysis of computer and communications networks. This course will also provide the major techniques in DBMS implementations.

Learning Outcomes: By the end of this course, students should be able to

1. Demonstrate the operation of various routing protocols and their performance analysis.
2. Illustrate design and implementation of network application, transport and network layer protocols within a simulated/real networking environment.
3. Demonstrate the principles of transaction management

Prerequisite: Fundamental course in Computer Networks and DBMS

Contents:

Routing versus forwarding, Static and dynamic routing, Unicast and Multicast Routing. Distance-Vector, Link-State, Shortest path computation, Dijkstra's algorithm, Network Layer Protocols (IP, ICMP), IP addressing, IPV6, Address binding with ARP, Scalability issues (hierarchical addressing), IP Multicasting

UDP, TCP and SCTP, Multiplexing with TCP and UDP, Principles of congestion control, Approaches to Congestion control, Router-Assisted Congestion Control: Active Queue Management, Quality of service, Flow characteristics, Techniques to improve QoS.

Naming and address schemes (DNS:Resource Discovery, Lookups, IP addresses, Uniform Resource Identifiers, etc.), Distributed applications (client/server, peer-to-peer, cloud, etc.), Distributed Hash Table (DHT) Abstraction and Algorithms, Routing in Overlay Networks, HTTP as an application layer protocol, Electronic mail, File transfer, Remote login.

Relational Query Languages, The SQL Query Language, Destroying and Altering Relations, Adding and Deleting Tuples, Integrity Constraints, Primary and Candidate Keys in SQL, Foreign Keys, Referential Integrity in SQL, Categories of SQL Commands, Data Definition, Data Manipulation Statements: SELECT - The Basic Form Subqueries, Functions, GROUP BY Feature, Updating the Database, Data Definition Facilities, Views, Embedded SQL *, Declaring Variables and Exceptions, Embedding SQL Statements, Transaction Processing, Consistency and Isolation, Atomicity and Durability, Dynamic SQL.

Introduction of transaction processing system, Storage Structure, Transaction atomicity and durability, Transaction Isolation, serializability and recoverability, Serializability by Locks, Concurrency Control by Timestamps, Concurrency Control by Validation, Database recovery management.

Text Books:

1. "*Database System Concepts*", A. Silberschatz, H. F. Korth, S. Sudharshan, Tata McGraw Hill, New Delhi, 2019.
2. "*Computer Networking: A Top Down Approach*", Kurose and Ross, Addison-Wesley, (2012).

Reference Books:

1. "*Fundamentals of Database Systems*", R. Elmasri, S. B. Navathe, Prentice Hall, New Delhi, 2016.
2. "*Computer Networks*", Tanenbaum , A.S., Prentice Hall (2010).
3. "*Computer Networking with Internet Protocols and Tech*", Stallings, W., Prentice Hall of India (2010).
4. "Data communication and Networking", Forouzan, B.A., McGraw Hill (2006).

CS661	Algorithms and DBMS Lab	0-0-2: 1

Objective: would be designed to provide hands-on experience in programming data structures and algorithms, followed by advanced database management systems to learn a few systems programming tools, and scripting.

Learning Outcomes: Upon successful completion of this course, student will be able to:

1. Understand the fundamentals behind the techniques, so that students are able to develop algorithms for new problems where these techniques can be applied.
2. Given a practical application, identify the computational issues and apply suitable algorithms to solve it effectively.
3. Demonstrate the use of various DBMS tools available

Prerequisite: Fundamental courses in Data structures and algorithms and Database management systems.

List of Experiments:

A. Algorithm

1. Time Complexity Analysis of various sorting algorithm: Searching Algorithms, Sorting Algorithms - Bubble, Selection, Insertion, Heap, Merge & Quick, Linear sort
2. Tree/Graph based algorithm including Graph Representation, Graph Traversal, Graph Searching
3. Implementation of Balanced Trees – AVL, Red Black Trees, B-Trees
4. Implementation of Shortest Path Algorithms
5. Implementation and Analysis of Greedy Algorithms
6. Implementation and Analysis of Dynamic Algorithms

7. Implementation and Analysis of Randomization Algorithms

B. DBMS

1. Creation of ER diagram for the databases (for ex. A company, an institute)
2. Create a small database (for ex. A company, an institute) in SQL/MySQL and answer various queries
3. Normalization of the database to answer various queries from SQL
4. Designing the rules for database using Triggers
5. Familiarity with MangoDB and postgresql Tool

Text / Reference Books:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, "*Introduction to Algorithms*", Prentice Hall India, 2002.
2. D.E.Knuth, "*The Art of Computer Programming*", Vols. 1 and 3, Addison Wesley, 1998.
3. E.Horowitz, S.Sahni, "*Fundamentals of Computer Algorithms*", Galgotia Publishers, 1984.
4. "*Database System Concepts*", A. Silberschatz, H. F. Korth, S. Sudharshan, Tata McGraw Hill, New Delhi, 2019.
5. "*Fundamentals of Database Systems*", R. Elmasri, S. B. Navathe, Prentice Hall, New Delhi, 2016.
6. "*Introduction to Linear Algebra*", Gilbert Strang, 5th Ed, SIAM, 2016.

Courses: Semester-II

Thesis Mode

Course Code	Course Name	Credits			
		L	T	P	C
CS612	Machine Learning	3	0	0	3
CSXXX	Program Electives*	x	x	x	11
HSXXX	Seminar / Technical Communication / Modular Course#	x	x	x	2
Total		**x**	**x**	**x**	**16**

Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
CS614	Information Security	3	0	0	3
CSXXX	Program Electives*	x	x	x	11
HSXXX	Seminar / Technical Communication / Modular Course#	x	x	x	2
Total		**x**	**x**	**x**	**16**

**List of Program Electives along with Course Code and Credits (L-T-P: C) is provided in Appendix-I. Minimum three Program Electives of total 11 credits will be offered by the department.*

#*The Course Code and Credits will be provided by the department.*

Courses and Contents

CS612	Machine Learning	3-0-0: 3

Objective: Machine Learning is a growing field in the area of pattern recognition, natural language processing, speech processing, image processing and vision. This course provides a broad introduction to machine learning architectures. The objectives include: 1. Formulate machine learning problems corresponding to different applications and solve using learning machines based approaches. 2. Read basic as well as current research papers and understand the issues raised by current research.

Learning Outcomes: After studying this course, students will be able to understand a variety of machine learning architectures including deep learning, and use them to solve a few problems. This course will expose students to cutting-edge research starting from a refresher in basics of machine learning, to recent developments in deep learning and random forest.

Prerequisite:

1. Linear algebra

2. Probability and Statistics
3. Computational tools: C/C++/Matlab/Python (any one of these)

Contents:

Problem setting and fundamentals of machine learning, Supervised, unsupervised, semi-supervised learning, Bayes' classifier, K-means, k-NN, principal component analysis (PCA), and least-squares estimation (LSE), minimum mean-squared estimation (MMSE).

Linear and Logistic regressions, concept of over-fitting, regularization.

Concept of convex/non convex functions, optimization methods (gradient descent/conjugate gradient descent/stochastic gradient descent).

Learning machines: Statistical theory of learning, Vapnik-Chervonkis (VC) dimension, Support vector machine (SVM): linear and nonlinear.

Introduction to neural networks and training a network: Back propagation algorithm, Convergence issues, Matrix calculus for training model architectures.

Markov networks (MRF), restricted Boltzmann Machine (RBM) and deep Boltzmann machine (DBM).

Auto encoders: Deep sparse autoencoder (SAE), Deep denoising auto encoder (DAE), Deep contractive autoencoders (CAE).

Convolution neural network (CNN): Deep CNN, All-CNN networks

Deep learning for computer vision problems, Bayesian deep learning

Decision trees and random forests

Fuzzy logic and rough set theory

Text Book:

1. Pattern classification by Duda and Hart, John Wiley.

Reference Books:

1. Deep learning book by Ian Goodfellow, MIT Press.
2. Pattern recognition and machine learning by Bishop, Springer.
3. Basic papers on machine learning by Vapnik, Hinton and other major contributors.
4. Research papers mainly from NIPS, ICML, ICLR, ICMV, ICCV, IGARSS, PReMI, IEEE signal processing magazine, IEEE computational intelligence magazine

CS614	Information Security	3-0-0: 3

Objective: The course intends to provide the basic foundations of information security and its impact on the IT infrastructure. The course includes not only the cryptographic techniques used in information security, but it also focuses on the hands-on experience with tools and techniques used to ensure network security.

Learning Outcomes: On successful completion of this course, students should be able to:

1. Understand the importance of information security of IT infrastructure.
2. Effective use the cryptographic algorithms to ensure the data confidentiality, integrity, availability, etc.
3. Effectively analyze the security strengths/weaknesses of cryptographic algorithms.
4. Learn the network security protocols used to ensure the web application security.
5. Identify network security threats to data outsourcing.

Prerequisite: Basics of Computer networks, Familiarity with at least one programming language

Contents:

Symmetric-key Cryptography: Classical ciphers, Feistel structure, Modern block ciphers such as Data Encryption Standard (DES) and Advanced Encryption Standard (AES), Cryptographic hash functions, Message authentication codes (MAC).

Asymmetric-key Cryptography: Applications of asymmetric-key cryptosystem, RSA cryptosystem, Diffie-Hellman key exchange protocol, Digital signature. Elliptic curve cryptography, Bilinear pairing.

User Authentication and Access Control: Password-Based/Token-Based/Biometric Authentication, Remote User Authentication, Security Issues for User Authentication, Access Control Principles, Subjects, Objects, and Access Rights, Hierarchical Access Control, Role-Based/Attribute-Based Access Control, Identity, Credential, and Access Management.

Network Security: Secure socket layer (SSL)/ Transport layer security (TLS), Firewalls, Packet filtering firewall, Stateful inspection firewalls, E-Mail security, Pretty good privacy (PGP), Secure Multipurpose Internet Mail Extensions (S/MIME), IP security overview, IP security policy, Encapsulating security payload (ESP).

Secure Data Outsourcing Issues: Data outsourcing architectures, Security considerations, Adversary models, Auditing, Applications.

Text Books:

1. Stallings and Brown, *Computer Security: Principles and Practice*, Third Edition, Publisher: Pearson, 2014.
2. M. Bishop, Computer Security: Art and Science, Reprint Edition, Addison-Wesley Professional, 2015.
3. Kaufman et al., Network Security, Second Edition, Publisher: Prentice Hall, 2002.

Reference Books:

1. Trappe and Washington, *Introduction to Cryptography with Coding Theory*, Second Edition, Publisher: Pearson, 2009.

2. Bruce Schneier, *Applied Cryptography: Protocols, Algorithms, and Source Code in C*, Second Edition, Publisher: Wiley, 1996.

Courses: Semester-III

Thesis Mode

Course Code	Course Name	Credits			
		L	T	P	C
CS791	Comprehensive Viva*	0	0	0	2
CS793	Research	0	0	3	2
CS795	Research	0	0	6	4
CS797	Research	0	0	6	4
HSXXX	Research Methodology / Modular Course / Seminar	x	x	x	2
Total		**x**	**x**	**x**	**14**

**Required to complete during the summer break. The evaluation will be done in the 3rd Semester.*

Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
CSXXX	Elective Course*	x	x	x	3
CS781	Project Work	0	0	6	4
CS783	Project Work	0	0	6	4
HSXXX	Research Methodology / Modular Course / Seminar	x	x	x	2
Total		**x**	**x**	**x**	**13**

**List of Electives along with Course Code and Credits is provided in Appendix-I.*

Courses: Semester-IV

Thesis Mode

Course Code	Course Name	Credits			
		L	T	P	C
CS792	Research	0	0	6	4
CS794	Research	0	0	6	4
CS796	Research	0	0	6	4
Total		**0**	**0**	**18**	**12**

Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
CS782	Project Work	0	0	6	4
CS784	Project Work	0	0	6	4
CS786	Project Work	0	0	6	4
CS788	Project Work	0	0	3	2
Total		**0**	**0**	**21**	**14**

Appendix-I

List of Program Electives for CSE

Course Code	Course Name	Credits (L-T-P: C)
CS630	Randomized Algorithms	3-x-x: 3/4
CS631	Game Theory	3-x-x: 3
CS632	Data Mining	3-x-x:4
CS633	Artificial Intelligence	3-x-x: 3/4
CS634	Data Analytics & Visualization	3-x-x: 4
CS635	Deep Learning	3-x-x: 3/4
CS636	Computer Vision	3-x-x: 4
CS637	Image Processing and Analysis	3-x-x: 3/4
CS638	Social Network Analysis	3-x-x: 3
CS639	Parallel Computing	3-x-x: 4
CS640	Advanced Computer Architecture	3-x-x: 3
CS641	Embedded Systems and Internet of Things	3-x-x: 3/4
CS642	Speech Technology	3-x-x: 3
CS643	Advanced Wireless Communications and Networks	3-x-x: 3
CS644	Distributed Systems	3-x-x: 4
CS645	Cloud Computing	3-x-x: 4
CS646	Cryptography and Network Security	3-x-x: 4
CS647	Blockchain Technology	3-x-x: 3/4
CS648	Web Development Techniques	X-1-2: 2
CS649	Cyber Security	3-x-x: 3
CS650	Distributed Databases	3-x-x: 3
CS651	Security Protocols	3-x-x: 3

Electronics and Communication Engineering

Courses: Semester-I

Thesis/Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
EC601	Probability, Statistics, Random Process	3	0	0	3
EC603	Digital Communication	3	0	0	3
EC605	Embedded Systems	3	0	0	3
EC661	Lab Course#	x	x	x	2
ECXXX	Program Elective*	x	x	x	3 / 4
ECXXX	Program Elective*	x	x	x	2 / 3
Total		**x**	**x**	**x**	**16 / 17**

#*The Course Name and Credits (L-T-P: C) will be provided by the department.*

**List of Program Electives along with Course Code and Credits is provided in Appendix-II*

Courses and Contents

EC601	Probability, Statistics and Random Process	3-0-0: 3

Objective: The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science mainly in signal/images processing, machine learning, artificial intelligence, and data networks.

Learning Outcomes: After studying this course, students will be able to understand and appreciate the key fundamentals of probability and statistical analysis which would be helpful to them in building strong foundations for advanced courses.

Prerequisite: Working knowledge of Linear Algebra and Calculus.

Contents:

Introduction: Classical, relative frequency and axiomatic definitions of probability, σ-field, measurable space, probability space, addition rule and conditional probability, multiplication rule, total probability, Bayes' theorem and independence.

Random Variables: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, Chebyshev's inequality.

Special Distributions: Discrete uniform, binomial, geometric, negative binomial, hypergeometric, Poisson, continuous uniform, exponential, gamma, beta, normal, lognormal, inverse Gaussian, Cauchy, double exponential distributions, reliability and hazard rate, reliability of series and parallel systems.

Joint Distribution: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution, representation of multivariate normal distribution.

Transformations: Functions of random vectors, distributions of order statistics, distributions of sums of random variables.

Sampling Distributions: Mean, median, variance, standard deviation, The law of large numbers, The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

Estimation: Unbiasedness, consistency, minimum mean-squared estimation, the method of moments, the method of maximum likelihood estimation, maximum a posterior probability estimation.

Random Processes: Definition and examples, Stationary processes, wide-sense stationary, strict sense stationary, Ergodicity and ergodic processes, Autocorrelation and autocovariance functions, Power spectral density, various noise processes like additive white Gaussian noise, fractional Gaussian noise, etc., Transmission of random process through linear time-invariant systems, Analysis of communication systems in the presence of noise.

Text Books:

1. A. Papoulis and S. Unnikrishnan Pillai, "*Probability, Random Variables and Stochastic Processes*," Fourth Edition, McGraw Hill.

Reference Books:

1. Steven Kay, "*Intuitive probability and random processes using MATLAB*", Springer.
2. Alberto Leon-Garcia, "*Probability, statistics, and random processes for electrical engineers*," Prentice Hall - Pearson.
3. Sheldon Ross, "*A first course in probability*", Eighth edition, Prentice Hall - Pearson. Sheldon Ross, "*Introduction to Probability and Statistics for Engineers and Scientists*", Academic Press.

EC603	Digital Communication	3-0-0: 3

Objective: The main objective of this course is to provide students with the foundations of communication theory mostly used in varied applications in digital communication engineering, wireless communication.

Learning Outcomes: Upon successful completion of this course, student will be able to:

1. To introduce signal space and vector space concepts of signal representation.
2. To study the optimum receiver policies and performance for the demodulation of digitally modulated signals.
3. To compute the performance of digital signals received through various types of AWGN channels.

Prerequisite: Working knowledge of Linear Algebra and Calculus.

Contents:

Introduction to communication signals and systems, Low pass and Bandpass representation of signals, Signal space representation, Orthogonal representation of signals. Dimensionality of signal spaces. Construction of orthogonal basis functions using the Gram-Schmidt orthogonalization procedure.

Definition and classification of Random Process, Stationary processes, wide-sense stationery, strict sense stationary, Ergodicity, and ergodic processes, Autocorrelation and autocovariance functions, Power spectral density, Representation of random processes (via sampling, K-L expansion, and narrow-band representations), Transmission of the random process through linear time-invariant systems, Basic Introduction to special random processes: white Gaussian noise, Wiener-Levy process, Poisson process, shot-noise process, Markov process.

Digital Modulation Techniques: Baseband modulation: Pulse amplitude modulation (binary and M-ary PAM, QAM) Bandpass modulation (M-ary ASK, PSK, FSK, DPSK), Continuous phase modulation (QPSK and variants, MSK, GMSK). Power spectral density and power efficiency of baseband and bandpass signals.

Demodulation and detection: Optimum receiver: Matched filter demodulator, Correlator demodulator, Basic of detection theory, Binary Detection, Optimum rule for ML and MAP detection, Performance, Bit-error rate, symbol error rate for coherent and non-coherent schemes. M-ary detection, 4-PAM, QPSK and M-ary PAM detection, Performance, bandwidth efficiency. Matched filters for deterministic signals in white and colored Gaussian noise, Wiener filters for random signals in white and colored Gaussian noise. carrier & symbol synchronization.

Modulation for bandlimited channels: Baseband signaling, Intersymbol interference, Pulse shape design for channels with ISI, Nyquist pulse, Partial response signaling (duo-binary and modified duo-binary pulses), Equalization techniques, Linear and Non-linear equalizers Special modulation techniques: Spread Spectrum Modulation, Generalised Nyquist criteria, Multicarrier (OFDM) modulation, Trellis coded modulation. Spread-spectrum modulation: Pseudo noise sequences, DS & FH spread spectrum.

Introduction to Information theory: Shannon information contents, Shannon entropy, conditional entropy, mutual information, statistics distances, Differential entropy & mutual information for discrete & continuous ensembles, Channel Capacities of various discrete and continuous channels.

Text Books:

1. "*Digital Communication*", John G. Proakis, Masoud Salehi, Fifth Edition, McGraw Hill.
2. "*Digital Communication*", Barry John, Le, Edward, David. G, Springer.

Reference Books:

1. "*Modern Digital And Analog Communication Systems*", Lathi, Oxford.
2. "*Digital Communications*", Simon Haykin, Wiley.

EC605	Embedded Systems	3-0-0: 3

Objective: The main objective of this course is to familiarize the students with the basic concept of embedded systems and embedded hardware. Students will learn to apply the embedded skills in some of the fastest growing domains like IoT, Automation, Robotics and AI.

Learning Outcomes: The course objective is to create embedded designers who will be able to: Design, describe, validate, and optimize embedded electronic systems in different industrial application areas. Design hardware and software to bridge the gap between hardware and software in some of the fastest growing domains like IoT, Automation, Robotics and AI. Use tools for the development and debugging on a variety of platforms.

Prerequisite: Fundamentals of C/ Embedded C, Assembly, Microcontroller, Digital Logic Design.

Contents:

Module-1: Introduction and Embedded Hardware

Introduction to Microcontroller, Microprocessor Vs Microcontroller, Criteria for selecting a Microcontroller, What are Embedded Systems?, Approaches to Embedded Systems, review of Embedded Systems, Embedded System types and applications, Timers and Counters, Watchdog Timers, Pulse Width Modulator, LCD Controllers ,Keypad Controllers, A/D converters ,Real Time Clock.

Module-2: Microcontroller/Processor Architecture

Pin Diagram, Block Diagram, Internal Registers, Memory, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Addressing Modes, Instruction Set, Low-Power Modes of Operation, libraries and contributed libraries.

Module-3: Embedded Programming and Debugging methods

C and Assembly programming style, Declarations Expressions-Arrays, Qualifiers and reading numbers, Decision and control statements-programming process, More control statements-Variable Scope and Functions C Preprocessor-advanced types, simple Pointers-Debugging and Optimization-In-line Assembly Debugging methods In-system Programming In-Application Programming, IDE Host-based Debugging, Remote Debugging

Module-4: Embedded Communication Protocols

Embedded Networking: introduction, Serial/Parallel Communications, Serial communication protocols-RS232, RS485, Synchronous Serial Protocol-Serial Peripheral Interface (SPI), Inter-Integrated Circuits, PC Parallel Port Programming-ISA/PCI Bus protocols Fire-wire.

Module-5: Real World Interfacing Applications

Robotic Sensor, Arduino Interfacing with LED, LCD, Bluetooth, Motor(DC, Stepper and Servo), IR Sensor, Wi-Fi, GMS Module, Temperature and Humidity sensor.

Module-6: Projects

Case study of Hexapod Robot and IoT based smart healthcare & farming solution.

Text Books:

1. "*Embedded System Design*", Frank Vahid and Tony Givargis, John Wiley and Sons, 2002.
2. "*Embedded Systems*", Raj Kamal, Tata McGraw-Hill Education.

Reference Books:

1. "*Embedded C*",:Michael J Pont, Pearson Education, 2007.
2. "*Embedded System Design*", Steve Heath, Elsevier, Second Edition, 2004.
3. "*Programming in C*", Stephen Kochan, 3rd Edition, Sams Publishing, 2009.

Courses: Semester-II

Thesis/Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
EC602	Digital and Adaptive Signal Processing	3	0	0	3
EC662	Digital and Adaptive Signal Processing Lab	0	0	2	1
ECXXX	Program Electives*	x	x	x	10
HSXXX	Seminar / Technical Communication / Modular Course#	x	x	x	2
Total		**x**	**x**	**x**	**16**

**List of Program Electives along with Course Code and Credits (L-T-P: C) is provided in Appendix-II. Minimum three Program Electives of total 10 credits will be offered by the department.*

#*The Course Code and Credits will be provided by the department.*

Courses and Contents

EC602	Digital and Adaptive Signal Processing	3-0-0: 3

Objective: The concepts of digital signal processing with statistics have found more and more relevance now due to fertile interactions with the domains of data analytics and machine learning. The course is positioned at the intersection of traditional adaptive signal processing, data analytics and machine learning.

Learning Outcomes: After successful completion of the course the students will be able to apply the adaptive signal processing algorithms to problems of learning and control along with traditional problems in communication and signal processing

Prerequisite: Probability and Random Processes, Linear Algebra, System and Signal Theory

Contents:

Introduction: Linear Systems, Digital Signal Processing, Fourier Transform and Algorithms, Frequency analysis.

Random Process: IIDs, Fundamentals of Random Process, Correlation, Covariance, Power Spectral Density, Cross power spectral density, Ergodicity, Time and Ensemble Averages, Biased -unbiased Estimators, Consistent estimator.

Optimum Linear Systems: Error surfaces and minimum mean square error; Optimum discrete time Wiener filter; Kalman filter; Principle of orthogonality and canonical forms; Constrained optimisation; Method of steepest descent - convergence issues; Stochastic gradient descent LMS - convergence in the mean and misadjustment. Least squares and recursive least squares. Linear Prediction - Forward and backward linear prediction; Levinson Durbin; Lattice filters.

Recent Trends: Array Signal Processing, Graph Signal Processing, Machine Learning meets Signal Processing.

Text Books:

1. S. Haykin "*Adaptive Filter Theory*".
2. B Widrow and S.D. Stearns, "*Adaptive Signal Processing*".

Reference Books:

1. S.T. Alexander, "*Adaptive Signal Processing - Theory and Applications*".
2. S.J. Orfanidis, *"Optimum Signal Processing*".
3. G.C. Goodwin and K.S. Sim, "*Adaptive Filtering, Prediction and Control*".
4. M.L. Honig and D.G. Messerschmidtt, "*Advanced Signal Processing*".
5. B.D.O. Anderson and J.B. Moore, "*Optimal Filtering*".
6. Poularikas, Z. Ramadan, "Adaptive Filtering Primer with MATLAB®".

Courses: Semester-III

Thesis Mode

Course Code	Course Name	Credits			
		L	T	P	C
EC791	Comprehensive Viva*	0	0	0	2
EC793	Research	0	0	3	2
EC795	Research	0	0	6	4
EC797	Research	0	0	6	4
HSXXX	Research Methodology / Modular Course / Seminar	x	x	x	2
Total		**x**	**x**	**x**	**14**

**Required to complete during the summer break. The evaluation will be done in the 3rd Semester.*

Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
ECXXX	Elective Course*	x	x	x	3
EC781	Project Work	0	0	6	4
EC783	Project Work	0	0	6	4
HSXXX	Research Methodology/ Modular Course/ Seminar	x	x	x	2
Total		**x**	**x**	**x**	**13**

**List of Electives along with Course Code and Credits is provided in Appendix-II*

Courses: Semester-IV

Thesis Mode

Course Code	Course Name	Credits			
		L	T	P	C
EC792	Research	0	0	6	4
EC794	Research	0	0	6	4
EC796	Research	0	0	6	4
Total		**0**	**0**	**18**	**12**

Project Mode

Course Code	Course Name	Credits			
		L	T	P	C
EC782	Project Work	0	0	6	4
EC784	Project Work	0	0	6	4
EC786	Project Work	0	0	6	4
EC788	Project Work	0	0	3	2
Total		**0**	**0**	**21**	**14**

Appendix-II

List of Program Electives for ECE

Course Code	Course Name	Credits (L-T-P: C)
EC620	Machine Learning	3-x-x: 3/4
EC621	Data Analytics	3-x-x: 3/4
EC622	Robotics	3-x-x: 3/4
EC623	IoT and Applications	3-x-x: 3/4
EC624	Special Topics in Embedded and VLSI System Designs	3-x-x: 3/4
EC625	Machine Learning for Wireless Communications	3-x-x: 3/4
EC626	Topics in VLSI Designs	3-x-x: 3/4
EC627	Statistical Signal Processing	3-x-x: 3/4
EC628	Graph Signal Processing	3-x-x: 3/4
EC629	Advanced Wireless Designs	3-x-x: 3/4
EC630	Deep Learning for Computer Vision	3-x-x: 3/4
EC631	Inverse Problems in Imaging	3-x-x: 3/4
EC632	Computer Vision	3-x-x: 3/4
EC633	Mathematical Foundations to Vision, Graphics, and Learning	3-x-x: 3/4
EC634	Statistical Communication Theory	3-x-x: 3/4
EC635	Introduction to Game Theory	3-x-x: 3/4
EC636	Introduction to Queuing Theory	3-x-x: 3/4
EC637	Introduction to Stochastic Geometry	3-x-x: 3/4
EC638	Low Power System Designs	3-x-x: 3/4
EC639	Statistical Estimation and Detection	3-x-x: 3/4
EC640	Information Theory, Coding, & Learning	3-x-x: 3/4
EC641	Queuing Theory and Networks	3-x-x: 3/4
EC642	Approximate Computing	3-x-x: 3/4
EC643	MIMO Communication	3-x-x: 3/4
EC644	5G Communication Network	3-x-x: 3/4
EC645	Advanced Algorithms	3-0-0: 3
EC646	Essential Mathematics	2-0-0: 2
EC647	Optical Communication Networks	3-x-x:3/4
EC648	Signal Processing for Communication	3-x-x:3/4
EC649	Wireless IoT	3-x-x:3/4

EC650	Free Space Optical Communication	3-x-x:3/4

Annex – IX

Ph.D. Ordinance: Proposed Additions

5. PROCESS FOR THESIS SUBMISSION

The PhD thesis can be submitted on completing the following steps

PHR 5.1 Open Seminar

On successful completion of course work, problem formulation and research work; a student is eligible to present his/her PhD thesis work in an Open Seminar. The Open Seminar is to be presented to the Research Progress Committee (RPC) in presence of an open audience. One subject expert senior (Associate Professor and above) from the local Institutions to be co-opted for the seminar.

The seminar will be OPEN with invitation to the entire IIIT Vadodara community and a notice of the same will be sent by the Chairperson of the RPC, at least one week in advance. The PhD student should present the first draft of Synopsis of the PhD thesis to all the members of RPC at least ONE week prior to the Open Seminar. The RPC members may suggest corrections/ comments/suggestions in the seminar which can improve the quality of the PhD thesis.

The recommendation of the RPC must be submitted by the Supervisor in the prescribed form (Form No. 5.1) within a week before the student proceeds to submit his/her PhD Synopsis (Final Draft) and Thesis. Thesis should be submitted within six months from the presentation of the open seminar. If the thesis is not submitted in a stipulated period, the Open Seminar has to be presented again.

PHR 5.2 Synopsis Presentation

On successful completion of an Open Seminar, the PhD student through his/her Supervisor(s) has to submit the following to enable him/her to submit the PhD thesis for evaluation.

a. A Synopsis in prescribed format
b. Draft PhD thesis (One soft bound printout)

The student has to present synopsis leading to thesis submission. The synopsis should be presented within six months of the open seminar. The thesis should be submitted within one month of synopsis presentation. If the thesis is not submitted within one month, the Director can provide an extension of one month. The application for extension of thesis submission should be routed through the Supervisor, HoD and Dean (Academic). The draft thesis (softcopy in pdf format and one hard copy in spiral-bound) should be presented to the RPC at the time of synopsis presentation. The synopsis notice, along with draft synopsis should be circulated by the Chairperson, RPC at least seven days in advance.

Details of Synopsis: The Synopsis should be a concise summary of the thesis (including figures, tables, key references, and list of publications from the work reported). It should be text typed in

Times News Roman font with font size 10/ 11 points and 1/ 1.2 spacing. The page layout should have normal margin, portrait orientation, A4 size and single column. The page limit is 15 pages. References and list of publications (including once submitted and under review) will not be considered within this limit of 15 pages.

The synopsis provides an opportunity to the RPC to evaluate the quality and quantity of research work for consideration of submission of a PhD thesis. The Synopsis should clearly list the contributions resulting from the research including advancement of knowledge in the field of investigation. The synopsis should help the examiner to consider accepting the thesis for evaluation. List of publications (including published, accepted, submitted in the refereed journals and conferences) or Patents (granted or applied) from the PhD work should be included in the synopsis.

On completion of the synopsis presentation, the RPC will propose a list of TEN (FIVE within India and FIVE from outside India) PhD thesis examiners in the prescribed format (Form No. 5.2). The proposed PhD thesis examiners recommended by the RPC should meet any of the following guidelines

i. Professor in an Institute/ University of International/ National repute
ii. Professor Emeritus of International/ National repute but active in his/her research field
iii. Scientist-F or above in a recognized Research Organization
iv. An individual having minimum 7 years of post-PhD industry experience/ 5 years post PhD teaching experience.

The foreign examiner should be preferably from a top 700 Times/QS ranking university. Top 500 ranking Times/QS ranking departments can be considered if a university is not in the list. The Indian examiner should be from an Institute of National Importance or an institute with in top 50 NIRF rank in specified field.

PHR 5.3 Thesis Submission

On completion of the synopsis presentation, following will be submitted as a part of thesis submission:

a. Soft bound PhD thesis (two copies) along with the required recommendation (Form No. 5.3A & B). The thesis should be formatted in following standard

Printing Format:	TWO SIDED PRINTING
Paper:	A4 Executive Bond
Font:	Times New Roman

Line Spacing:	1.5, Font Size: 12

b. One soft copy of the thesis (in single file pdf format) should be provided in pen drive (CD drive is not acceptable since many computers do not have CD drive today).

c. The thesis supervisor(s) recommendation as a part of the thesis.

d. Recommendation of the RPC on quality and volume of work and recommendation for submitting thesis for evaluation.

In case of different opinions among the committee members on the quality and quantity of work pertaining to the PhD thesis being submitted (during synopsis presentation), the Director will constitute a committee to decide on acceptance of the thesis for consideration of evaluation.

On completion of thesis submission, the student is permitted to leave the institute to join job or other assignments as the case may be. Hostel accommodation if availed by a student should be vacated within one month of thesis submission.

PHR 6 THESIS EVALUATION

PHR 6.1 Panel of PhD Examiners

The panel of the PhD Examiners consists of the following members:

i. ONE examiner from outside India out of the panel of examiners proposed by the RPC.
ii. ONE examiner from within India out of the panel of examiners proposed by the RPC
iii. PhD Supervisor(s)

From the list of suggested examiners, the Director will provide the order in which the examiners from each category will be contacted to provide willingness to evaluate the PhD thesis. The Dean (Academics) will send a request (email) to one examiner from each of the categories for evaluation of thesis along with the thesis synopsis. If consent or reply is not received within FIFTEEN days, a reminder request will be sent to the examiner. If no reply is received from the examiner within 15 days of reminder, the thesis synopsis will be sent to the next member(s) of the category in order of sequence. From the list of suggested examiners, if NO examiner agrees to evaluate the thesis the concerned Doctoral Committee will suggest an additional set of examiners.

The names of the selected examiners will be confidential till the receipt of respective reports.

Note:

(a) In case the Dean, (Academic Affairs) is the thesis supervisor, then the Director may consult any other Dean(s) for the specific thesis.

(b) In case the Director is the thesis supervisor then TWO senior most members of the Senate will select the thesis Examiners.

PHR 6.2 Examiners Report

The PhD Thesis evaluation panel consists of the thesis supervisor(s) and the thesis examiners selected as mentioned in section 6.1. The softcopy of the PhD thesis will be sent to all the Examiners. The print copy will be sent to Indian Examiner only. The examiner(s) will be requested to send the evaluation report thesis within TWO months from receipt of the PhD thesis in the prescribed format (Form No. 6.1). If the evaluation report is not received within Three months, a reminder will be sent to the examiner(s) for sending the evaluation report within the next TWO weeks. In exceptional cases, the Examiner(s) can be given additional two weeks for the evaluation report (maximum within four months total). If a report is not received by then, the next examiner can be contacted. In the unfortunate case of death of an Examiner, the thesis will be sent to the next examiner as per sequence.

The PhD Examiners will be asked to recommend ONLY ONE of the following four options along with the detailed report/ feedback justifying his/ her recommendation.

Option A: The thesis in its present form is acceptable for the award of the PhD Degree. Queries to be clarified at viva-voce are included.

Option B: The thesis is recommended for the award of the PhD degree subject to the completion of minor correction and clarification of the queries/ comments before the PhD oral Examination Board. If the Doctoral Committee deems it appropriate, the same should be incorporated in the thesis. The revised thesis need not be sent to the examiner.

Option C: The thesis is accepted subject to revision and the thesis need not be sent back to me for re-evaluation.

Option D: The thesis needs major revision. Thesis needs to be sent back to me for re-evaluation and consideration.

Option E: The thesis be rejected.

Recommendation of the Thesis Examiners	**Action to be taken**
1. Option A or B	Thesis defence/ oral examination can be scheduled. Minor corrections if any should be incorporated before finalizing the viva-voce date and the required action to be taken.
2. Option C	i. The thesis to be REVISED as per the suggestions of the Examiner. A modified/revised thesis and rebuttal to be provided to the RPC ii. The Revised thesis to be considered by RPC for completeness of compliance to reviewer reports iii. The Oral examination to be conducted only after all compliance is approved by the Director.
3. Option D	i. The supervisor along with the student should provide a plan of work for resolution of examiner comments. ii. The thesis to be REWORKED and REVISED in consultation with the thesis supervisor(s) incorporating the comments/ feedback of the Examiner(s). The revision should improve the overall quality of the PhD work. iii. Revised thesis along with rebuttal to be submitted to the RPC for evaluation of compliance. iv. The thesis is resubmitted and will be sent to the examiner(s) for re-evaluation.

4. Option-E	If both the external examiners have same view on the thesis following will be process forward: i. The supervisor has to work out a plan of work. In the rarest of the rare, a request for addition of a co-supervisor may be permitted at this stage (proper justification to be provided). ii. The PhD thesis work will be reworked as per the guidance of the RPC so as to comply with the reviewer comments and include additional work if needed. iii. OPEN seminar will be presented again. On successful completion of OPEN Seminar, the thesis will be submitted as a new thesis. iv. The procedure of the thesis evaluation to be followed considering it as a new thesis. v. The revised thesis should be submitted only after six months of work. If one of the external examiners rejects the thesis and other external examiner accepts the thesis, following process will be adopted: i. If there is a difference of opinion on the fundamental aspect of work, the examiner rejecting the thesis can be replaced with the approval of the Director. Else the examiner/s will not be replaced. ii. The supervisor(s) in consultation with the student will work out a research plan. This plan should be approved by the RPC. iii. The thesis will be reworked as per the guidance of the RPC so as to comply with the reviewer comments and include additional work if needed. iv. The thesis will be re-submitted for evaluation. v. The evaluation process will be initiated. The examiner rejecting the thesis can be considered to be replaced, if the doctoral committee requests with proposer justification. vi. The revised thesis can be submitted after three months of work. If change in the examiner is sought, the thesis should be submitted after six months of additional work.

PHR 6.3 Thesis viva-voce/ defense seminar and board of exam

On receipt of a report from the examiners, the AR (Academic) will present the report in the Form No. 6.2A & B for approval. The report will be presented to the Director on recommendation of Dean (Academic). Following Directors approval, the examiner reports along with associated documents will be sent to the Chairperson, RPC through the HoD. The RPC will review the examiner comments and will provide a copy of the examiner comments to the student through the Supervisor. The details of the Examiners will remain confidential for the student. The student with advice from the Supervisor(s) will make corrections to the thesis and prepare rebuttals. The RPC will evaluate the correction and recommend for conduct of viva-voce.

In case there is a substantial difference of opinion among the members of the RPC on compliance to the reviewer's queries, an internal evaluation committee will be constituted by the Director with addition of 2 more members (local experts) to evaluate the compliance to the Examiners comments. These members will be preferably from the Institute. On approval of this thesis viva-voce can be held.

The PhD viva-voce/ defense examination board will be constituted with following members:

1	Chairperson, Doctoral Committee of student	Chairperson
2	Thesis Supervisor(s)	Convenor*
3	Examiner of the Thesis (Inside India)	Member
4	Members of the RPC	Member
5	HoD of the department	Member

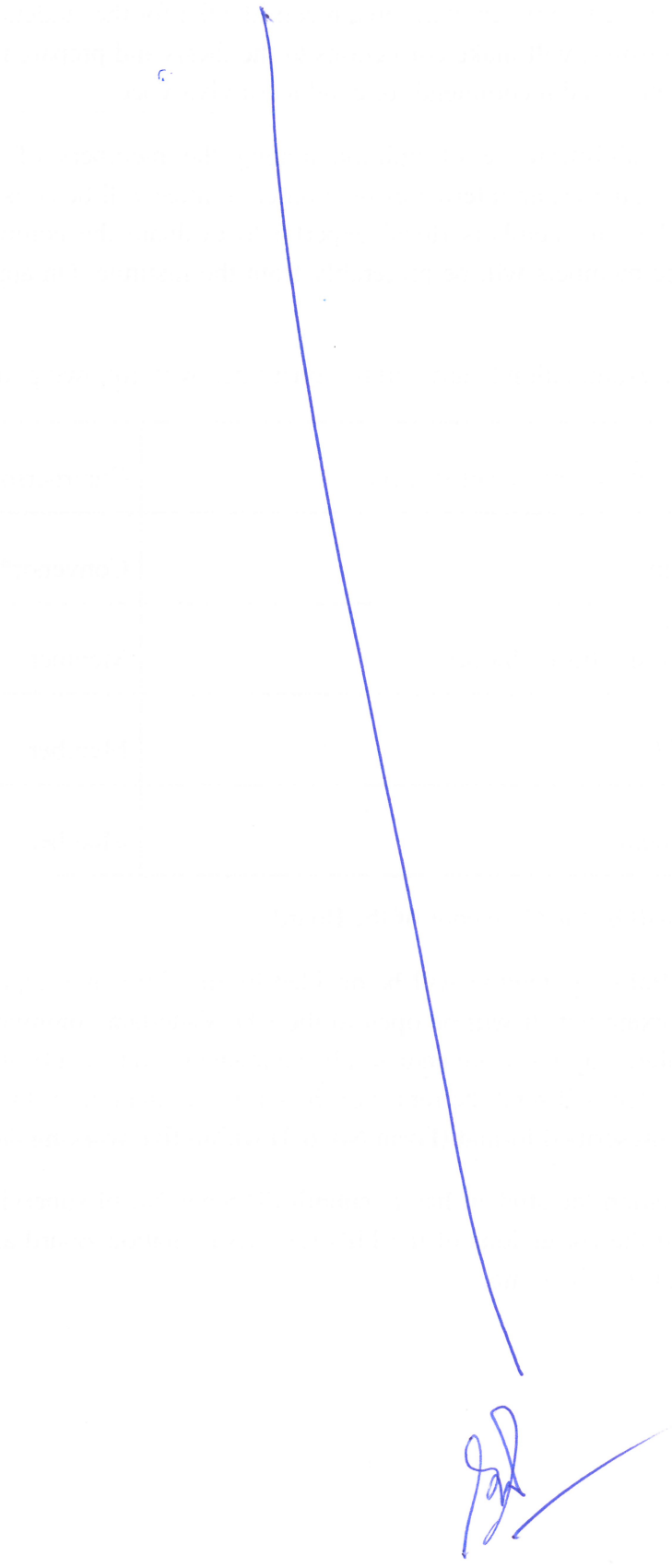
*The Principal Supervisor will be the Convenor of the Board.

The date and time of the Oral Examination will be decided by the Convenor depending on the availability of the external examiner. It will be open to the IIIT Vadodara community. A notice for the same must be circulated by the Convenor to all the students and faculty in the institute well in advance. The committee will send the report of the Oral Examination of the viva-voce to the Academic Office in the prescribed format (Form No. 6.3) within five working days.

On successful Oral Examination the student has to submit (Three + No of supervisor(s)) of the PhD thesis incorporating all the corrections of the PhD Oral Examination Board along with the required form (Form No. 6.4) for the same.

The copies of thesis submitted will be used for following places:

(a) Academic section for record
(b) Institute Library
(c) Department library
(d) Supervisor(s)



Indian Institute of Information Technology Vadodara IITV/Form 5.1

OPEN SEMINAR REPORT

1. Student Name : _____ Roll No.: _____
2. Department: _____ Date: _____
3. Name of Supervisor (s) : 1. _____
   2. _____
4. Date and time on which open seminar held : _____ Time:_____
5. Number of persons present: _____
6. Quality of presentation : _____
7. Title of thesis to be submitted incorporating comments of RPC : _____

_____

_____

8. The work presented appears to be acceptable (qualitatively and quantitatively) for compilation and submission of PhD thesis:

_____ _____

Supervisor Co-Supervisor

_____

Head of the Department

_____

Dean(AC)

Approved /Not Approved

_____

Director

Indian Institute of Information Technology Vadodara IIITV/Form 5.2
SYNOPSIS PRESENTATION AND LIST OF EXAMINERS

Certified that_____, ID: _____ a student of Ph.D. in the Department of _____ _____ has earned the required credit in course work and to be eligible for the submission of thesis and his/ her research work has been completed. He/She will be able to submit his/ her dissertation by (maximum one month from the date of approval of Synopsis) which is on or after the earliest date of thesis submission.

Date : _____

_____ _____

Signature of Co-Supervisor **Signature of Supervisor**

The notice for the synopsis seminar was circulated on _____ and the RPC members were provided with a draft copy of the thesis along with the seminar notice. Accordingly the student has made an oral presentation before the RPC and a general audience. The RPC members have reviewed the synopsis and heard the oral presentation. The student has completed the required number of academic credits. The RPC is satisfied that he/ she can submit the thesis in one month. The list of possible external examiners is enclosed for approval.

The thesis will be seen by the Committee before submission.

Encl :
1. One copy of synopsis along with One copy of synopsis in electronic media (MS WORD/ PDF format)
3. Panel of Examiners in enclosed format
4. Reports of the RPC members on the thesis (in sealed envelope)
5. Copy of draft thesis
6. Money receipt in support of payment

_____ _____

Chairperson, RPC **Head of the Department**

Put up for your kind perusal and recommendation to the Director for approval and serialization of the list of examiners.

Asst. Registrar (Academic)

Recommended to Director for approval and serialization of list of examiners.

Additional Comments (if any) :

_____

_____

Dean (Academic)
Approved and Serialized.

_____
Director, IIIT Vadodara

Date: _____

Recommendations on Composition of the Board of Examiners for Adjudication of Ph.D. Thesis Date:

1. Full Name of the Student : _____ Roll No. _____

2. (a) Department attached to :

(b) Studentship Category : Full Time Student with Fellowship/Assistantship

3. (a) Enrolment Date : _____ (b) Registration Date : _____

(c) Earliest date of thesis submission: _____

4. Title of Thesis:

5. (a) Credits already earned :

(i) Course Credits: _____ credits (ii) Research Credits: _____credits

(b) Credits registered in the current semester:

(c) Total Credits:

6. (a) Synopsis Seminar Date: _____ (b) Seminar approved on: _____

(c) Performance: _____ (d) Grade obtained: _____

7. (a) During Synopsis seminar, whether any suggestion was given by any RPC member or audience to improve the thesis: _____

(b) if yes, Suggestion: Correction of all chapters in terms of typos and proper alignment of Figures: _____

(c) Whether the suggestion was accepted: _____

(i) if yes, Chapter no. : All Chapters which RPC recommended to include in thesis.

8. Degree for which the thesis is to be submitted: Ph.D. in _____

9. Name of supervisor(s) : (a)_____ (b) _____

10. Panel of names for composition of the Board of Examiners for adjudication of thesis:

(a) External Examiners Panel I: [from outside India]

(1) Name : _____
Designation : _____ Specialisation : _____
Affiliation : _____
Postal Address :
_____
_____
Email : _____ QS/ Times Rank: _____
Website : _____ Phone No. : _____ Fax No. : _____
(2) Name : _____
Designation : _____ Specialisation : _____
Affiliation : _____
Postal Address :
_____
_____
Email : _____ QS/ Times Rank: _____

Website : _____ Phone No. : _____ Fax No. : _____

(3) Name : _____
Designation : _____ Specialisation : _____
Affiliation : _____
Postal Address :

_____

_____
Email : _____ QS/ Times Rank: _____
Website : _____ Phone No. : _____ Fax No. : _____

(4) Name : _____
Designation : _____ Specialisation : _____
Affiliation : _____
Postal Address :

_____

_____
Email : _____ QS/ Times Rank: _____
Website : _____ Phone No. : _____ Fax No. : _____

(5) Name : _____
Designation : _____ Specialisation : _____
Affiliation : _____
Postal Address :

_____

_____
Email : _____ QS/ Times Rank: _____
Website : _____ Phone No. : _____ Fax No. : _____

Indian Examiners

(1) Name : _____
Designation : _____ Specialisation : _____
Department : _____
Postal Address :

_____

_____
Email : _____
Phone No. : _____ Fax No. : _____

(2) Name : _____
Designation : _____ Specialisation : _____
Department : _____
Postal Address :

_____

_____
Email : _____
Phone No. : _____ Fax No. : _____

(3) Name : _____
Designation : _____ Specialisation : _____
Department : _____

Indian Institute of Information Technology Vadodara IIITV/ Form 5.3A

SUBMISSION OF THESIS BY PH.D STUDENT

Name of the Student: _____ ID: _____

Department: _____

Date of Enrolment: _____ Date of Registration: _____

Title of the thesis :

_____

_____

_____

I hereby submit my thesis to the Institute for consideration and award of Ph. D. Degree

Encl :
(1) 2 hard copies of soft bound thesis
(2) 1Pen drive containing thesis in electronic media (PDF and word if applicable)
(3) Report of Supervisor
(4) Report of Co-Supervisor, if applicable

_____

_____

Date _____ Signature of Student _____

Recommended for acceptance for the purpose of evaluation:

_____

_____

_____ _____ _____

Principal Supervisor Chairman, RPC Head of the Department
(Co–Supervisor in his absence)

To
Assistant Registrar (AC)

Postal Address :

_____

_____

Email : _____

Phone No. : _____ Fax No. : _____

(4) Name : _____

Designation : _____ Specialisation : _____

Department : _____

Postal Address :

_____

_____

Email : _____

Phone No. : _____ Fax No. : _____

(5) Name : _____

Designation : _____ Specialisation : _____

Department : _____

Postal Address :

_____

_____

Email : _____

Phone No. : _____ Fax No. : _____

Internal (supervisor(s)) :

1. Supervisor Details
2. Co-supervisor Details (if any)

The committee has also scrutinized the draft thesis and considers that the work is of the standard required. We recommend the composition of the Board of Examiners as proposed.

_____ _____ _____

SIGNATURE OF THE MEMBERS OF THE RESEARCH PROGRESS COMMITTEE

_____ _____

(chairperson) Head of the Dept./Centre

Approved in order of preference as marked on the margin

_____

Director

Indian **I**nstitute of **I**nformation **T**echnology **V**adodara IIITV/ Form 5.3B

LETTER TO STUDENT CONFIRMING THESIS ACCEPTED FOR EVALUATION

Name of the student : _____

Roll No. : _____

Department : _____

Title of the thesis :

_____

_____

_____

Received _____ copies of the above-mentioned thesis from Head, Department of _____ _____ for examination as per regulations of the Institute. The department will be informed on the status of examination in due course.

It is certified that the student has completed all formalities related to his academic programme and may leave the Institute awaiting adjudication of his/her thesis.

_____

Assistant Registrar (AC)

To

(1) Head, Department of .....

(2) Student concerned.

(3) Employer of student (if applicable)

(4) Warden if hostel resident

Indian Institute of Information Technology Vadodara IIITV/ Form 6.1

RECOMMENDATION OF EXAMINER ON Ph.D. THESIS

Name of the Candidate: _____ Roll No: _____

Title of the thesis :

_____

_____

1. Please give your assessment of the thesis (academic standard + volume of work) in the form of a detailed report highlighting strength, weaknesses and suggestions for improvement.

2. In addition to the detailed report, please give your specific recommendation by marking cross mark [x] on any one of the following options.

☐ The thesis meets the academic standard necessary for award of Ph.D. degree in institutions of higher learning around the world. It may be accepted in its present form. Questions raised in the report may be clarified at the time of viva voce.

OR

☐ The thesis is acceptable subject to minor modifications and correction of errors as suggested in the report. No major modification of scientific, technical or conceptual contents is suggested. After modification/correction, the thesis need not be referred back to me.

OR

☐ The thesis is acceptable subject to enhancement/modification of scientific/technical content or substantial revision of text as per enclosed details. After modification and scrutiny by the Institute committee the thesis need NOT be referred back to me.

OR

☐ The thesis is acceptable subject to enhancement/modification of scientific/technical content or substantial revision of text as per enclosed details. After modification the thesis should be referred back to me for final assessment.

OR

☐ The thesis does not meet the standards of comparable works in institutions of higher learning. It is rejected.

Note: We expect to receive your reports (summary + detailed report, original and signed) within 2 months from the date of your receiving the thesis. We shall be grateful if you kindly give early attention to this thesis in spite of your other commitments. The hard copy of the thesis need not be returned to the institute unless it contains instructions for correction.

Name of the Examiner: _____ Signature: _____

Date: _____ Affiliation: _____

Please return it to:

Dean (Academic) _____

Indian Institute of Information Technology Vadodara IIITV/ Form 6.2A

SUMMARY OF EXAMINER'S REPORT ON Ph.D. THESIS

Name of the candidate: _____ Roll No: _____

Department/Centre: _____

Title of the thesis :

_____

_____

Date of Registration: _____

Date of submission: _____

External examiners: 1) _____ (Foreign/ Abroad)

2) _____ (Indian)

Supervisor (s): 1) _____ (Supervisor)

2) _____ (Co-Supervisor)

Reports on the Ph.D. thesis of the candidate have been received from the examiners and the enclosed herewith for review.

_____

Asst Registrar (Academic)

Comments by Dean(Academic) on Examiners Report:

Report	Comments of Examiners			
Only one (√) in each column	Foreign / Indian	Indian	Supervisor	Supervisor -II (If applicable)
The thesis be accepted for award of the PhD degree The thesis is acceptable subject to clarification of certain points at the time of viva-voce				
The thesis is acceptable subject to minor modifications and correction of errors as suggested in the report. No major modification of scientific, technical or conceptual contents is suggested. After modification/ correction, the thesis need not be referred back to me.				
The thesis is acceptable subject to enhancement/modification of scientific/technical content or substantial revision of text as per enclosed details. After modification and scrutiny by Institute committee **the thesis need NOT be referred back to me.**				

The thesis is acceptable subject to enhancement/ modification of scientific/ technical content or substantial revision of text as per enclosed details. After modification**the thesis should be referred back to me for final assessment.**				
The thesis does not meet the standards of comparable works in institutions of higher learning. It is **rejected**.				

Additional Comments from Examiner

_____

_____

Recommendation

☐ Examiners' comments are generally favourable and unanimous except for certain points to be clarified at the time of viva-voce.

RPC / Prof ☐ may be advised to make arrangements for conducting viva-voce. _____ of _____ and the student may be contacted by HOD for fixing the date of viva-voce.

☐ Examiners' comments are generally favourable, However, certain serious issues have been raised by _____ and _____.

_____

_____

____

Any other

_____

_____

_____

Dean (Academic) _____

REMARKS OF DIRECTOR

The reports of the examiners may be reviewed by the DEC in light of the observation of Dean(Academic) and the recommendations of the DEC be sent to the Director for approval. The HOD may, if the DEC thinks fit, give copies of the reports to the students to make necessary changes in the thesis if so advised by the examiners. The HOD may contact the examiner viva-voice date. However, viva-voice to be conducted only after the Recommendation of DCE on Reports of Examiners is approved.

_____

Director

Indian Institute of Information Technology Vadodara IIITV/Form 6.2 B

RECOMMENDATION OF RPC ON REPORTS OF EXAMINERS

1. Department: _____ Date: _____
2. Name of the Candidate: _____ Roll No.: _____
3. Date of Enrollment: _____ and Registration: _____
4. Title of the Thesis:

_____

_____

5. Whether Adjudicators' Report are unanimous and favorable, if not state the difference:

_____

6. Observations if any, of the Committee: _____
7. Changes made in the thesis if any (Attach separate sheet)
8. Proposed date of Viva- Voce Examination: _____
9. We have considered the reports of the members of the Board of Examiners and recommend that the candidate may now be asked to appear for a viva-voce examination by the Board already formed. We also recommend that on the favorable report of the viva- voce Board one candidate be admitted to the Degree of Doctor of Philosophy in _____
10. Proposed Name and Address of Viva-Voce Examiner:

_____

_____

Signature of the members of the RPC Members:

1. _____ 3. _____

2. _____ 4. _____

_____ _____ _____

Supervisor(s) Co-Supervisor Chairman, DC

_____

Head of the Department

_____

Dean(AC)

_____

Director

Indian Institute of Information Technology Vadodara IIITV/ Form 6.3

REPORT ON DEFENCE OF Ph.D. DEGREE

Department : _____ Date: _____

Name of the Scholar: _____ Roll no: _____

Title of the thesis: _____

_____

Review of Examiners' reports

Examiner I: Prof./ Dr. _____ Examiner

II: Prof./ Dr. _____ Examiner

Supervisor(s): Prof./Dr. _____ _____

Date of Viva-Voce: _____ Number of persons present in seminar: _____

Recommendation:

(a) Performance: _____

(b) Degree (if recommended to be awarded): Ph.D. in _____

Modifications/ Corrections as suggested by examiners have been incorporated and modified versions of the thesis submitted.

Signature of members of RPC/ board of viva-voce examiners:

_____

Members of Committee

_____ _____ _____

(Supervisor) (Co-Supervisor) (External Examiner)

_____ _____

(Chairman, RPC) (Head of the Department)

1. Two copies of the corrected bound thesis received.
2. Two soft copies of the corrected thesis in the form of a pen drive MS-WORD (if applicable) and PDF files received.
3. The copies of thesis in paper and electronic form will be sent to Institute Library

_____

Asst Registrar (Academic)

The recommendation of the Panel of examiners may be accepted for award of Ph.D. degree.

_____

Dean (AC)

The student is provisionally accepted for award of PhD degree, subject to approval by the Senate and BOG.

_____

Director

Indian Institute of Information Technology Vadodara IIITV/ Form 6.4

SUBMISSION OF THESIS (ON COMPLETION OF VIVA-VOCE)

1. Name of the Student : _____ Roll No. _____

2. Department :

3. Name of Supervisor (s) : 1. _____
2. _____

4. Title of Thesis:

_____

_____

5. Date of Viva-Voce : _____

6. Number of hand copies of thesis submitted : _____

7. Soft copy of thesis (PDF): YES/NO

Signature of the Student _____

Forwarded by:

_____ _____

(Supervisor) (Head of the Dept./Centre)

To
Assistant Registrar (Academics)

Approved
Dean (Academics)

Annx - X

Minutes of the meeting of the Committee set up by the Director
to formulate a Proposal for Remuneration to Visiting Faculty from Foreign Countries
18th August, 2020

The following members were present during the meetings conducted on 22nd July and 5th August, 2020.

Exempted under section 8 (1) (j) of RTI Act 2005

The institute is taking services of visiting faculty to meet its teaching requirements at UG and PG level courses. In order to include faculty members from foreign Universities/ Institutes for online teaching, this committee was set up by the director on 22nd July 2020. The committee is to recommend the remuneration amount for the visiting faculty who are regular faculty of a foreign University/ Institute (full time teaching faculty at foreign universities).

Discussion:
The committee decided to identify the base policy on which the proposal could be built. The policy that the committee identified is of GIAN courses.

References:

1. https://www.mhrd.gov.in/guidelines-implementation-gian
2. https://www.mhrd.gov.in/sites/upload_files/mhrd/files/Guidelines_GIAN.pdf (Annexure-1)
3. https://gian.iitkgp.ac.in/images/BriefGuidelinesforProposalSubmission.pdf (Annexure-2)

The committee deliberated on the proposal based on the GIAN as a base guideline. Considering the institute's dependence on the visiting faculty and the existing policy on remuneration to visiting faculty (Annexure-3), the following are the major recommendations which are covered in the proposal prepared by the committee.

Recommendations:
The number of visiting faculty and the upper cap on the remuneration per course depends on the institute's financial health and budget. The committee has decided to put an upper cap on the maximum remuneration for a course to 8000 USD (600000 INR). An equivalence drawn with the GIAN courses excluding the travel expense. The proposed policy on remuneration is placed as Annexure-4.

Annexure - 4

Proposal for Remuneration to Visiting Faculty from Foreign Countries

1. The base remuneration based on the designation/ scale of the faculty on per credit (USD) is proposed to be as per the Table 1.

Table 1 : Base Remuneration in USD

		Per Credit Remuneration in USD		
Category	**Designation**	**Theory**	**Tutorial**	**Laboratory**
C1	Assistant Professor	450	225	225
C2	Associate Professor	650	325	325
C3	Professor	850	425	425

2. To cater to the value and brand associated with the foreign faculty member of a higher ranking University/ Institute, the additional factor to be multiplied with the base remuneration is proposed in Table 2. This will incentivize the faculty members from higher QS World Ranking to participate in teaching at IIIT Vadodara.

Table 2 : Factor based on QS World Ranking of the University

Sr. No.	QS World University Ranking	Factor
1	1-100	2
2	101-250	1.5
3	Others	1

3. The student strength in a course is also factored into the calculation of remuneration considering the larger student strength typically demands additional efforts in book keeping and evaluation. Table 3 provides factors to be multiplied with the overall remuneration calculated for the given student strength.

Table 3 : Factor based on the Number of students

Sr. No.	Number of Students	Factor
1	Upto 100	1
2	101-200	1.1
3	201 and Above	1.2

4. The courses offered by foreign visiting faculty will be assigned teaching assistants by the institute based on the institute policy.
5. Some example calculations are presented in Table 4 as a reference.

Table 4 : Example Calculations in USD (Upto the class strength of 100 students)

	Example Calculations			QS - 50			QS - 150			QS - 251		
Sr No.	L (credits)	T (credits)	P (credits)	C1	C2	C3	C1	C2	C3	C1	C2	C3
1	3	0	0	2700	3900	5100	2025	2925	3825	1350	1950	2550
2	3	1	0	3150	4550	5950	2362.5	3412.5	4462.5	2175	2275	2975
3	3	1	2	4050	5850	7650	3037.5	4387.5	5737.5	2025	2925	3825

Guidelines for Proposal Submission

a) All course proposals should have minimum 5 day duration.

b) Minimum number of lecture hours (excluding tutorial/practical) should be 12 hrs.

c) Normally, course proposals are expected to be between 12-14 lecture hours in 5 day duration and 24-28 hours in 10 day duration.

d) Minimum 8000 dollars (for 12-14 lecture hours in 5 day duration) and maximum 12000 dollars (24-28 hours in 10 day duration) will be paid for each course to support (i) travel and honorarium for the foreign faculty (ii) honorarium for the host faculty & local coordinator (iii) video recording (iv) incidental/contingency expenses.

e) Course having more than 10 day duration/ 28 lectures may be allowed with no extra financial support.

f) Course proposals should have mass appeal and shall be amenable for conversion to MOOC. Necessary consent for this purpose from the foreign faculty/expert should be explicitly included in the proposal.

g) An institute is permitted to submit maximum 50 proposals with maximum 2 proposals per host faculty/course coordinator.

h) Association of each Foreign faculty/expert would be restricted to maximum 2 distinctly different proposals.

i) Minimum 60% of the course including lectures and tutorials should be taught by the foreign faculty.

j) The National faculty / host faculty may get honorarium at the rate of 3000/- per lecture hour and 2500/- per tutorial hour for a course, subject to a maximum of total 12 lectures /tutorials. This should be within the approved maximum allotment of 8000/12000 dollars for a course.

k) Optional conversion of GIAN courses to MOOC format will be taken as an input during proposal submission. If the proposal is approved, two sanction letters, one for GIAN and other for MOOC will be generated by National Co-ordinating Institute. Preference will be given to those proposals which are having MOOC conversion possibility. Cost of MOOC conversion will be transferred to the concerned Institutes to be utilized as per the Swayam Guidelines.

Annx - XI

Minutes of the Meeting
held on
8 March, 2020

Draft a policy on evaluation of SWAYAM courses

The following were present during the meeting

Exempted under Section 8 (1) (j) of RTI Act 2005

As per the senate recommendation, "a student of B.Tech. program can opt for SWAYAM course as a Science and/ or HSS elective. Total credits for which a student's credit transfer will be considered is limited to 4 (four) in the case of a Science elective and, 4 (four) in the case of a Humanities and Social Science elective, i.e. a total of eight credits. The maximum credit in a semester that a student can register for courses through SWAYAM is limited to 4 credits."

The following is proposed for transfer of evaluation to the grades for a SWAYAM course:

1. Students have to register for the SWAYAM course by taking due approval on the course content by applying for the same to the respective faculty advisor. All such applications will be approved by the Director/ PIC Academics. Course code will be allotted by the academic section.
2. If the student takes the SWAYAM course the grades or mark received under SWAYAM evaluation will be reflected in the grade card.
3. Students registered for the SWAYAM courses will have to take a Proctored exam or an exam at the institute under the supervision of an invigilator and earn a certificate mentioning the percentage.
4. Percentage to grade conversion table.

Percentage (SWAYAM)	Equivalent Grade (IIITV)	Grade Point	Remark
>=0 and <=30 %	F	0	The cutoff range for each grade is proposed considering the institute's policy on CPI to percentage conversion. To calculate percentage, CPI is multiplied by a factor of 10. Considering the above, in a course if the grade received is AB, the corresponding Grade point is 9 and the upper threshold
>30 and <=40 %	DD	4	
>40 and <=50%	CD	5	
>50 and <=60%	CC	6	
>60 and <=70%	BC	7	

>70 and <=80%	BB	8	is 90%.
>80 and <=90%	AB	9	
>90%	AA	10	

Annx - XII

Minutes of Meeting
held on
8 March, 2020

Draft a policy on transferring credits and evaluation for IIT Gandhinagar courses

The following were present during the meeting

Exempted under Section 8 (1) (j) of RTI Act 2005

Since the institute does not have sufficient strength and expertise in specialized areas, the PhD students of the institute are permitted to opt for courses at the other institutes of national importance. As of now, a student who has joined the PhD in Mathematics program at IIIT Vadodara has registered for two courses at IIT Gandhinagar.

The following is proposed for transfer of evaluation to the grades for the IIT Gandhinagar courses:

1. Students have to register for the courses with IIT Gandhinagar by taking due approval on the course content by applying for the same to the respective faculty advisor. All such applications will be approved by the Director / PIC Academics. Course code will be allotted by the academic section.
2. If the student takes the IIT Gandhinagar course the grade or mark received under IIT Gandhinagar evaluation will be reflected in the grade card.

Committee Recommendation:

1. Semester Grade point (IITGN)

(a) For courses taken at IIT Gandhinagar are both 4 credit courses. The grading pattern followed is similar to IIIT Vadodara grade point system except for provision of A+ (11 Grade points) and E (2 grade points) in IIT Gandhinagar Evaluation.

(b) However the max SPI / CPI at the end of semester is bounded above by 10.00.

(c) It is therefore recommended that A+ be combined with A and E be combined with F to arrive at grade conversion as follows.

IIT Gandhinagar		IIIT Vadodara	
Grade	Grade points	Grade	Grade points
A+	11	AA	10
A	10		
A-	9	AB	9
B	8	BB	8
B-	7	BC	7
C	6	CC	6
C-	5	CD	5
D	4	DD	4
E	2	F	0
F	0		

ANNEXURE – XIII

(Exempted under Section 8 (1) (e) and section 8 (1) (j) of RTI Act 2005)

ANNEXURE – XIV

(Exempted under Section 8 (1) (e) and section 8 (1) (j) of RTI Act 2005)

ANNEXURE – XV

(Exempted under Section 8 (1) (e) and section 8 (1) (j) of RTI Act 2005)

Annx - XVI

Curriculum-2020

Master of Technology

in

Computer Science and Engineering

Indian Institute of Information Technology Vadodara

Table of Contents

Master of Technology Program

The Institute offers a 2-years Master of Technology (M. Tech.) program in Computer Science and Engineering (CSE). The first year is devoted to course work while in the second year, a student has to work for his/her M.Tech. thesis. The student is expected to work either on research problems or on industry oriented problems.

Academic Year (1st July - 30th June)

Each academic year is divided into two semesters of approximately eighteen weeks duration with at least seventy working days for classes in each semester. The two semesters are:

1. Autumn Semester (July-November)
2. Winter Semester (January-April)

In addition, there are two inter-semester breaks:

1. Winter (December)
2. Summer (May-June)

The Senate approves schedules of academic activities for an academic year, inclusive of dates for registration, mid-semester and end-semester examinations, inter-semester breaks etc. The schedule is laid down in the Academic Calendar for the year.

Registration

At the beginning of each semester, until the completion of the program, a student must register for the semester and for the courses that he/she will study during the semester.

Eligibility for Course Registration

A student with no backlog courses (*i.e.* who has passed all the previous courses) will be eligible to register for all courses prescribed in the curriculum for semester. A student who has a backlog course(s) or is on academic probation may be recommended a different set of courses by the Dean of Academic Programs (Dean-AP).

Prerequisite Courses

A student registering for a course must have successfully completed the prerequisite course(s), if any, for that particular course. For hard prerequisites, a minimum grade of 'DD' is required.

Auditing of Courses

Auditing of courses allows students to gain exposure to additional subjects without increasing their overall workload. Registration of courses for Audit is permitted from third semester onwards under the following conditions:

1. A student can audit a maximum of two courses during the entire program.
2. A student has to enter the courses to be audited in the Course Registration Form while registering for the semester. The word 'Audit' would be specially mentioned in the remarks column of the student's course registration form.

3. A student can register a course for audit provided the following two conditions are satisfied: (*i*) the course instructor permits and approves the registration, and (*ii*) the lecture, lab and tutorial time-table strictly permits.
4. An audit course will not be considered as an overload.
5. If the student's performance is satisfactory, a grade of 'P' (Pass) would be awarded. If the performance is not satisfactory, 'F' (Fail) would be awarded.
6. An audit course will not be considered for the calculation of Semester Performance Index (SPI) / Cumulative Performance Index (CPI). However, the course will be reflected in the Semester Grade Report and Transcript as an Audit Course provided a grade of 'P' was obtained, otherwise the course will not appear in the Semester Grade Report and Transcript.

Course Load in Regular Semesters

A student is permitted to register for additional courses over the prescribed courses in the curriculum for a regular semester provided the total number of courses does not exceed 7 and the total credits do not exceed 26. A student is permitted to under-load his/her prescribed academic load in a regular semester by dropping one or more courses provided the number of courses is at least 4 and the registered credits are not less than 12.

Letter Grade (10-point Scale)

For every course registered by a student, he/she is awarded a letter grade based on his/her combined performance in all the assessments. These letter grades are assigned points on a 10-point scale as described in the table below:

Letter Grade	Points	Remark
AA	10	Outstanding
AB	9	Excellent
BB	8	Very Good
BC	7	Good
CC	6	Average
CD	5	Below Average
DD	4	Poor
F	0	Fail
P	-	Pass
I	-	Incomplete

A student passes the course if he/she gets any grade in the range of 'AA' to 'DD', but fails if he/she gets the grade 'F'. Certain courses are indicated as Pass/Fail courses, and in these courses a grade of 'P' or 'F' is awarded. 'F' grade may also be awarded in case of malpractice in examination/continuous evaluation process. Pass/Fail courses are not considered for calculation of SPI/CPI.

'I' grade will be awarded in a course if the overall performance of the student is satisfactory in the course, but the student either misses the end-semester examination due to illness, accident/death in the family or obtains such an approval from the Dean-AP under exceptional circumstances. A student who misses the end-semester examination must apply for permission with reasoning and proof. An application not so supported will not be considered. Grade 'I' awarded for missing the end-semester examination will be converted into a performance grade (depending on the overall performance of the student in the course) after taking an examination equivalent to the end-semester examination of that particular course. An 'I' grade must be converted into a performance grade by the specified date in the academic calendar for the next semester, otherwise it will be converted into an 'F' grade.

Performance Indices

[A] Semester Performance Index (*SPI*)

The performance of a student in a semester is indicated by the *SPI*. The *SPI* is the weighted average of the grade points obtained in all the courses registered by the student during the semester, calculated to two decimal places.

[B] Cumulative Performance Index (*CPI*)

An up-to-date assessment of the overall performance of a student from the time of entering the Institute is obtained by calculating the student's *CPI*. The *CPI* is a weighted average of the grade points obtained in all the courses registered for credit by the student after entering the Institute. The *CPI* is also calculated to two decimal places.

Calculation of *SPI* and *CPI*

Let the course credits are, U1, U2,....and the numeric values of the corresponding grade awarded in the courses are ,G1, G2….., respectively, the SPI is given by

$$SPI = \frac{U1G1+U2G2+.....}{U1+U2+.....}$$

In the above computation, the courses with 'P' grade are not considered. Similarly, the *CPI* indicates the cumulative academic performance in all the courses taken including those taken in the current semester as

$$CPI = \frac{1}{Total\ Credits} \sum_{i=1}^{4} \left(SPI \times Total\ credits\ of\ the\ i^{th}\ Semester\right)$$

Graduating *CPI* and *Class*

For the purposes of computing the *CPI* at the end of the M. Tech. program, the students' *CPI* will be computed on the basis of the best *CPI* obtained from the courses taken. The grade of M. Tech. Thesis/Project (if graded as prescribed in the curriculum) will be included while computing the final *CPI* of the student. The minimum *CPI* for eligible to graduate the M. Tech. program is 6.00. The Transcript of a graduating student will indicate

1. *Distinction* when $CPI \geq 9.00$,
2. *First Class* when $6.50 \leq CPI < 9.00$ and
3. *Pass* when $6.00 \leq CPI < 6.50$

Repeating a Course

[A] As a Backlog Course

A student must repeat a course taken for credit in which he/she has obtained an 'F' grade. Such a course is regarded as a backlog course. A backlog elective course can be replaced by another elective of the same category. A student can appear for examination (Mid-Semester and End-Semester) components only as a backlog course. The component of continuous evaluation

will be carried forward from earlier evaluation. In case a student has obtained an 'F' grade in a Lab Course, he/she has to repeat the course, i.e., attend all lab sessions and take lab exams.

[B] For Grade Improvement

A student whose *CPI* is less than 5.00 can be permitted to reappear in the courses in which a 'DD' grade was obtained. This is for the purpose of grade improvement in a regular semester only. The grade obtained in the repeated attempt(s) will be considered for the purpose of calculating the *CPI* for the semesters thereafter. However, the grade obtained in the first and subsequent attempt(s) will be shown in the Transcript.

Award of Degree

The M. Tech. (CSE) will be conferred on a student after he/she has fulfilled the graduation requirements stipulated in the curriculum (as approved by the senate).

Award of Medals

The students with highest scholastic performance will be awarded with the Chairperson's Gold Medal and the Institute Medals as per the Institute policy.

Minimum and Maximum Period for Completion of M. Tech. Program

The minimum period to complete the program is two academic years. In any case, a student should fulfil the requirements for her/his degree within a maximum period of three academic years, failing which she/he will be required to leave the Institute. The period of three years excludes any semester in which the student has availed "withdrawn" status.

M. Tech. Program: Course Categories and Distribution of Credits

Definition of Credits

Teaching of the courses shall be reckoned in credits; credits are assigned to the courses based on the following general pattern:

1 hour of Lecture (L) per week	1 Credit
1 hour of Tutorial (T) per week	1 Credit
2 hours of Laboratory (P) per week	1 Credit
3 hours of Laboratory (P) per week	2 Credits
6 hours of Thesis (P) per week	4 Credits

Course Categories and Range of Credits for M. Tech. Program

M. Tech. program offered by the institute is designed with the following credit guidelines presented in table below

Course Categories	Min. Credits	Max. Credits
Program Core	12	16
Program Elective	14	20
Thesis	22	24
Total Credits	**54-60**	

Courses in terms of Lecture-Tutorial-Practicals: Credits (L-T-P: C)

Program Core	3-0-0: 3, 0-1-2: 2, 2-0-0: 2, 1-0-2: 2, 3-0-2: 4, 3-1-0: 4
Program Elective	3-0-0: 3, 1-0-0: 1, 1-0-2: 2, 0-1-2: 2, 1-0-2: 2
Comprehensive Viva	0-0-0: 2
Thesis	0-0-3: 2, 0-0-6: 4

Note: *Courses with (1-x-x) or (0-x-x) will not be evaluated through mid- and end-semester examinations.*

Semester wise credit distribution:

Computer Science and Engineering

Semester	Course Category	Credits			
		L	T	P	C
I	Mathematics	2	0	0	2
	Program Core	x	x	x	9
	Program Elective	x	x	x	4
	Lab Course	0	0	2	1
	Total	**x**	**x**	**x**	**16**
II	Program Core	3	0	0	3
	Program Elective	x	x	x	11
	Humanities and Social Sciences	x	x	x	2
	Total	**x**	**x**	**x**	**16**
III	Comprehensive Viva	0	0	0	2
	Humanities and Social Sciences	x	x	x	2
	Thesis	0	0	15	10
	Total	**0**	**0**	**15**	**14**
IV	Thesis	0	0	18	12
	Total	**0**	**0**	**18**	**12**
Grand Total		**x**	**x**	**x**	**58***

*****The credits given are for guidelines. The total credits may vary in the range 58-60.*

Graduation Requirements

A student to be eligible to receive M. Tech. degree should meet the following criteria:

1. completed all registered courses with minimum DD/Pass Grade.
2. should have secured CPI ≥ 6.00 (on 10.00 point scale).
3. should have acquired minimum 34 credits in 'Graded Courses' out of which there must be at least
   - 14 credits from Program Core,
   - 14 credits from Program Electives and
   - 4 credits from Humanities and Social Sciences Electives.
4. should have secured minimum 22 credits from 'Thesis' and 2 credits of Comprehensive viva.

Computer Science and Engineering

Courses: Semester-I

Course Code	Course Name	Credits			
		L	T	P	C
MA601	Essential Mathematics	2	0	0	2
CS603	Advanced Algorithms	3	0	0	3
CS609	Probability, Statistics, Random Process	3	0	0	3
CS611	Computer Systems	3	0	0	3
CS661	Algorithms and DBMS Lab	0	0	2	1
CSXXX	Program Elective*	x	x	x	4
Total		**x**	**x**	**x**	**16**

**List of Program Electives along with Course Code and Credits is provided in Appendix-I*

Courses and Contents

MA601	Essential Mathematics	2-0-0: 2

Objective: Students entering a PG program usually find that their mathematical foundation is inadequate to pursue research for their thesis. It is also a fact that, for them to achieve the required level of mathematical maturity entirely through self-study is difficult. This course is designed with an objective to provide the essential knowledge required to remove this inadequacy. The content of the course is designed keeping in mind the mixed audience coming from computer science and allied engineering disciplines. At the conclusion of this course, students should have a sound understanding of what mathematics is about, and should have acquired a level of mathematical literacy that would enable them to see its relevance in their own domain of knowledge.

Learning Outcomes: Upon successful completion of this course, student will be able to formulate the engineering problems in the language of mathematics

Prerequisite: Nil

Contents:

Module 1: Sets, Relations and Functions: Order, Equivalence and Correspondence; Groups, Rings and Fields: Permutations, Symmetries, Polynomials.

Module 2: Vector Space: Basis, Linear transformat-ions, Norm and Inner-Product, Orthogonality, Metric: continuity, convergence and completeness, Finite Dimensional Vector Space: System of linear equations, Eigen-values, Eigen vectors, Matrix inverse, Least squares and Pseudo inverse, Change of basis and similarity transform.

Module 3: Introduction to Graphs and Connections with Linear Algebra: Random Graphs, Adjacency and Incidence matrices, Graph spectrum, Graph Partitioning and Clustering, Max-Min flow and Graph cuts, Shortest path algorithms.

Text Books:

1. *Introduction to Linear Algebra*, Gilbert Strang, 5th Ed, SIAM, 2016.
2. Kolman, Busby, Ross, *Discrete Mathematical Structures*, Sixth Edition, Pearson, 2008

Reference Books:

1. Lehman, Leighton and Meyer, *Mathematics for Computer Science*, 2017. https://courses.csail.mit.edu/6.042/spring17/mcs.pdf
2. *Linear Algebra*, Kunze Ray, Hoffman Kenneth 2nd Ed, Phi Learning, 2014.
3. *Fundamentals of Matrix Computations*, David S. Watkins, 3rd ed, Wiley.
4. Kepner and Jananthan, *Mathematics of Big Data*, 2018

CS603	Advanced Algorithms	3-0-0: 3

Objective: Advanced Algorithms is an advanced course on designing and analysis of algorithms and is an important part of computer science. This course introduces students to advanced techniques for the design and analysis of algorithms, and explores a variety of applications.

Learning Outcomes: By the end of this course, students should develop the following skills:

1. Understand and apply the algorithms discussed, prove their correctness, and analyze their time complexity in a mathematically rigorous manner.
2. Understand the fundamentals behind the techniques, so that you are able to develop algorithms for new problems where these techniques can be applied.
3. Given a practical application, identify the computational issues and apply suitable algorithms to solve it effectively.

Prerequisite: Fundamental course in algorithms or complexity.

Contents:

Review of Algorithm analysis, order arithmetic: Growth functions, Recurrences and solution of recurrence equations, time and space complexities, average and worst case analysis, lower bounds. Algorithm design techniques: divide and conquer, Greedy Algorithms, Dynamic Algorithm.

Review of Advanced Data Structures: AVL Trees, Red-Black Trees, Augmenting Data Structures, Optimal Binary Search Trees, Skip Lists, Self-Adjusting Binary Search Trees (Splay trees/amortized analysis), Binomial Heaps, Fibonacci Heaps, Disjoint Sets (union-find trees), Hashing, Perfect Hashing.

Introduction to Amortized analysis, Aggregate, Accounting, and Potential methods, String Matching. Algorithms: Naive Algorithm; Robin-Karp Algorithm, String matching with Finite Automata, Knuth-Morris-Pratt and Boyer-Moore Algorithms.

Graph Algorithms: Review of Graph Traversal algorithms (BFS and DFS), Bellman-Ford Algorithm Shortest paths in a DAG, Johnson's Algorithm for sparse graphs, Flow networks and the Ford-Fulkerson Algorithm, Maximum bipartite matching.

Hard problems- Problem classes P, NP, NP-hard and NP-complete, Reducibility, Introduction to Approximation Algorithms and Randomized Algorithms

Text Book:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, "*Introduction to Algorithms*", Prentice Hall India, 2002.

Reference Books:

1. D.E.Knuth, "*The Art of Computer Programming*", Vols. 1 and 3, Addison Wesley, 1998.
2. A.V.Aho, J.E.Hopcroft, J.D.Ullman, "*Design and Analysis of Algorithms*", Addison Wesley, 1976.
3. E.Horowitz, S.Sahni, "*Fundamentals of Computer Algorithms*", Galgotia Publishers, 1984.
4. K.Melhorn, "*Data Structures and Algorithms*", Vols.1 and 2, Springer Verlag, 1984.
5. P.W.Purdom, Jr. and C.A.Brown, "*The Analysis of Algorithms*", Holt Rhinehart and Winston, 1985.

CS609	Probability, Statistics and Random Process	3-0-0: 3

Objective: The main objective of this course is to provide students with the foundations of probabilistic and statistical analysis mostly used in varied applications in engineering and science mainly in signal/images processing, machine learning, artificial intelligence, and data networks.

Learning Outcomes: After studying this course, students will be able to understand and appreciate the key fundamentals of probability and statistical analysis which would be helpful to them in building strong foundations for advanced courses.

Prerequisite: Working knowledge of Linear Algebra and Calculus.

Contents:

INTRODUCTION: Classical, relative frequency and axiomatic definitions of probability, σ-field, measurable space, probability space, addition rule and conditional probability, multiplication rule, total probability, Bayes' theorem and independence.

RANDOM VARIABLES: Discrete, continuous and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, probability and moment generating function, median and quantiles, Markov inequality, Chebyshev's inequality.

SPECIAL DISTRIBUTIONS: Discrete uniform, binomial, geometric, negative binomial, hypergeometric, Poisson, continuous uniform, exponential, gamma, beta, normal, lognormal, inverse Gaussian, Cauchy, double exponential distributions, reliability and hazard rate, reliability of series and parallel systems.

JOINT DISTRIBUTIONS: Joint, marginal and conditional distributions, product moments, correlation and regression, independence of random variables, bivariate normal distribution, representation of multivariate normal distribution.

TRANSFORMATIONS: Functions of random vectors, distributions of order statistics, distributions of sums of random variables.

SAMPLING DISTRIBUTIONS: Mean, median, variance, standard deviation, The law of large numbers, The Central Limit Theorem, distributions of the sample mean and the sample variance for a normal population, Chi-Square, t and F distributions.

ESTIMATION: Unbiasedness, consistency, minimum mean-squared estimation, the method of moments, the method of maximum likelihood estimation, maximum a posterior probability estimation.

RANDOM PROCESSES: Definition and examples, Stationary processes, wide-sense stationary, strict sense stationary, Ergodicity and ergodic processes, Autocorrelation and autocovariance functions, Power spectral density, various noise processes like additive white Gaussian noise, fractional Gaussian noise, etc., Transmission of random process through linear time-invariant systems, Analysis of communication systems in the presence of noise.

Text Book:

1. A. Papoulis and S. Unnikrishnan Pillai, *"Probability, Random Variables and Stochastic Processes,"* Fourth Edition, McGraw Hill.

Reference Books:

1. Steven Kay, *"Intuitive probability and random processes using MATLAB"*, Springer.
2. Alberto Leon-Garcia, *"Probability, statistics, and random processes for electrical engineers,"* Prentice Hall - Pearson.
3. Sheldon Ross, *"A first course in probability"*, Eighth edition, Prentice Hall - Pearson.
4. Sheldon Ross, *"Introduction to Probability and Statistics for Engineers and Scientists"*, Academic Press.

CS611	Computer Systems	3-0-0: 3

Objective: The objective of this course is to expose students to the "full span" of the computer network and DBMS. It will give the students a performance perspective towards analysis of computer and communications networks. This course will also provide the major techniques in DBMS implementations.

Learning Outcomes: By the end of this course, students should be able to

1. Demonstrate the operation of various routing protocols and their performance analysis.
2. Illustrate design and implementation of network application, transport and network layer protocols within a simulated/real networking environment.
3. Demonstrate the principles of transaction management

Prerequisite: Fundamental course in Computer Networks and DBMS

Contents:

Introduction to Routing versus forwarding, Static and dynamic routing, Unicast and Multicast Routing. Distance-Vector, Link-State, Shortest path computation, Dijkstra's algorithm, Network Layer Protocols (IP, ICMP), IP addressing, IPV6, Address binding with ARP, Scalability issues (hierarchical addressing), IP Multicasting

Review to UDP, TCP and SCTP protocols, Multiplexing with TCP and UDP, Principles of congestion control, Approaches to Congestion control, Router-Assisted Congestion Control: Active Queue Management, Quality of service, Flow characteristics, Techniques to improve QoS.

Naming and address schemes (DNS:Resource Discovery, Lookups, IP addresses, Uniform Resource Identifiers, etc.), Distributed applications (client/server, peer-to-peer, cloud, etc.), Distributed Hash Table (DHT) Abstraction and Algorithms, Routing in Overlay Networks, HTTP as an application layer protocol, Electronic mail, File transfer, Remote login.

Overview of Relational Query Languages, The SQL Query Language, Destroying and Altering Relations, Adding and Deleting Tuples, Integrity Constraints, Primary and Candidate Keys in SQL, Foreign Keys, Referential Integrity in SQL, Categories of SQL Commands, Data Definition, Data Manipulation Statements: SELECT - The Basic Form Subqueries, Functions, GROUP BY Feature, Updating the Database, Data Definition Facilities, Views, Embedded SQL *, Declaring Variables and Exceptions, Embedding SQL Statements, Transaction Processing, Consistency and Isolation, Atomicity and Durability, Dynamic SQL.

Introduction of transaction processing system, Storage Structure, Transaction atomicity and durability, Transaction Isolation, serializability and recoverability, Serializability by Locks, Concurrency Control by Timestamps, Concurrency Control by Validation, Database recovery management.

Text Books:

1. "*Database System Concepts*", A. Silberschatz, H. F. Korth, S. Sudharshan, Tata McGraw Hill, New Delhi, 2019.
2. "*Computer Networking: A Top Down Approach*", Kurose and Ross, Addison-Wesley, (2012).

Reference Books:

1. "*Fundamentals of Database Systems*", R. Elmasri, S. B. Navathe, Prentice Hall, New Delhi, 2016.
2. "*Computer Networks*", Tanenbaum , A.S., Prentice Hall (2010).
3. "*Computer Networking with Internet Protocols and Tech*", Stallings, W., Prentice Hall of India (2010).
4. "Data communication and Networking", Forouzan, B.A., McGraw Hill (2006).

CS661	Algorithms and DBMS Lab	0-0-2: 1

Objective: would be designed to provide hands-on experience in programming data structures and algorithms, followed by advanced database management systems to learn a few systems programming tools, and scripting.

Learning Outcomes: Upon successful completion of this course, student will be able to:

1. Understand the fundamentals behind the techniques, so that students are able to develop algorithms for new problems where these techniques can be applied.
2. Given a practical application, identify the computational issues and apply suitable algorithms to solve it effectively.
3. Demonstrate the use of various DBMS tools available

Prerequisite: Fundamental courses in Data structures and algorithms and Database management systems.

List of Experiments:

A. Algorithm

1. Time Complexity Analysis of various sorting algorithm: Searching Algorithms, Sorting Algorithms - Bubble, Selection, Insertion, Heap, Merge & Quick, Linear sort
2. Tree/Graph based algorithm including Graph Representation, Graph Traversal, Graph Searching
3. Implementation of Balanced Trees – AVL, Red Black Trees, B-Trees
4. Implementation of Shortest Path Algorithms
5. Implementation and Analysis of Greedy Algorithms
6. Implementation and Analysis of Dynamic Algorithms

7. Implementation and Analysis of Randomization Algorithms

B. DBMS

1. Creation of ER diagram for the databases (for ex. A company, an institute)
2. Create a small database (for ex. A company, an institute) in SQL/MySQL and answer various queries
3. Normalization of the database to answer various queries from SQL
4. Designing the rules for database using Triggers
5. Familiarity with MangoDB and postgresql Tool

Text / Reference Books:

1. T.H.Cormen, C.E.Leiserson, R.L.Rivest, "*Introduction to Algorithms*", Prentice Hall India, 2002.
2. D.E.Knuth, "*The Art of Computer Programming*", Vols. 1 and 3, Addison Wesley, 1998.
3. E.Horowitz, S.Sahni, "*Fundamentals of Computer Algorithms*", Galgotia Publishers, 1984.
4. "*Database System Concepts*", A. Silberschatz, H. F. Korth, S. Sudharshan, Tata McGraw Hill, New Delhi, 2019.
5. "*Fundamentals of Database Systems*", R. Elmasri, S. B. Navathe, Prentice Hall, New Delhi, 2016.
6. "*Introduction to Linear Algebra*", Gilbert Strang, 5th Ed, SIAM, 2016.

Courses: Semester-II

Thesis Mode

Course Code	Course Name	Credits			
		L	T	P	C
CS612	Machine Learning	3	0	0	3
CSXXX	Program Electives*	x	x	x	11
HSXXX	Seminar / Technical Communication / Modular Course#	x	x	x	2
Total		**x**	**x**	**x**	**16**

**List of Program Electives along with Course Code and Credits (L-T-P: C) is provided in Appendix-I. Minimum three Program Electives of total 11 credits will be offered by the department.*

#*The Course Code and Credits will be provided by the department.*

Courses and Contents

CS612	Machine Learning	3-0-0: 3

Objective: Machine Learning is a growing field in the area of pattern recognition, natural language processing, speech processing, image processing and vision. This course provides a broad introduction to machine learning architectures. The objectives include: 1. Formulate machine learning problems corresponding to different applications and solve using learning machines based approaches. 2. Read basic as well as current research papers and understand the issues raised by current research.

Learning Outcomes: After studying this course, students will be able to understand a variety of machine learning architectures including deep learning, and use them to solve a few problems. This course will expose students to cutting-edge research starting from a refresher in basics of machine learning, to recent developments in deep learning and random forest.

Prerequisite:

1. Linear algebra
2. Probability and Statistics
3. Computational tools: C/C++/Matlab/Python (any one of these)

Contents:

Problem setting and fundamentals of machine learning, Supervised, unsupervised, semi-supervised learning, Bayes' classifier, K-means, k-NN, principal component analysis (PCA), and least-squares estimation (LSE), minimum mean-squared estimation (MMSE).

Linear and Logistic regressions, concept of over-fitting, regularization.

Concept of convex/non convex functions, optimization methods (gradient descent/conjugate gradient descent/stochastic gradient descent).

Learning machines: Statistical theory of learning, Vapnik-Chervonkis (VC) dimension, Support vector machine (SVM): linear and nonlinear.

Introduction to neural networks and training a network: Back propagation algorithm, Convergence issues, Matrix calculus for training model architectures.

Markov networks (MRF), restricted Boltzmann Machine (RBM) and deep Boltzmann machine (DBM).

Auto encoders: Deep sparse autoencoder (SAE), Deep denoising auto encoder (DAE), Deep contractive autoencoders (CAE).

Convolution neural network (CNN): Deep CNN, All-CNN networks

Deep learning for computer vision problems, Bayesian deep learning

Decision trees and random forests

Fuzzy logic and rough set theory

Text Book:

1. Pattern classification by Duda and Hart, John Wiley.

Reference Books:

1. Deep learning book by Ian Goodfellow, MIT Press.
2. Pattern recognition and machine learning by Bishop, Springer.
3. Basic papers on machine learning by Vapnik, Hinton and other major contributors.
4. Research papers mainly from NIPS, ICML, ICLR, ICMV, ICCV, IGARSS, PReMI, IEEE signal processing magazine, IEEE computational intelligence magazine

Courses: Semester-III

Course Code	Course Name	Credits			
		L	T	P	C
CS791	Comprehensive Viva*	0	0	0	2
CS793	Thesis	0	0	3	2
CS795	Thesis	0	0	6	4
CS797	Thesis	0	0	6	4
HSXXX	Research Methodology / Modular Course / Seminar	x	x	x	2
Total		**x**	**x**	**x**	**14**

**Required to complete during the Summer break (May-June). The evaluation will be done in the 3rd Semester.*

Courses: Semester-IV

Course Code	Course Name	Credits			
		L	T	P	C
CS792	Thesis	0	0	6	4
CS794	Thesis	0	0	6	4
CS796	Thesis	0	0	6	4
Total		**0**	**0**	**18**	**12**

Appendix-I

List of Program Electives for CSE

Course Code	Course Name	Credits (L-T-P: C)
CS630	Randomized Algorithms	3-x-x: 3/4
CS631	Game Theory	3-x-x: 3
CS632	Data Mining	3-x-x:4
CS633	Artificial Intelligence	3-x-x: 3/4
CS634	Data Analytics & Visualization	3-x-x: 4
CS635	Deep Learning	3-x-x: 3/4
CS636	Computer Vision	3-x-x: 4
CS637	Image Processing and Analysis	3-x-x: 3/4
CS638	Social Network Analysis	3-x-x: 3
CS639	Parallel Computing	3-x-x: 4
CS640	Advanced Computer Architecture	3-x-x: 3
CS641	Embedded Systems and Internet of Things	3-x-x: 3/4
CS642	Speech Technology	3-x-x: 3
CS643	Advanced Wireless Communications and Networks	3-x-x: 3
CS644	Distributed Systems	3-x-x: 4
CS645	Cloud Computing	3-x-x: 4
CS646	Cryptography and Network Security	3-x-x: 4
CS647	Blockchain Technology	3-x-x: 3/4
CS648	Web Development Techniques	X-1-2: 2
CS649	Cyber Security	3-x-x: 3
CS650	Distributed Databases	3-x-x: 3
CS651	Security Protocols	3-x-x: 3