MCKV INSTITUTE OF ENGINEERING

NAAC Accredited Grade "A" Autonomous Institute under UGC Act, 1956
Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology
243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India
Ph: +91 33 26549315/17 Fax +91 33 26549318 Web: www.mckvie.edu.in

Date: 14.05.2026

Record Minutes of the 39th Meeting of Internal Quality Assurance Cell (IQAC) held on 12.05.2026 at 02:00 pm at the Conference Hall of the institute.

Members Present:

- Prof. (Dr.) Abhijit Lahiri
- Dr. Pubali Mukherjee
- Dr. Tamal Roy
- Mr. Avijit Bose
- Mr. Sachin Balo
- Dr. Abhijit Dutta
- Mr. Tapas Biswas
- Dr. Dipankar Ghosh
- Dr. Juin Ghosh Sarkar
- Prof. (Dr.) S. S. Thakur
- Prof. (Dr.) Parthasarathi Chakraborthy
- Mr. Abhay Kejriwal
- Prof. (Dr.) Sudipto Chaki
- Prof. (Dr.) Arun Kumar Jalan
- Prof. (Dr.) Prasenjit Chatterjee
- Dr. Krishnendu Chattopadhyay
- Mr. Sandip Dutta
- Ms. Sharmistha Shee Kanrar (online)
- Dr. Debopoma Kar Roy
- Mr. Subir Bhadra
- Mr. Sudeep Samanta
- Prof. (Dr.) Satadal Saha

Members Absent:

- Mr. Abhijit Roy
- Mr. Biswajit Majumdar
- Ms. Rupika Debnath
- Mr. Devasish Basu
- Mr. Debasis Saha
- Mr. Rahul Saha

Agenda of the meeting:

1. Confirmation of the minutes of 38th meeting of IQAC held on 30.01.26.
2. Approval of Academic Calendar for Even semester, 2025-26.
3. Approval of Event Calendar for Even semester, 2025-26.
4. Approval of Detailed Syllabus for 3rd and 4th sem of UG and PG programs.
5. Registration fee reimbursement for presenting research paper.
6. Recruitment/Re-designation/Resignation information.
7. Preparation of AQAR for A.Y. 2024-25.
8. Activity report from IIC.
9. Placement status report for 2026 POB from TP Cell.
10. Miscellaneous.

Proceedings of the meeting:

Prof. (Dr.) Satadal Saha, Coordinator, IQAC welcomed all the members present in the meeting. Following points were discussed and included in the resolution of the meeting:

Item No. 1 of Agenda: Confirmation of the minutes of 38th meeting of IQAC held on 30.01.26.

Minutes of the 38th meeting of IQAC of MCKVIE, held on 30.01.2026, as circulated to all the members, were unanimously confirmed.

Item No. 2 of Agenda: Approval of Academic Calendar for Even semester, 2025-26.

The Academic Calendar for Even Semester, 2025-26 (**Annexure-I**) is unanimously approved by the members present in the meeting.

Item No. 3 of Agenda: Approval of Event Calendar for Even semester, 2025-26.

The Event Calendar for Even Semester, 2025-26 (**Annexure-II**) is unanimously approved by the members present in the meeting.

Item No. 4 of Agenda: Approval of Detailed Syllabus for 3rd and 4th sem of UG and PG programs.

As informed by IQAC Coordinator, the detailed syllabi as submitted by the HoDs are having minor errors that require editing/ corrections. The HoDs are requested to submit the corrected detailed syllabus as soon as possible so that it can be circulated along with the MoM for getting necessary approval from the IQAC members (**Annexure-III**).

Item No. 5 of Agenda: Registration fee reimbursement for presenting research paper.

As presented by IQAC Coordinator, applications have been submitted by Mr. Sekhar Rana, Asst. Prof., ECE Dept, Ms. Debasree Maity, Asst. Prof., ECE Dept., Ms. Mahua Raha Patra, Asst. Prof., ECE Dept. and Mr. Avijit Bose, Asst. Prof., CSE Dept. for reimbursement of the registration fees for presenting research paper in conference. As reported by IQAC Coordinator, although all the applications are having necessary documents for getting the reimbursement, but two of the papers are not yet indexed in SCOPUS. Accordingly, it is unanimously decided that the reimbursement may be done against the applications submitted by Mr. Sekhar Rana and Mr. Avijit Bose as per the incentive policy of the institute (**Annexure-IV**). It is also decided that the reimbursement against other two papers can be done only when they are indexed in SCOPUS. HoD-ECE is requested to ask the corresponding faculty members to inform IQAC Coordinator as soon as the papers are being indexed in SCOPUS.

Item No. 6 of Agenda: Recruitment/Re-designation/Resignation information.

The IQAC Coordinator presented a list of faculty members, Lab Instructors and other staff members who have joined the institute, left the institute, confirmed, promoted, are availing maternity leave and have resigned during February, 2026 to April, 2026 (**Annexure-V**).

Item No. 7 of Agenda: Preparation of AQAR for A.Y. 2024-25.

All the Criteria In-Charges are requested to submit the collected data as per the AQAR format by 22.05.26.

Item No. 8 of Agenda: Activity report from IIC.

The IIC Event Calendar and activity report (**Annexure-VI**) is being displayed by IQAC Coordinator. Many of the planned activities are found to be not yet implemented. IIC Chairman is requested to execute all the pending activities in the current or subsequent quarter.

Item No. 9 of Agenda: Placement status report for 2026 POB from TP Cell.

The placement statistics for 2026 POB (**Annexure-VII**) as submitted by TP Cell is presented by the IQAC Coordinator. All the members present in the meeting expressed their concern on poor value of (a) percentage placement, (b) number of eligible students, especially for CSE and allied programs. Head- TP Cell and other HoDs are requested to take proactive measures so that the placement ratio can be improved significantly.

Item No. 10 of Agenda: Miscellaneous.

The following points have been discussed under this agenda.

- *NIRF-2026 Data submission*: The NIRF data for 2026 was successfully submitted on 17th February, 2026.
- *Selection of Proposal under National Quantum Mission for Establishment of Undergraduate Teaching Laboratories in Quantum Technologies*: MCKVIE's proposal titled "Undergraduate Teaching Laboratories in Quantum Technologies" was favorably recommended for support under the National Quantum Mission for establishing an Undergraduate Teaching Laboratory in Quantum Technologies. Honbl'e Chairman Sir attended the Annual Quantum Conclave and the Announcement Ceremony that was held on 10th April, 2026 at IIT Bombay. MCKVIE was among the 23 Institutions nationwide and the only private engineering college in West Bengal to have earned this prestigious recognition.
- *MoU with AICTE-BSNL*: MCKVIE signed a MoU with AICTE-BSNL collaboration on 9th March, 2026, to strengthen industry–academia collaboration in skill-based training, education, and applied research.
- *Campus visit of Delegates from IUH Vietnam*: Esteemed delegates – Professor Bùi Thanh Hùng, Faculty of Information Technology and Dr. Le Nhat Duy, Dean- from Industrial University of Ho Chi Minh City (IUH), Vietnam visited the campus on 23rd March, 2026 to address the students and faculties of the Department of Computer Science and Engineering (CSE) and Information Technology (IT) w.r.t. collaborative research, student/faculty exchange program etc.
- *MCKVIE Research Symposium (MRS-2026)*: The 1st MCKVIE Research Symposium was held on 21st April, 2026 that involved presentation of Abstract from different research domains – Engineering, Science and Management by students and faculties. A total of 146 Abstracts were submitted and Researchers were awarded Certificates and Medals in the categories of Abstract content and research concept depth and Presentation skills.
- *E-Waste Certification by Hulladek*: MCKVIE was awarded a Certificate (**Annexure-VIII**) of E-Waste Recycling on 22nd April, 2026 for the ethical collection and channelization for recycling of 1293.30 kgs of E-Waste as per collection done on 31st March, 2026.
- *NBA data preparation status of Department of Management Science (MS)*: The faculty members of MS department have been preparing the documentations required for filling the SAR. HoD-MS is requested to submit the filled SAR to Dean-Academics by 30th June, 2026.
- *GDG Cloud Cohort Program*: The GDG Cloud Cohort Program was conducted as a one-month intensive learning initiative, aimed at empowering students with practical cloud computing skills. Organized by students under GDG on Campus MCKVIE, a total of 165 students enrolled in the cohort, out of which 110 participants successfully completed the

program. The Prize distribution ceremony was held on 31st March, 2026. The cohort was supported by Google through GDG Cloud credits, where each participant received $400 in Google Cloud credits. Also, to recognize excellence, the top 20 performers were awarded special gifts from Google.

There being no other issues the meeting was ended with a vote of thanks to the Chair.

Prof. (Dr.) Satadal Saha
Coordinator, IQAC

Prof. (Dr.) Abhijit Lahiri
Chairman, IQAC

Minutes circulated to:

- Chairman Sir
- All the members of IQAC

Annexure-I

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Academic Calendar

Even Semester, A.Y. 2025-26

(February, 2026 – July, 2026)

B. Tech, M. Tech and MBA 2nd Semester

Sl. No.	Event	Date	Day
1	College reopens for Even Semester 2025-26	05.01.2026	Mon
2	Last date of submission of Course Coverage Report (Previous Semester) as per new format	20.02.2026	Fri
3	Last date of submission of Lesson Plan (Current Semester) as per new format	20.02.2026	Fri
4	Commencement of Academic Programme	23.02.2026	Mon
5	Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.)	23.03.2026 – 25.03.2026	Mon - Wed
6	Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	30.03.2026 – 02.04.2026	Mon - Thu
7	Enrollment for Even Semester	01.04.2026 - 10.04.2026	Wed – Fri
8	Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test	13.04.2026 – 17.04.2026	Mon – Fri
9	Marks Submission for Continuous Assessment (Phase I) (CA1)	16.04.2026 – 20.04.2026	Thu – Mon
10	Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1))	04.05.2026 – 06.05.2026	Mon – Wed
11	Continuous Assessment 3 (Phase III) (CA3) (May be in the form of Assignment/Quiz etc.)	11.05.2026 – 13.05.2026	Mon – Wed
12	Examination Form Fill-up for Even semester	11.05.2026 - 20.05.2026	Mon - Wed
13	Marks Submission for Continuous Assessment (Phase III) (CA3)	18.05.2026 – 20.05.2026	Mon – Wed
14	Continuous Assessment for Practical Papers (PCA2) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	18.05.2026 – 22.05.2026	Mon - Fri
15	Continuous Assessment 4 (Phase IV) (CA4) (May be in the form of Class Test)	01.06.2026 – 05.06.2026	Mon – Fri
16	Admit Card generation	04.06.2026	Thu
17	Even Semester Practical Examinations & Viva-Voce	08.06.2026 – 12.06.2026	Mon – Fri
18	Teaching End	13.06.2026	Sat
19	Marks Submission for Continuous Assessment (Phase IV) (CA4 & Internal Marks of Practical (PCA2))	15.06.2026 – 17.06.2026	Mon – Wed
20	Even Semester Theory Examinations	16.06.2026 – 03.07.2026	Tue - Fri
21	Spot evaluation of answer scripts (Phase 1)	19.06.2026 – 03.07.2026	Fri - Fri
22	Submission of Course Coverage Report for the current semester	30.06.2026	Tue
23	Submission of Lesson Plan for the next odd semester	30.06.2026	Tue
24	Inter-semester break for Students	06.07.2026 – 17.07.2026	Mon - Fri
25	Inter-semester break for Academic Staffs	06.07.2026 – 17.07.2026	Mon - Fri
26	Commencement of Odd Sem Academic Programme for 2026-27	20.07.2026	Mon
27	Spot evaluation of answer scripts (Phase 2)	20.07.2026 – 31.07.2026	Mon - Fri
28	Publication of Even Semester Result: (Tentative)	17.08.2026	Mon

Note:

- If the requisite number of lectures is not sufficient as per scheduled classes; the faculty members may, in consultation with the students and respective HOD, decide a schedule of extra classes. The requisite number of lectures in a full semester course is as per the prescribed syllabus.
- Saturdays falling within the semester examination slot, it will be used for conducting examinations.
- The Coordinators for MOOCs for Honours Degree and MAR activities will be held responsible to upload data to the University / Institute portal time to time throughout the semester.
- The calendar is prepared on the basis of information and guidelines of MAKAUT, WB as well as of the Institute. It may change as and when required based on the instructions/ requirements of the University and Institute.

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Academic Calendar

Even Semester, A.Y. 2025-26

(February, 2026 – July, 2026)

B. Tech, M. Tech and MBA 2nd Semester

February, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	

Teaching Days: 3

May, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
					1	2	3
	4	5	6	7	8	9	10
	11 CA3	12 CA3	13 CA3	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27	28	29	30	31

Teaching Days: 19

March, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
							1
	2	3 Holiday	4 Holi	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21 Eid-ul-Fitr	22
	23 CA1	24 CA1	25 CA1	26 Ram Navami	27	28	29
	30	31					

Teaching Days: 19

June, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1 CA4	2 CA4	3 CA4	4 CA4	5 CA4	6	7
	8 Semester Practical Exam	9 Semester Practical Exam	10 Semester Practical Exam	11 Semester Practical Exam	12 Semester Practical Exam	13	14
	15	16 Semester Theory Exam	17 Semester Theory Exam	18 Semester Theory Exam	19 Semester Theory Exam	20	21
	22 Semester Theory Exam	23 Semester Theory Exam	24 Semester Theory Exam	25 Semester Theory Exam	26 Muharram	27	28
	29 Semester Theory Exam	30 Semester Theory Exam					

Teaching Days: 10

April, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1	2	3 Good Friday	4	5
	6	7	8	9	10	11	12
	13 CA2	14 Ambedkar Jayanti	15 Bengali New Year	16 CA2	17 CA2	18	19
	20	21	22	23	24	25	26
	27	28	29	30			

Teaching Days: 16

July, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1 Semester Theory Exam	2 Semester Theory Exam	3 Semester Theory Exam	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		

Teaching Days: 0

Total No. of Teaching Days: 68

Mon:15 , Tue:14 , Wed:13 , Thu:14, Fri:13

	Teaching Days/ Working Days
	Holidays/ Weekly Off Days

	Pre & Post Examination Activity Days
	Examination Activity Days

Principal

Dean (Academics)

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Academic Calendar
Even Semester, A.Y. 2025-26
(March, 2026 – July, 2026)
B. Tech 4th Semester

Sl. No.	Event	Date	Day
1	College reopens for Even Semester 2025-26	05.01.2026	Mon
2	Last date of submission of Course Coverage Report (Previous Semester) as per new format	20.02.2026	Fri
3	Last date of submission of Lesson Plan (Current Semester) as per new format	20.02.2026	Fri
4	Commencement of Academic Programme	23.03.2026	Mon
5	Enrollment for Even Semester	01.04.2026 - 10.04.2026	Wed – Fri
6	Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.)	06.04.2026 – 08.04.2026	Mon – Wed
7	Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test)	13.04.2026 – 17.04.2026	Mon – Fri
8	Marks Submission for Continuous Assessment (Phase I) (CA1)	16.04.2026 – 20.04.2026	Thu – Mon
9	Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	20.04.2026 – 24.04.2026	Mon – Fri
10	Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1))	04.05.2026 – 06.05.2026	Mon – Wed
11	Continuous Assessment 3 (Phase III) (CA3) (May be in the form of Assignment/Quiz etc.)	11.05.2026 – 13.05.2026	Mon – Wed
12	Examination Form Fill-up for Even semester	11.05.2026 - 20.05.2026	Mon - Wed
13	Marks Submission for Continuous Assessment (Phase III) (CA3)	18.05.2026 – 20.05.2026	Mon – Wed
14	Continuous Assessment for Practical Papers (PCA2) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	18.05.2026 – 22.05.2026	Mon - Fri
15	Continuous Assessment 4 (Phase IV) (CA4) (May be in the form of Class Test)	01.06.2026 – 05.06.2026	Mon – Fri
16	Admit Card generation	04.06.2026	Thu
17	Even Semester Practical Examinations & Viva-Voce	08.06.2026 – 12.06.2026	Mon – Fri
18	Teaching End	13.06.2026	Sat
19	Marks Submission for Continuous Assessment (Phase IV) (CA4 & Internal Marks of Practical (PCA2))	15.06.2026 – 17.06.2026	Mon – Wed
20	Even Semester Theory Examinations	16.06.2026 – 03.07.2026	Tue - Fri
21	Spot evaluation of answer scripts (Phase 1)	19.06.2026 – 03.07.2026	Fri - Fri
22	Submission of Course Coverage Report for the current semester	30.06.2026	Tue
23	Submission of Lesson Plan for the next odd semester	30.06.2026	Tue
24	Inter-semester break for Students	06.07.2026 – 17.07.2026	Mon - Fri
25	Inter-semester break for Academic Staffs	06.07.2026 – 17.07.2026	Mon - Fri
26	Commencement of Odd Sem Academic Programme for 2026-27	20.07.2026	Mon
27	Spot evaluation of answer scripts (Phase 2)	20.07.2026 – 31.07.2026	Mon - Fri
28	Publication of Even Semester Result: (Tentative)	17.08.2026	Mon

Note:

- If the requisite number of lectures is not sufficient as per scheduled classes; the faculty members may, in consultation with the students and respective HOD, decide a schedule of extra classes. The requisite number of lectures in a full semester course is as per the prescribed syllabus.

- Saturdays falling within the semester examination slot, it will be used for conducting examinations.

- The Coordinators for MOOCs for Honours Degree and MAR activities will be held responsible to upload data to the University / Institute portal time to time throughout the semester.

- The calendar is prepared on the basis of information and guidelines of MAKAUT, WB as well as of the Institute. It may change as and when required based on the instructions/ requirements of the University and Institute.

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Academic Calendar
Even Semester, A.Y. 2025-26
(March, 2026 – July, 2026)
B. Tech 4th Semester

March, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
							1
	2	3 Holiday	4 Holi	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21 Id-ul-Fitr	22
	23	24	25	26 Ram Navami	27	28	29
	30	31					

Teaching Days: 7

June, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1 CA4	2 CA4	3 CA4	4 CA4	5 CA4	6	7
	8 Semester Practical Exam	9 Semester Practical Exam	10 Semester Practical Exam	11 Semester Practical Exam	12 Semester Practical Exam	13	14
	15	16 Semester Theory Exam	17 Semester Theory Exam	18 Semester Theory Exam	19 Semester Theory Exam	20	21
	22 Semester Theory Exam	23 Semester Theory Exam	24 Semester Theory Exam	25 Semester Theory Exam	26 Muharram	27	28
	29 Semester Theory Exam	30 Semester Theory Exam					

Teaching Days: 12

April, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1	2	3 Good Friday	4	5
	6 CA1	7 CA1	8 CA1	9	10	11	12
	13 CA2	14 Ambedkar Jayanti	15 Bengali New Year	16 CA2	17 CA2	18	19
	20	21	22	23	24	25	26
	27	28	29	30			

Teaching Days: 19

July, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1 Semester Theory Exam	2 Semester Theory Exam	3	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		

Teaching Days: 0

May, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
					1 Buddha Purnima	2	3
	4	5	6	7	8	9 Rabindra Jayanti	10
	11 CA3	12 CA3	13 CA3	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27 Bakrid/ Id-ul-Zuha	28	29	30	31

Teaching Days: 12

Total No. of Teaching Days: 60

Mon: 11, Tue: 11, Wed: 10, Thu: 10, Fri: 9, Sat: 9

	Teaching Days/ Working Days
	Holidays/ Weekly Off Days

	Pre & Post Examination Activity Days
	Examination Activity Days

Principal

Dean (Academics)

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Academic Calendar

Even Semester, A.Y. 2025-26

(January, 2026 – June, 2026)

B. Tech- 6th and 8th semester, M. Tech- 4th semester and MBA- 4th semester

Sl. No.	Event	Date	Day
1	College reopens for Even Semester 2025-26	05.01.2026	Mon
2	Last date of submission of Course Coverage Report (Previous Semester) as per new format	07.01.2026	Wed
3	Last date of submission of Lesson Plan (Current Semester) as per new format	07.01.2026	Wed
4	Commencement of Academic Programme	07.01.2026	Wed
5	Continuous Assessment 1 (Phase I)(CA1) (May be in the form of Assignment/Quiz etc.)	23.02.2026 – 25.02.2026	Mon-Wed
6	Enrollment for Even Semester	23.02.2026 – 27.02.2026	Mon-Fri
7	Marks Submission for Continuous Assessment (Phase I) (CA1)	09.03.2026 - 11.03.2026	Mon-Wed
8	Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	09.03.2026 - 13.03.2026	Mon-Fri
9	Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test)	23.03.2026-25.03.2026	Mon-Wed
10	Examination Form Fill-up for Even semester	01.04.2026 – 10.04.2026	Wed-Fri
11	Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1))	06.04.2026 – 08.04.2026	Mon-Wed
12	Continuous Assessment for Practical Papers (PCA2) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	06.04.2026-10.04.2026	Mon-Fri
13	Continuous Assessment 3 (Phase III) (CA3) (May be in the form of Assignment/Quiz etc.)	08.04.2026 – 10.04.2026	Wed-Fri
14	Continuous Assessment 4 (Phase IV) (CA4) (May be in the form of Class Test)	13.04.2026-17.04.2026	Mon-Fri
15	Marks Submission for Continuous Assessment (Phase III) (CA3)	16.04.2026-20.04.2026	Thu-Mon
16	Admit Card generation	21.04.2026	Tue
17	Even Semester Practical Examinations & Viva-Voce	23.04.2026-29.04.2026	Thu-Wed
18	Marks Submission for Continuous Assessment (Phase IV) (CA4 & Internal Marks of Practical (PCA2))	27.04.2026 – 29.04.2026	Mon-Wed
19	Teaching End	30.04.2026	Thu
20	Even Semester Theory Examinations	04.05.2026-15.05.2026	Mon-Fri
21	Spot evaluation of answer scripts	18.05.2026 – 08.06.2026	Mon-Mon
22	Inter-semester break for Students	18.05.2026-17.07.2026	Mon-Fri
23	Submission of Course Coverage Report for the current semester	29.05.2026	Fri
24	Submission of Lesson Plan for the next odd semester	26.06.2026	Fri
25	Publication of Even Semester Result: (Tentative)	30.06.2026	Tue
26	Inter-semester break for Academic Staffs	06.07.2026-17.07.2026	Mon-Fri
27	Commencement of Odd Sem Academic Programme for 2026-27	20.07.2026	Mon

Note:

- If the requisite number of lectures is not sufficient as per scheduled classes; the faculty members may, in consultation with the students and respective HOD, decide a schedule of extra classes. The requisite number of lectures in a full semester course is as per the prescribed syllabus.

- Saturdays falling within the semester examination slot, it will be used for conducting examinations.

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Academic Calendar

Even Semester, A.Y. 2025-26

(January, 2026 – June, 2026)

B. Tech- 6th and 8th semester, M. Tech- 4th semester and MBA- 4th semester

January, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
				1 New Year's Day	2	3	4
	5	6	7	8	9	10	11
	12 Swami Vivekananda Jayanti	13	14	15	16	17	18
	19	20	21	22	23 Netaji Subhas Chandra Bose Parakram Diwas	24	25
	26 Republic Day	27	28	29	30	31	

Teaching Days: 19

April, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
			1	2	3 Good Friday	4	5
	6	7	8 CA3	9 CA3	10 CA3	11	12
	13 CA4	14 Ambedkar Jayanti	15 Bengali New Year	16 CA4	17 CA4	18	19
	20	21	22	23 Semester Practical Exam	24 Semester Practical Exam	25	26
	27 Semester Practical Exam	28 Semester Practical Exam	29 Semester Practical Exam	30			

Teaching Days: 16

February, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23 CA1	24 CA1	25 CA1	26	27	28	

Teaching Days: 20

May, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
					1 Buddha Purnima	2	3
	4 Semester Theory Exam	5 Semester Theory Exam	6 Semester Theory Exam	7 Semester Theory Exam	8 Semester Theory Exam	9 Rabindra Jayanti	10
	11 Semester Theory Exam	12 Semester Theory Exam	13 Semester Theory Exam	14 Semester Theory Exam	15 Semester Theory Exam	16	17
	18	19	20	21	22	23	24
	25	26	27 Ramzan/ Id-ul-Zuha	28	29	30	31

Teaching Days: 6

March, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
							1
	2	3 Holi	4 Holi	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21 Good Friday	22
	23 CA2	24 CA2	25 CA2	26 Ram Navami	27	28	29
	30	31					

Teaching Days: 18

June, 2026

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
	1	2	3	4	5	6	7
	8	9	10	11	12	13	14
	15	16	17	18	19	20	21
	22	23	24	25	26 Muharram	27	28
	29	30					

Teaching Days: 8

Total No. of Teaching Days: 67

Mon: 12, Tue: 13, Wed: 14 , Thu: 15 , Fri: 13

	Teaching Days/ Working Days
	Holidays/ Weekly Off Days

	Pre & Post Examination Activity Days
	Examination Activity Days

Principal

Dean (Academics)

MCKV INSTITUTE OF ENGINEERING

Approved by AICTE & affiliated to Maulana AbulKalam Azad University of Technology

NAAC Accredited 'A' Grade Autonomous Institute

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Academic Calendar

Even Semester, A.Y. 2025-26

(April, 2026 – July, 2026)

B. Voc 2nd and 4th Semester

Sl. No.	Event	Date	Day
1	College reopens for Even Semester 2025-26	05.01.2026	Mon
2	Last date of submission of Course Coverage Report (Previous Semester) as per new format	20.02.2026	Fri
3	Last date of submission of Lesson Plan (Current Semester) as per new format	20.02.2026	Fri
4	Commencement of Academic Programme	01.04.2026	Wed
5	Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.)	11.05.2026 – 13.05.2026	Mon - Wed
6	Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	18.05.2026 – 22.05.2026	Mon - Fri
7	Marks Submission for Continuous Assessment (Phase I) (CA1)	21.05.2026 – 22.05.2026	Thu - Fri
8	Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test)	01.06.2026 – 05.06.2026	Mon - Fri
9	Admit Card generation	04.06.2026	Thu
10	Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1))	18.06.2026 – 19.06.2026	Thu - Fri
11	Enrollment for Even Semester	01.04.2026 - 10.04.2026	Wed - Fri
12	Examination Form Fill-up for Even semester	11.05.2026 - 20.05.2026	Mon - Wed
13	Even Semester Practical Examinations & Viva-Voce	08.06.2026 – 12.06.2026	Mon – Fri
14	Teaching Ends	12.06.2026	Fri
15	Even Semester Theory Examinations	16.06.2026 – 03.07.2026	Tue - Fri
16	Spot evaluation of answer scripts (Phase 1)	19.06.2026 – 03.07.2026	Fri - Fri
17	Submission of Course Coverage Report for the current semester	30.06.2026	Tue
18	Submission of Lesson Plan for the next odd semester	30.06.2026	Tue
19	Spot evaluation of answer scripts (Phase 2)	20.07.2026 – 31.07.2026	Mon - Fri
20	Inter-semester break for Students	06.07.2026 - 17.07.2026	Mon - Fri
21	Publication of Even Semester Result: (Tentative)	17.08.2026	Mon
22	Inter-semester break for Academic Staffs	06.07.2026 – 17.07.2026	Mon - Fri
23	Commencement of Odd Sem Academic Programme for 2026-27	20.07.2026	Mon

Note:

- If the requisite number of lectures is not sufficient as per scheduled classes; the faculty members may, in consultation with the students and respective HOD, decide a schedule of extra classes. The requisite number of lectures in a full semester course is as per the prescribed syllabus.

- Saturdays falling within the semester examination slot, it will be used for conducting examinations.

- The Coordinators for MOOCs for Honours Degree and MAR activities will be held responsible to upload data to the University / Institute portal time to time throughout the semester.

- The calendar is prepared on the basis of information and guidelines of MAKAUT, WB as well as of the Institute. It may change as and when required based on the instructions/ requirements of the University and Institute.

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Academic Calendar

Even Semester, A.Y. 2025-26

(April, 2026 – July, 2026)

B. Voc 2nd and 4th Semester

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
April, 2026			1	2	3 Good Friday	4	5
	6	7	8	9	10	11	12
	13	14 Ambedkar Jayanti	15 Bengali New Year	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30			

Teaching Days: 19

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
June, 2026	1 CA4	2 CA4	3 CA4	4 CA4	5 CA4	6	7
	8 Semester Practical Exam	9 Semester Practical Exam	10 Semester Practical Exam	11 Semester Practical Exam	12 Semester Practical Exam	13	14
	15	16 Semester Theory Exam	17 Semester Theory Exam	18 Semester Theory Exam	19 Semester Theory Exam	20	21
	22 Semester Theory Exam	23 Semester Theory Exam	24 Semester Theory Exam	25 Semester Theory Exam	26 Muharram	27	28
	29 Semester Theory Exam	30 Semester Theory Exam					

Teaching Days: 10

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
May, 2026					1 Buddha Purnima	2	3
	4	5	6	7	8	9 Rabindra Jayanti	10
	11 CA3	12 CA3	13 CA3	14	15	16	17
	18	19	20	21	22	23	24
	25	26	27 Bakrid/ Id-ul-Zuha	28	29	30	31

Teaching Days: 19

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
July, 2026			1 Semester Theory Exam	2 Semester Theory Exam	3 Semester Theory Exam	4	5
	6	7	8	9	10	11	12
	13	14	15	16	17	18	19
	20	21	22	23	24	25	26
	27	28	29	30	31		

Teaching Days: 8

Total No. of Teaching Days: 48

Mon: 10, Tue: 09, Wed: 09 , Thu: 11, Fri: 9

	Teaching Days/ Working Days
	Holidays/ Weekly Off Days

	Pre & Post Examination Activity Days
	Examination Activity Days

Principal

Dean (Academics)

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Academic Calendar

Even Semester, A.Y. 2025-26

(February, 2026 – May, 2026)

B. Voc 6th Semester

Sl. No.	Event	Date	Day
1	College reopens for Even Semester 2025-26	05.01.2026	Mon
2	Commencement of Academic Programme	16.02.2026	Mon
3	Last date of submission of Course Coverage Report (Previous Semester) as per new format	20.02.2026	Fri
4	Last date of submission of Lesson Plan (Current Semester) as per new format	20.02.2026	Fri
5	Enrollment for Even Semester	23.02.2026 – 27.02.2026	Mon – Fri
6	Examination Form Fill-up for Even semester	01.04.2026 – 10.04.2026	Wed - Fri
7	Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice	06.04.2026 – 10.04.2026	Mon - Fri
8	Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.)	08.04.2026 – 10.04.2026	Wed - Fri
9	Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test)	13.04.2026 – 17.04.2026	Mon - Fri
10	Admit Card generation	21.04.2026	Tue
11	Marks Submission for Continuous Assessment (Phase I) (CA1)	21.04.2026 – 22.04.2026	Tue - Wed
12	Even Semester Practical Examinations & Viva-Voce	24.04.2026 – 30.04.2026	Fri - Thu
13	Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1))	30.04.2026	Thu
14	Teaching Ends	30.04.2026	Thu
15	Even Semester Theory Examinations	06.05.2026 – 18.05.2026	Wed - Mon
16	Spot evaluation of answer scripts	11.05.2026 – 08.06.2026	Mon - Mon
17	Submission of Course Coverage Report for the current semester	29.05.2026	Fri
18	Submission of Lesson Plan for the next odd semester	26.06.2026	Fri
19	Publication of Even Semester Result: (Tentative)	30.06.2026	Tue
20	Inter-semester break for Academic Staffs	06.07.2026-17.07.2026	Mon - Fri

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Note:

- If the requisite number of lectures is not sufficient as per scheduled classes; the faculty members may, in consultation with the students and respective HOD, decide a schedule of extra classes. The requisite number of lectures in a full semester course is as per the prescribed syllabus.
- Saturdays falling within the semester examination slot, it will be used for conducting examinations.
- The Coordinators for MOOCs for Honours Degree and MAR activities will be held responsible to upload data to the University / Institute portal time to time throughout the semester.
- The calendar is prepared on the basis of information and guidelines of MAKAUT, WB as well as of the Institute. It may change as and when required based on the instructions/ requirements of the University and Institute.

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Academic Calendar

Even Semester, A.Y. 2025-26

(February, 2026 – May, 2026)

B. Voc 6th Semester

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
February, 2026							1
	2	3	4	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21	22
	23	24	25	26	27	28	

Teaching Days: 06

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
April, 2026			1	2	3 Good Friday	4	5
	6	7	8 CA1	9 CA1	10 CA1	11	12
	13 CA2	14 Ambedkar Jayanti	15 Bengali New Year	16 CA2	17 CA2	18	19
	20	21	22	23	24 Semester Practical Exam	25	26
	27 Semester Practical Exam	28 Semester Practical Exam	29 Semester Practical Exam	30 Semester Practical Exam			

Teaching Days: 16

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
March, 2026							1
	2	3 Holiday	4 Holi	5	6	7	8
	9	10	11	12	13	14	15
	16	17	18	19	20	21 End of Eid	22
	23	24	25	26 Ram Navami	27	28	29
	30	31					

Teaching Days: 19

M/D	Mon	Tue	Wed	Thu	Fri	Sat	Sun
May, 2026					1 Buddha Purnima	2	3
	4	5	6 Semester Theory Exam	7 Semester Theory Exam	8 Semester Theory Exam	9 Rabindra Jayanti	10
	11 Semester Theory Exam	12 Semester Theory Exam	13 Semester Theory Exam	14 Semester Theory Exam	15 Semester Theory Exam	16	17
	18 Semester Theory Exam	19	20	21	22	23	24
	25	26	27 Bakrid/ Id-uz-Zuha	28	29	30	31

Teaching Days: 8

Total No. of Teaching Days: 41
Mon:09 , Tue:08 , Wed:08 , Thu:08, Fri:08

	Teaching Days/ Working Days
	Holidays/ Weekly Off Days

	Pre & Post Examination Activity Days
	Examination Activity Days

Principal

Dean (Academics)

Annexure-II

MCKV INSTITUTE OF ENGINEERING

An Autonomous Institute under UGC Act 1956
Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal
NAAC Accredited "A" Grade Institute
243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India
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Tentative Event Calendar for January 2026 to June 2026

Date	Day	Activity
1-Jan-26	Thu	New Year's Day
2-Jan-26	Fri	
3-Jan-26	Sat	Off Day
4-Jan-26	Sun	Sunday Ekal Run
5-Jan-26	Mon	
6-Jan-26	Tue	
7-Jan-26	Wed	•Last date of submission of Course Coverage Report of previous semseter and Lesson Plan of current semester for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester •Commencement of Academic Programme for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester
8-Jan-26	Thu	
9-Jan-26	Fri	
10-Jan-26	Sat	Off Day
11-Jan-26	Sun	Sunday
12-Jan-26	Mon	Swami Vivekananda Jayanti
13-Jan-26	Tue	
14-Jan-26	Wed	•Workshop: Paving Way to Innovation by **Department of BSH (14.01.2026-16.01.2026)** •32th National Youth Day Celebration and Swami Vivekananda Jayanti **by Swami Vivekananda Centre of Positive Thinking (SVCPT)**
15-Jan-26	Thu	
16-Jan-26	Fri	•DAC Meeting of **Department of EE** •Induction Session for 1st Year students organized by **Startup Club**
17-Jan-26	Sat	Off Day
18-Jan-26	Sun	Sunday
19-Jan-26	Mon	Exploring Emerging Research Trends in Computing Technologies: AI, ML and IoT (E2RTCT-2K26) by **Department of CSE (19.01.2026 - 23.01.2026)**
20-Jan-26	Tue	DAC Meeting of **Department of ECE**
21-Jan-26	Wed	
22-Jan-26	Thu	Winter Training on VLSI by organised by **Department of ECE (22.01.2026 - 30.01.2026)**
23-Jan-26	Fri	Netaji Subhash Chandra Bose Jayanti/ Saraswati Puja
24-Jan-26	Sat	Off Day
25-Jan-26	Sun	Sunday
26-Jan-26	Mon	Republic Day
27-Jan-26	Tue	
28-Jan-26	Wed	•GDG Tech Spring leveraging the Power of AI by **Department of CSE** •DAC Meeting of **Department of AUE**
29-Jan-26	Thu	DAC Meeting of **Department of BSH** Training on CNG and Advanced Automobile Technology by **Department of AUE (29.01.2026-30.01.2026)**
30-Jan-26	Fri	•IQAC Meeting •DAC Meeting of **Department of IT** •DAC Meeting of **Department of MS** •DAC meeting of **Department of ME** •DAC meeting of **Department of CSE**

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Dean-Academics

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Principal

Date	Day	Activity
31-Jan-26	Sat	Off Day Alumni Meet of **Department of CSE**
1-Feb-26	Sun	Sunday
2-Feb-26	Mon	
3-Feb-26	Tue	
4-Feb-26	Wed	
5-Feb-26	Thu	
6-Feb-26	Fri	Industrial tour or company visit for 6th Semester Students of **Department of EE**
7-Feb-26	Sat	Off Day
8-Feb-26	Sun	Sunday
9-Feb-26	Mon	
10-Feb-26	Tue	Workshop on AI and Innovation Sprints: Rapid Prototype for Digital Transformation by **Department of ME (10.02.2026 - 11.02.2026)**
11-Feb-26	Wed	
12-Feb-26	Thu	
13-Feb-26	Fri	•Innovative Project Contest-**IIC Event** by **Department of IT** •Seminar/Webinar by **Department of AUE** •DAC Meeting of **Department of EE** •Introduction to Linux & Cybersecurity with CTF workshop by **Department of CSE** •BOS of **Department of BSH**
14-Feb-26	Sat	Off Day
15-Feb-26	Sun	Sunday
16-Feb-26	Mon	•Commencement of Academic Programme for B. Voc 6th Semester •Industry Visit for 6th Semester Students organised by **Department of IT**
17-Feb-26	Tue	
18-Feb-26	Wed	
19-Feb-26	Thu	Sri Ramakrishna Birth Tithi Puja Celebration by **Swami Vivekannada Centre of Positive Thinking (SVCPT)**
20-Feb-26	Fri	•Last date of submission of Course Coverage Report of previous semseter and Lesson Plan of current semester for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd, 4th and 6th semester •DAC Meeting of **Department of BSH** •Industry Tour by **Department of AUE**
21-Feb-26	Sat	Off Day
22-Feb-26	Sun	Sunday
23-Feb-26	Mon	•Commencement of Academic Programme for B. Tech, M. Tech and MBA 2nd semester •Continuous Assessment 1 (Phase I)(CA1) (May be in the form of Assignment/Quiz etc.) B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(23.02.2026 - 25.02.2026)** •Enrollment for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester and B.Voc 6th semester **(23.02.2026 - 27.02.2026)** •Cyber Awareness Program for Staff & Students Organised by Cyber Cell and **Department of IT** •Celebration of National Management Day by **Department of MS in collaboration with IIC** •Industry Tour by **Department of AUE** •High Voltage Engineering Lab visit for 6th Semester Students of **Departmnet of EE (23.02.2026 - 27.02.2026)** •DAC Meeting of **Department of AUE**
24-Feb-26	Tue	•DAC Meeting of **Department of ECE** •Inaugural ceremony of Centre for EV Technology in Collaboration with Ather Energy Limited organiused by **Department of AUE**
25-Feb-26	Wed	DAC Meeting of **Department of IT**
26-Feb-26	Thu	•IETE Students' Chapter Program/ Invited Talk by **Department of IT** •DAC Meeting of **Department of CSE**

20/03/26

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20/03/26.

Principal

Date	Day	Activity
27-Feb-26	Fri	•DAC Meeting of **Department of MS** •Industry Tour by **Department of AUE** •DAC Meeting of **Department of ME** •Expert Talk/ Seminar on Emerging Trends (FDP on Prompt Engineering) by **Department of CSE**
28-Feb-26	Sat	Off Day
1-Mar-26	Sun	Sunday
2-Mar-26	Mon	
3-Mar-26	Tue	Doljatra
4-Mar-26	Wed	Holi
5-Mar-26	Thu	
6-Mar-26	Fri	
7-Mar-26	Sat	Off Day
8-Mar-26	Sun	Sunday
9-Mar-26	Mon	•Marks Submission for Continuous Assessment (Phase I) (CA1) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(09.03.2026 - 11.03.2026)** •Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voce for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(09.03.2026 - 13.03.2026)** •Workshop by IIMCIP-TIC jointly organized by **Department of ME** and BUILD CLUB •Continuous Education Program beyond Curriculum by **Department of CSE (09.03.2026 - 14.03.2026)**
10-Mar-26	Tue	•Indudtry Visit for 6th Semester Students organised by **Department of IT** •Entrepreneurship Awareness Program in association with Entrepreneurship Development Institute of India (EDII), (Institutional event in collaboration with **IIC, MCKVIE**) Ahmedabad by **Department of MS** •**Bania Buddhi** organized by **Startup Club (10.03.2026-11.03.2026)**
11-Mar-26	Wed	**Pragati-2026:Technical Fest (11.03.2026-13.03.2026)**
12-Mar-26	Thu	
13-Mar-26	Fri	Session on Startup Legal and Ethical Steps by **Department of EE**
14-Mar-26	Sat	Off Day
15-Mar-26	Sun	Sunday
16-Mar-26	Mon	•Celebration of International π-Day by **Department of BSH** •One day industry visit to Durgapur Steel Thermal Power Station (DSTPS) by **Department of EE**
17-Mar-26	Tue	BOS of **Departmnet of ECE**
18-Mar-26	Wed	Expert Talk on Union Budget 2026, by Mr. Abhinay Kumar Shaw, Company Secretary and Compliance Officer at Bandhan Financial Holdings by **Department of MS in collaboration with IIC, MCKVIE**
19-Mar-26	Thu	•Workshop on Design Tools by **Department of AUE (19.03.2026 - 20.03.2026)** •Practical Workshop on innovative Electric Circuit Design: Hands-On Experience organised by Department of EE **(19.03.2026 - 20.03.2026)** •**Annual Sports (19.03.2026-22.03.2026)**
20-Mar-26	Fri	FDP/ Training by IIMCIP-TIC jointly organized by **Department of ME** and BUILD CLUB
21-Mar-26	Sat	Off Day/ Eid-ul-Fitr BOS of **Department of AUE**
22-Mar-26	Sun	Sunday
23-Mar-26	Mon	•Commencement of Academic Programme for B.Tech 4th semester •Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.) for B. Tech, M. Tech and MBA 2nd semester **(23.03.2026 – 25.03.2026)** •Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(23.03.2026-25.03.2026)** •Electronics Workshop for School students organised by **Department of ECE (23.03.2026 - 27.03.2026)** •Campus visit of Delegates from Industrial University of Ho Chi Minh City (IUH), Vietnam and interaction session with faculties and students of **Department of CSE & IT**
24-Mar-26	Tue	DAC Meeting of **Department of BSH**

20/03/26

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20/03/26

Principal

Date	Day	Activity
25-Mar-26	Wed	•VECV Workshop organised by **Department of AUE** •BOS of **Department of EE**
26-Mar-26	Thu	Ram Navami
27-Mar-26	Fri	•DAC Meeting of **Department of MS** •DAC Meeting of **Department of ME** •DAC Meeting of **Department of CSE** •Parent Teacher Meeting of **Department of EE** •**Annual Sports (27.03.2026 - 30.03.2026)**
28-Mar-26	Sat	Off Day
29-Mar-26	Sun	Sunday
30-Mar-26	Mon	•Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voce for B. Tech, M. Tech and MBA 2nd semester **(30.03.2026 - 02.04.2026)** •DAC Meeting of **Department of IT** •Training programme on Advanced Auomobile Technology by **Department of AUE (30.03.2026 - 31.03.2026)**
31-Mar-26	Tue	•Submission of Innovative Ideas and Reports (Phase I) under "Nurturing Innovation" by **Department of BSH** •DAC Meeting of **Department of ECE** •Special Lecture Meet for VAC Students' organised by **Department of IT** •BoS of **Department of IT**
1-Apr-26	Wed	•Enrollment for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd and 4th Semester **(01.04.2026 - 10.04.2026)** •Examination Form Fill-up for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester and B. Voc 6th Semester **(01.04.2026 - 10.04.2026)** •Commencement of Academic Programme for B. Voc 2nd and 4th Semester •Intership at BOSCH Ltd. for 3rd year students of **Department of AUE (01.04.2026 - 09.04.2026)**
2-Apr-26	Thu	Industry visit by **Department of AUE**
3-Apr-26	Fri	Good Friday
4-Apr-26	Sat	Off Day BOS of **Department of CSE**
5-Apr-26	Sun	Sunday
6-Apr-26	Mon	•Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.) for B.Tech 4th semester **(06.04.2026 - 08.04.2026)** •Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1)) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(06.04.2026 - 08.04.2026)** •Continuous Assessment for Practical Papers (PCA2) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(06.04.2026-10.04.2026)** •Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voice for B. Voc 6th Semester **(06.04.2026-10.04.2026)** •BOS of **Department of MS**
7-Apr-26	Tue	
8-Apr-26	Wed	•Continuous Assessment 3 (Phase III) (CA3) (May be in the form of Assignment/Quiz etc.) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(08.04.2026 - 10.04.2026)** •Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.) for B. Voc 6th Semester **(08.04.2026 - 10.04.2026)** •Invited Talk/ Outreach Program organised by **Swami Vivekananda Centre of Positive Thinking (SVCPT)** •**SPARKADE 2K26:Students' Technical Quiz competition by Department of EE** •Parent Teacher Meeting of **Department of CSE**
9-Apr-26	Thu	**Insignia 2K26** - Inter college coding competition by **Department of CSE**
10-Apr-26	Fri	•PTM of students of **Department of ECE** •Nasha Mukt Bharat Abhiyaan (NMBA) activities organised by **Department of IT** •Alumni Interaction by **Department of AUE** •DAC Meeting of **Department of EE** •BOS of **Department of ME**
11-Apr-26	Sat	Off Day
12-Apr-26	Sun	Sunday
13-Apr-26	Mon	•Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B.Voc 6th semester **(13.04.2026 - 17.04.2026)** •Continuous Assessment 4 (Phase IV) (CA4) (May be in the form of Class Test) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(13.04.2026-17.04.2026)** •Expert Talk/ Seminar on Emerging Trends by **Department of CSE**
14-Apr-26	Tue	Dr. Ambedkar Jayanti
15-Apr-26	Wed	Bengali New Year (Nababarsha)

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Date	Day	Activity
16-Apr-26	Thu	•Marks Submission for Continuous Assessment (Phase I) (CA1) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(16.04.2026 – 20.04.2026)** •Marks Submission for Continuous Assessment (Phase III) (CA3) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(16.04.2026-20.04.2026)**
17-Apr-26	Fri	•Outreach Program by **Swami Vivekananda Centre of Positive Thinking (SVCPT)** •Alumni Interaction by **Department of AUE**
18-Apr-26	Sat	Off Day **Utopia-2026: Cultural Fest of MCKVIE (18.04.2026 - 19.04.2026)**
19-Apr-26	Sun	Sunday
20-Apr-26	Mon	•Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voce for B.Tech 4th semester **(20.04.2026 – 24.04.2026)** •Course on 3D Printing & Scanning by **Department of ME (20.04.2026 - 05.05.2026)** •PLC Traing at Cental Tool Room MSME for students of **Department of EE (20.04.2026 - 24.04.2026)**
21-Apr-26	Tue	•Admit Card generation for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester and B.Voc 6th semester •Marks Submission for Continuous Assessment (Phase I) (CA1) for B.Voc 6th semester **(21.04.2026 – 22.04.2026)** •Orientation Program for Auditee/ Process Owner of Administrative Department by **Audit Cell**
22-Apr-26	Wed	•**Anharmonicity: The Battle of Unconventional Minds**- Student Contest by **Department of BSH** •Industry Visit for Students' organised by **Department of IT** •Workshop on Business Model Canvas (BMC) & Business Model Fit (an **IIC Calendar Event**) organised by **Department of MS**
23-Apr-26	Thu	•Even semester Practical Examinations & Viva-Voce for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(23.04.2026-29.04.2026)** •DAC Meeting of **Department of BSH**
24-Apr-26	Fri	Even Semester Practical Examinations & Viva-Voce for B. Voc 6th Semester **(24.04.2026 – 30.04.2026)**
25-Apr-26	Sat	Off Day •Parent Teacher Meeting of 1st year students by **Department of BSH** •Parent Teacher Meeting of **Department of CSE**
26-Apr-26	Sun	Sunday
27-Apr-26	Mon	•Marks Submission for Continuous Assessment (Phase IV) (CA4 & Internal Marks of Practical (PCA2)) for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(27.04.2026 – 29.04.2026)** •Students Idea Selection (Phase II) under "Nurturing Innovation" by **Department of BSH (27.04.2026-04.05.2026)** •Innovative Idea Contest-**IIC Event** by **Department of IT**
28-Apr-26	Tue	
29-Apr-26	Wed	•DAC Meeting of **Department of IT** •Alumni Talk by **Department of MS**
30-Apr-26	Thu	•Teaching ends for B. Tech 6th and 8th semester, M. Tech 4th semester, MBA 4th semester and B.Voc 6th semester •Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1)) for B.Voc 6th semester •DAC Meeting of **Department of ECE** •DAC Meeting of **Department of MS** •DAC Meeting of **Department of ME** •DAC Meeting of **Department of CSE** •DAC Meeting of **Department of AUE** •**Pulse-2K26:** Students' Innovation/ Prototype Contest by **Department of IT**
1-May-26	Fri	Buddha Purnima
2-May-26	Sat	Off Day
3-May-26	Sun	Sunday
4-May-26	Mon	•Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1)) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(04.05.2026 – 06.05.2026)** •Even semester Theory Examinations for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester **(04.05.2026-15.05.2026)**
5-May-26	Tue	Invited Talk/Webinar Organised by **Department of IT**
6-May-26	Wed	•Even Semester Theory Examinations for B.Voc 6th semester **(06.05.2026 – 18.05.2026)** •Industrial Visit organised by **Department of MS** in collaboration with **IIC, MCKVIE** •Workshop: Protecting IPR and IP Management for startups by **Department of EE**
7-May-26	Thu	•Alumni Meeting of **Department of IT** •IQAC Meeting
8-May-26	Fri	•Seminar organised by **Department of AUE** •DAC Meeting of **Department of EE**
9-May-26	Sat	Off Day/ Rabindra Jayanti
10-May-26	Sun	Sunday

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Date	Day	Activity
11-May-26	Mon	•Continuous Assessment 3 (Phase III) (CA3) (May be in the form of Assignment/Quiz etc.) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(11.05.2026 – 13.05.2026)** •Examination Form Fill-up for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd and 4th Semester **(11.05.2026 - 20.05.2026)** •Continuous Assessment 1 (Phase I) (CA1) (May be in the form of Assignment/Quiz etc.) for B. Voc 2nd and 4th Semester **(11.05.2026 – 13.05.2026)** •ECAD Workshop students of **Department of EE (11.05.2026 - 15.05.2026)**
12-May-26	Tue	
13-May-26	Wed	Expert Talk on Raising Capital and Finance Management for Start-ups by **Department of MS** in collaboration with **IIC, MCKVIE**
14-May-26	Thu	
15-May-26	Fri	•Poster Presentation of Business Plans & Mentor Linkages (**IIC Calendar Event**) by **Department of MS** •DAC Meeting of **Department of AUE**
16-May-26	Sat	Off Day
17-May-26	Sun	Sunday
18-May-26	Mon	•Marks Submission for Continuous Assessment (Phase III) (CA3) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(18.05.2026 – 20.05.2026)** •Continuous Assessment for Practical Papers (PCA2) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voce for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(18.05.2026 – 22.05.2026)** •Continuous Assessment for Practical Papers (PCA1) : In the form of Performance of Lab experiments/submission of Lab reports/Viva Voce for B. Voc 2nd and 4th Semester **(18.05.2026 – 22.05.2026)** •Expert lecture session organised by **Department of ME (18.05.2026 - 20.05.2026)**
19-May-26	Tue	Students' Idea Contest (Phase III) under "Nurturing Innovation" by **Department of BSH (19.05.2026-20.05.2026)**
20-May-26	Wed	•DAC Meeting of **Department of ECE** •Invited Talk/ Outreach Program organised by **Swami Vivekananda Centre of Positive Thinking (SVCPT)** •Internal Audit of Administrative Department by **Audit Cell (20.05.2026 - 21.05.2026)**
21-May-26	Thu	•Marks Submission for Continuous Assessment (Phase I) (CA1) for B. Voc 2nd and 4th Semester **(21.05.2026 – 22.05.2026)** •DAC Meeting of **Department of BSH**
22-May-26	Fri	•**PRAYAS:** Students' Technical Article Writing Inter College Competition by **Department of ECE** •PTM of students of **Department of IT**
23-May-26	Sat	Off Day
24-May-26	Sun	Sunday
25-May-26	Mon	Lecture Series / Invited Talk by **Department of ECE (25.05.2026 - 29.05.2026)**
26-May-26	Tue	
27-May-26	Wed	Bakrid/ Id-ud-Zoha
28-May-26	Thu	
29-May-26	Fri	•Submission of Course Coverage Report for the current semester for B. Tech 6th and 8th semester, M. Tech 4th semester and MBA 4th semester and B.Voc 6th semester •DAC Meeting of **Department of ECE** •DAC Meeting of **Department of MS** •DAC Meeting of **Department of ME** •DAC Meeting of **Department of EE**
30-May-26	Sat	Off Day
31-May-26	Sun	Sunday
1-Jun-26	Mon	•Continuous Assessment 4 (Phase IV) (CA4) (May be in the form of Class Test) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(01.06.2026 – 05.06.2026)** •Continuous Assessment 2 (Phase II) (CA2) (May be in the form of Class Test) for B. Voc 2nd and 4th Semester **(01.06.2026 – 05.06.2026)** •Session on Accelerators/Incubation Opportunities organized by **Startup Club**
2-Jun-26	Tue	
3-Jun-26	Wed	
4-Jun-26	Thu	Admit Card generation for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd and 4th Semester
5-Jun-26	Fri	•PTM of students of **Department of ECE** •IQAC Meeting
6-Jun-26	Sat	Off Day
7-Jun-26	Sun	Sunday

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Date	Day	Activity
8-Jun-26	Mon	•Even semester Practical Examinations & Viva-Voce for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd and 4th Semester **(08.06.2026 – 12.06.2026)** •Faculty Development Program by **Department of ECE (08.06.2026 -12.06.2026)**
9-Jun-26	Tue	
10-Jun-26	Wed	
11-Jun-26	Thu	
12-Jun-26	Fri	•Teaching ends for B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd and 4th Semester •DAC Meeting of **Department of EE**
13-Jun-26	Sat	Off Day Teaching ends for B. Tech 4th semester
14-Jun-26	Sun	Sunday
15-Jun-26	Mon	•Marks Submission for Continuous Assessment (Phase IV) (CA4 & Internal Marks of Practical (PCA2)) for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester **(15.06.2026 – 17.06.2026)** •Online Faculty Development Program (FDP) on Power System Optimization by **Department of EE (15.06.2026 - 19.06.2026)** •DAC Meeting of **Department of AUE**
16-Jun-26	Tue	•Even semester Theory Examinations for B.Tech 4th semester and B. Tech, M. Tech and MBA 2nd semester and B. Voc 2nd and 4th Semester **(16.06.2026 – 03.07.2026)** •DAC Meeting of **Department of ECE**
17-Jun-26	Wed	
18-Jun-26	Thu	Marks Submission for Continuous Assessment (Phase II) (CA2 & Internal Marks of Practical (PCA1)) for B. Voc 2nd and 4th Semester **(18.06.2026 – 19.06.2026)**
19-Jun-26	Fri	•IETE Students' Chapter Program/ Industry Centric Talk by **Department of IT** •DAC Meeting of **Department of ME**
20-Jun-26	Sat	Off Day
21-Jun-26	Sun	Sunday
22-Jun-26	Mon	5 days FDP on Cyber Security in Collaboration with TCS by **Department of IT (22.06.2026 - 26.06.2026)**
23-Jun-26	Tue	
24-Jun-26	Wed	DAC Meeting of **Department of BSH**
25-Jun-26	Thu	•DAC Meeting of **Department of MS** •Publication of Digital Magazine of **Department of CSE**
26-Jun-26	Fri	Muharram
27-Jun-26	Sat	Off Day
28-Jun-26	Sun	Sunday
29-Jun-26	Mon	•DAC Meeting of **Department of IT** •DAC Meeting of **Department of CSE**
30-Jun-26	Tue	•Submission of Course Coverage Report for the current semester and Lesson Plan for the next semester •Colloquium on"Agentic AI"-IIC Event organised by **Department of IT**

20/03/26

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20/03/26

Principal

Annexure-IIIA

Detailed Curriculum for Undergraduate Degree
B. Tech in Automobile Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Engineering Mechanics**		
Course Code:	ES-AUE301	**Category:**	Engineering Science Course
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to preparing a good foundation for taking up advanced courses in the area in the subsequent semesters.
2	A working knowledge of statics with emphasis on force equilibrium and free body diagrams provides an understanding of the kinds of stress and deformation, and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.
3	To develop the ability to analyze the motion of bodies under the action of forces using Newton's laws, energy and momentum principles, collision theory, and basic vibration concepts, enabling students to solve practical engineering problems involving dynamic systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Statics of Particles and Rigid Bodies:** Fundamental Concepts: Basic units and dimensions, introduction to vector algebra (Scalar and Vector products). System of Forces: Coplanar and non-coplanar force systems; Resultant of force systems. Equilibrium: Free-Body Diagrams (FBDs), Equations of equilibrium for particles and rigid bodies. Distributed Forces: Centroid and Center of Gravity of lines, areas, and volumes. Moment of Inertia: Area and Mass Moment of Inertia; Parallel and Perpendicular axis theorems.	8L+2T
2	**Structural Mechanics:** Trusses: Analysis of plane trusses using the Method of Joints and Method of Sections. Frames: Analysis of simple frames and machines. Virtual Work: Principle of Virtual Work and its application to stable structures	6L+2T

3	**Friction and Applications:** Friction: Laws of friction, Angle of friction, and Cone of friction. Mechanical Applications: Wedge-and-Ladder friction. Screw Jacks, Belt-Pulley Systems, and flat/V-belt drives, Rolling friction.	6L+2T
4	**Kinematics of Particles and Rigid Bodies:** Rectilinear & Curvilinear Motion: Position, velocity, and acceleration in Cartesian, Cylindrical, and Spherical polar coordinates. Projectile Motion: Range, time of flight, and trajectory. Rigid Body Kinematics: Translation and Rotation; Instantaneous Center of Rotation (ICR); General plane motion.	6L+2T
5	**Dynamics and Kinetics:** Newton's Second Law: D'Alembert's Principle and Inertia Forces. Work and Energy: Work-energy theorem, Kinetic and Potential energy, Conservation of energy. Impulse and Momentum: Linear and Angular impulse-momentum principles; Law of conservation of momentum. Collision: Elastic and plastic collision; Law of Restitution. Lagrange's Equation: Introduction to Lagrangian mechanics	6L+2T
6	**Introduction to Vibrations:** Single Degree of Freedom (SDOF) Systems: Free and forced undamped vibrations. Spring-Mass Systems: Determination of natural frequency	4L+2T
Total:		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Resolve complex 2D and 3D force systems into equivalent components and determine the static equilibrium of rigid bodies using vector-based Free Body Diagrams.
2	Perform structural analysis on plane trusses and evaluate the mechanical advantage of friction-based machine elements like screw jacks and belt drives.
3	Predict the position, velocity, and acceleration of particles and rigid bodies using Cartesian, Polar, and Path coordinate systems for various engineering mechanisms.
4	Apply Energy-Momentum principles and Lagrangian formulations to analyze central impacts, dynamic systems, and the natural frequency of single-degree-of-freedom vibrations.

Learning Resources:	
1	B. Bhattacharyya, *Engineering Mechanics*, 2nd ed. Oxford: Oxford University Press, 2014.
2	Ferdinand P. Beer and E. Russell Johnston Jr., *Vector Mechanics for Engineers*, Vol. I (Statics) & Vol. II (Dynamics), 9th ed. New Delhi, India: Tata McGraw-Hill, 2011.
3	Irving H. Shames, *Engineering Mechanics*, 4th ed. New Delhi, India: Prentice Hall, 2006.
4	R. K. Bansal, *A Textbook of Engineering Mechanics*, 8th ed. New Delhi, India: Laxmi Publications, 2015.
5	Shanes and Rao, *Engineering Mechanics*, 4th ed. India: Pearson Education, 2006.
6	J. L. Meriam and L. G. Kraige, *Engineering Mechanics*, Vol. 1 (Statics) & Dynamics, 3rd ed. New York, USA: John Wiley & Sons, 1993.
7	Stephen P. Timoshenko and D. H. Young, *Engineering Mechanics*, 4th ed. New York, USA: McGraw-Hill, 1956.

8	Ferdinand P. Beer and E. Russell Johnston Jr., *Mechanics for Engineers*, 4th ed. New York, USA: McGraw-Hill, 1987.
9	Isaac M. Daniel and Ori Ishai, *Engineering Mechanics of Composite Materials*, 2nd ed., Oxford University Press, 2005.
10.	Robert M. Jones, *Mechanics of Composite Materials*, 2nd ed., USA: CRC Press, 1998.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Engineering Mechanics	Prof. K. Ramesh, Prof. Tarkes Dora Pallicity	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106286		
2	Engineering Mechanics - Statics and Dynamics	Prof. Anubhab Roy	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106180		
3	Engineering Mechanics	Prof. U.S. Dixit, Dr. G. Saravana Kumar	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/112103108		
4	Engineering Mechanics	Prof. Manoj K Harbola	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/122104014 https://nptel.ac.in/courses/122104015		

Course Name:	**Materials Engineering**		
Course Code:	ES-AUE302	**Category:**	Engineering Science Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understanding of the correlation between the internal structure of materials, their mechanical properties, and various methods to quantify their mechanical integrity and failure criteria.
2	To provide a detailed interpretation of equilibrium phase diagrams.
3	Learning about different phases and heat treatment methods to tailor the properties

	of materials.
4	Learning about different materials for engineering applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction:** Atomic bonding, Classification of materials	2L
2	**Crystal geometry and imperfections:** Space lattices, Unit cells, Crystal structure, Crystal directions and planes, Crystal imperfections- Point defects, Line defects, Surface defects, Volume defects.	6L
3	**Constitution of alloys:** Types of solid solutions- substitutional and interstitial; Hume-Rothery rules for solid solutions; Solidification and microstructural evolution in metals and alloys; Construction and interpretation of binary equilibrium diagrams-isomorphous, eutectic, and peritectic-type phase diagrams, Intermediate phases, Gibbs' phase rule, lever rule.	8L
4	**Mechanical properties:** Elasticity and plasticity in materials, Stress-strain curve, tensile properties, hardness and hardness measurement, impact properties, fatigue, and creep.	5L
5	**Steels and Cast Irons:** Iron-carbon phase diagram, Types of steels- low, medium, and high carbon steels, stainless steels, alloy steels, and their applications; Heat treatment- annealing, normalizing, hardening, tempering, surface hardening; Cast irons properties, types and application.	8L
6	**Non-ferrous Metals and Alloys:** Properties and applications of - Cu and its alloys, Al and its alloys, Age hardening, Ti and its alloys, Ni-based alloys.	3L
7	**Ceramics, Polymers and Composites:** Structure and unique properties of important ceramics, polymers, and composites; rule of mixtures.	2L
8	**Material Degradation and Prevention:** Fundamentals of material degradation; corrosion – definition and basic mechanism; types of corrosion – galvanic, pitting, crevice; environmental effects on degradation (humidity, salts, temperature). Basic corrosion prevention methods – protective coatings (painting, galvanization)	2L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify crystal structures and crystal defects of materials
2	Construct, interpret, and apply binary alloy phase diagrams, including phase rules and microstructural evolution, to predict material behavior in alloys.
3	Correlate the microstructure and mechanical properties of materials.
4	Describe the types, properties and applications of steels and cast iron, non-ferrous alloys, ceramics and polymers
5	Identify corrosion types and explain degradation and prevention methods in materials

Learning Resources:	
1	William D. Callister Jr., *Materials Science and Engineering: An Introduction*, 6th ed. New

	Delhi, India: Wiley India, 2006.
2	V. Raghavan, *Materials Science and Engineering*, 5th ed. New Delhi, India: Prentice Hall of India Pvt. Ltd., 2004.
3	R. K. Rajput, *Fundamentals of Material Science*, 2nd ed. New Delhi, India: S. K. Kataria & Sons, 2010.
4	William F. Smith, *Materials Science and Engineering*, 4th ed. New Delhi, India: Tata McGraw-Hill, 2008.
5	Ever J. Barbero, *Finite Element Analysis of Composite Materials Using Abaqus*, 1st ed., CRC Press, 2013.
6	K. S. Ghosh, *Foundations of Corrosion Science and Engineering*, 1st ed. New Delhi, India: McGraw-Hill Education, 2012.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Introduction to materials science and engineering	Prof. Rajesh Prasad	IIT Delhi
	Course Link: https://nptel.ac.in/courses/113102080		
2	Materials Science	Prof. Satish V Kailas	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/112108150		
3	Basics of Materials Engineering	Prof. Ratna Kumar Annabattula	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106293		

Course Name:	**Mathematics-III**		
Course Code:	BS-M301	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3–0–0	**Pre-Requisites:**	High School Mathematics, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05
Course Objectives:			
1	To understand probability distributions and their applications.		
2	To apply basic statistical methods and regression analysis for data interpretation.		
3	To use complex differentiation and integration techniques in engineering problems		

4	To study Bessel and Legendre functions and their applications in physical systems.
5	To solve partial differential equations related to heat, wave, and Laplace equations

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variable: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); Applications; (iii) Expectation and variance of random variable; **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance; (ii)**Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance.	8L
2	**Statistics:** **Measure of Central Tendency & Dispersion** (i) Statistical data and frequency distribution; (ii) Mean, Median and Mode; (iii)Variance and standard deviation. **Correlation & Regression** (i) Introduction to bivariate data; Scatter diagram; (ii) Correlation and Correlation Coefficient, Rank Correlation; (iii) Linear Regression and properties; (iv) Introduction to non-linear regression.	6L
3	**Calculus of Complex Variables:** (i) Function of complex variable; Limit, continuity and differentiability; (ii) Analytic function; Cauchy-Riemann equations (Statement only); Sufficient conditions for a function to be analytic; Harmonic function and Conjugate Harmonic function; Milne-Thomson Method; (iii) Zeros and singularities (iv) Cauchy's Theorem (statement only), Cauchy-Goursat Theorem (statement only); Cauchy's Integral Formula; (v) Taylor's and Laurent's series; (vi) Residues of a given function; Cauchy's Residue Theorem (statement only); evaluation of definite integrals involving sine and cosine.	10L
4	**Series Solution of Ordinary Differential Equations:** (i) Introduction to Series solution; Ordinary and Singular points; (ii) Bessel's equation; Bessel's function; Recurrence relations of Bessel's function of first kind; (iii) Legendre's equation; Legendre's Polynomials; Generating function and Orthogonal Properties; Recurrence relations; Rodrigue's Formula (statement only).	6L

5	**Solution of Partial Differential Equations:** (i) Brief introduction to PDEs; Types of PDEs; Solutions of PDE by Lagrange's Method; (ii) Solution of Boundary Value Problems by Method of Separation of Variables; (a) Two-dimensional Laplace equation; (b) One dimensional heat conduction equation; (c) One dimensional wave equation.	6L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of probability distributions to model random variables and solve engineering and scientific problems involving uncertainty.
2	Analyze data using basic statistical measures and regression analysis to interpret relationships between variables and support data-driven decision making.
3	Apply techniques of complex differentiation and integration to solve problems involving analytic functions and engineering applications.
4	Analyze and solve problems involving Bessel and Legendre functions, and apply these special functions in boundary-value and physical system problems.
5	Solve partial differential equations associated with heat, wave, and Laplace equations using appropriate analytical methods for engineering applications

Learning Resources:	
1	Erwin Kreyszig, *Advanced Engineering Mathematics*. New York, USA: John Wiley & Sons.
2	Michael D. Greenberg, *Advanced Engineering Mathematics*. India: Pearson Education.
3	B. S. Grewal, *Higher Engineering Mathematics*. New Delhi, India: Khanna Publishers.
4	N. G. Das, *Statistical Methods (Combined Volume)*. New Delhi, India: Tata McGraw-Hill.
5	Sheldon Ross, *A First Course in Probability*. India: Pearson Education.
6	William Feller, *An Introduction to Probability Theory and Its Applications*, Vol. 1. New York, USA: John Wiley & Sons.
7	N. P. Bali and Manish Goyal, *A Textbook of Engineering Mathematics*. New Delhi, India: Laxmi Publications, 2010.
8	M. D. Raisinghania, *Advanced Differential Equations*. New Delhi, India: S. Chand & Company.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Introduction to Probability Theory and Statistics	Prof. S Dharmaraja	IIT Delhi
	Course Link: https://nptel.ac.in/courses/111102160		
2	Probability and Statistics	Prof. Somesh Kumar	IIT Kharagpur

	Course Link: https://nptel.ac.in/courses/111105041		
3	First Course on Partial Differential Equations – I	Prof. A. K. Nandakumaran, Prof. P. S. Datti	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/111108144		

Course Name:	**Thermodynamics and Thermal Engineering**		
Course Code:	PC-AUE301	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	High school Physics, Mathematics-I (BS-M101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn about work and heat interactions, and the balance of energy between the system and its surroundings.
2	To learn about the application of the first and second laws of thermodynamics for various energy conversion devices.
3	To learn about gas and vapor cycles and their first law and second law efficiencies.
4	To evaluate the changes in the properties of substances in various processes.
5	To understand the refrigeration cycle and the air-conditioning system

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Fundamentals & Zeroth Law:** Concepts: Macroscopic vs. Microscopic; Continuum; Systems (Closed, Open, Isolated); State, Path, and Point functions; Thermodynamic Equilibrium. Zeroth Law: Equality of temperature; Thermometry scales; Ideal gas temperature scale.	3L+1T
2	**First Law of Thermodynamics:** Energy Interactions: Work transfer (displacement and other forms); Heat transfer; First Law for a Cycle and a Process. Closed Systems: Internal Energy (U) and Enthalpy (H); Specific Heats (C_p, C_v). Open Systems: Steady Flow Energy Equation (SFEE); Applications to Nozzles, Turbines, Compressors, and Heat Exchangers. Unsteady Flow: Filling and emptying of tanks	6L+2T
3	**Second Law & Entropy:** Statements: Kelvin-Planck and Clausius statements; Heat Engines, Refrigerators, and Heat Pumps; Carnot Cycle and Corollaries. Entropy: Clausius Inequality; Entropy changes for solids, liquids, and gases; Entropy generation (S_{gen}). Exergy (Availability): Available and Unavailable energy; Exergy of a process/cycle; Second Law Efficiency	8L+2T
4	**Pure Substances & Thermodynamic Relations:**	5L+2T

	Pure Substances: P–V, P–T, T–s diagrams; Triple point and Critical point; Steam Tables and Mollier Chart. Relations: Maxwell's Equations; Tds equations; Clausius-Clapeyron equation; Joule-Thomson coefficient.	
5	**Vapor and Gas Power Cycles:** Vapor Cycles: Rankine Cycle; Reheat and Regenerative cycles; Feedwater heaters (Open/Closed); Binary cycles. Gas Power Cycles: Air-standard Otto, Diesel, and Dual cycles; Brayton Cycle (Gas Turbine) with Intercooling, Reheating, and Regeneration.	6L+2T
6	**Refrigeration, air conditioning & Psychrometry:** Refrigeration: Vapor Compression (VCR) and Absorption (VAR) systems; Refrigerants. Basic principles and types of air conditioning. Psychrometry: Properties of moist air; Psychometric chart; Cooling/Heating and Humidification/Dehumidification.	6L+2T
7	**Compressors:** Compressors: Reciprocating compressors; Volumetric efficiency; Multistage compression with intercooling.	2L+1T
Total:		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Resolve complex energy balance problems for steady and unsteady flow systems using SFEE.
2	Evaluate entropy generation and second-law efficiency for engineering devices using thermodynamic tables and charts
3	Evaluate the performance of energy conversion devices
4	Calculate psychometric properties and calculate air-conditioning requirements and compressible flow parameters for high-speed mechanical applications.

Learning Resources:	
1	P. K. Nag, *Engineering Thermodynamics*. New Delhi, India: Tata McGraw-Hill, 2018.
2	Richard E. Sonntag, Claus Borgnakke, and Gordon J. Van Wylen, *Fundamentals of Thermodynamics*. New York, USA: John Wiley & Sons, 2007.
3	Michael J. Moran and Howard N. Shapiro, *Fundamentals of Engineering Thermodynamics*. New York, USA: John Wiley & Sons, 1999.
4	J. B. Jones and R. E. Duggan, *Engineering Thermodynamics*. New Delhi, India: Prentice-Hall of India, 1996.
5	Merle C. Potter and Craig W. Somerton, *Schaum's Outline of Thermodynamics for Engineers*. New York, USA: McGraw-Hill, 2014.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Applied Thermodynamics	Prof. Niranjan Sahoo, Prof. Pranab Kumar Mondal	IIT Guwahati

	Course Link: https://nptel.ac.in/courses/112103307		
2	Basic Thermodynamics	Prof. Suman Chakraborty	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105123		
3	Laws of Thermodynamics	Prof. S.K Som, Prof. Suman Chakraborty	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105220		
4	Concepts of Thermodynamics	Prof. Suman Chakraborty, Prof. Aditya Bandopadhyay	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105266		

Course Name:	**Manufacturing Technology**		
Course Code:	PC-AUE302	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	4
L-T-P:	4-0-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To impart knowledge and train students with the basic principles, design aspects, defects, applications in the areas of metal casting, welding, forming, machining and additive manufacturing processes.
2	To enable students to apply their knowledge of metal casting, welding, forming, machining and additive manufacturing processes for solving complex problems

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Casting:** Introduction, Pattern making, Moulding, Melting, Pouring and Solidification; Casting design considerations; Estimation of pouring and solidification time; Casting processes: Sand, Centrifugal, Die, Investment, Shell mould, Lost foam; Casting defects and residual stresses.	10L
2	**Joining/fastening processes**: Physics of welding; Types of welding; Oxyfuel welding techniques; Arc welding processes: Shielded metal arc welding; GMAW (MIG), GTAW (TIG); Resistance welding: Spot, Seam, Butt, Projection, Percussion welding; Solid state welding: Friction welding, Friction-stir welding, Ultrasonic welding; Laser welding; Thermit welding; Estimation of heat input in welding processes; Brazing and soldering; Defects in welding.	12L

3	**Forming Processes:** Introduction to bulk and sheet metal forming; Plastic deformation and yield criteria; Fundamentals of hot and cold working processes; Basic principles, types, and load estimation for bulk forming (Forging, Rolling, Extrusion, Drawing) and sheet forming (Shearing, Deep drawing, Bending).	10L
4	**Conventional Machining processes:** Single and multi-point cutting tools; Orthogonal cutting, Various force components; Chip formation, Tool wear and tool life; Estimation of shear angle, shear stress, shear strain, velocity relationship, cutting force and tool life; cutting tool materials, cutting fluids, Surface finish, and Machinability; General principles of working and commonly performed operations in the following machines: Lathe, Shaper, Milling, Drilling, and Grinding machine; Estimation of machining time and Material removal rate.	12L
5	**Additive Manufacturing Processes:** Extrusion; Vat polymerization, Powder bed fusion; Material jetting; Binder jetting; Direct energy deposition and Sheet lamination processes.	4L
Total:		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic principles and methods of casting, welding, forming, machining (conventional and nonconventional), and additive manufacturing processes.
2	Interpret different process parameters and relationships among those parameters for casting, welding, forming, and machining (conventional and nonconventional).
3	Solve problems related to casting, welding, forming, and machining processes using standard methods.
4	Analysing different subsystems of casting, welding, forming, and machining processes.

Learning Resources:	
1	Mikell P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*. New Delhi, India: Wiley India, 2018.
2	J. T. Black and Ronald A. Kohser, *DeGarmo's Materials and Processes in Manufacturing*, SI ed. New Delhi, India: Wiley India, 2017.
3	Serope Kalpakjian and Steven R. Schmid, *Manufacturing Processes for Engineering Materials*, 5th ed. India: Pearson India, 2014.
4	P. N. Rao, *Manufacturing Technology: Foundry, Forming and Welding*, vol. 1, 5th ed. New Delhi, India: Tata McGraw-Hill, 2018.
5	P. N. Rao, *Manufacturing Technology: Metal Cutting and Machine Tools*, vol. 2, 5th ed. New Delhi, India: Tata McGraw-Hill, 2018.
6	Amitabha Ghosh and Ashok Kumar Mallick, *Manufacturing Science*, 2nd ed. New Delhi, India: East-West Press Pvt. Ltd., 2010.
7	Sabrie Soloman, *3D Printing and Design*. New Delhi, India: Khanna Publishing House, 2020.
8	A. B. Chattopadhyay, *Machining and Machine Tools*, 2nd ed. New Delhi, India: Wiley, 2017.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Fundamentals of Manufacturing Processes	Prof. D. K. Dwivedi, Prof. Shamik Basak	IIT Roorkee
	Course Link: https://nptel.ac.in/courses/112107219		

Course Name:	**Automotive Engines**		
Course Code:	PC-AUE 303	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Engineering Thermodynamics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To familiarize with the terminology associated with IC engines
2	To understand the basics of IC engines
3	To understand combustion, and various parameters and variables affecting it in various types of IC engines
4	To learn about various systems used in IC engines and the type of IC engine required for various applications

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction:** Basic air standard cycle Otto, Diesel & dual fuel cycle, comparison between Otto, Diesel and Dual fuel cycles. Basic Concepts: Air standard cycles and fuel-air cycles. Assumptions, Valve Timing diagram, Actual engine cycle.	3L
2	**Engine Construction:** Construction and working of 4-stroke SI and CI Engine, Comparison between SI and CI engines, SI and CI engine fuel rating, octane number and cetane number, SI and CI Engine fuel properties, Alternative fuels (Alcohol, Biogas, Hydrogen, CNG, LPG).	3L
3	**SI Engine:** Theory of Carburetion, Types of carburetors, electronic fuel injection system, GDI. Combustion in spark Ignition engines, stages of combustion, flame propagation, rate of pressure rise, and abnormal combustion. Phenomenon of Detonation in SI engines, effect of engine variables on Detonation. Combustion Chambers. Rating of fuels in SI engines and additives.	5L

4	**CI Engine:** Fuel supply system, types of fuel pump, injector and distribution system, Combustion in compression ignition engines, stages of combustion, factors affecting combustion, Phenomenon of knocking in CI engine. Effect of knocking, Types of combustion chambers, rating of fuels in CI engines. Additives Comparison of knocking in SI & CI engines, Concepts of Supercharging and Turbocharging.	5L
5	**Engine systems and components:** Ignition system (battery, magneto & electronic); Lubrication system; Engine starting system; Engine cooling system; Governing system (quality and quantity hit & miss governing); Intake and exhaust systems (two valves & four valves); Drive train (cam shaft, valves, etc.). Variable valve timing, HCCI, PCCI engine	5L
6	**Fuels and Emissions:** Chemical structure of the Petroleum, Refining process for petroleum, important qualities of the Engine fuels- (SI & CI engines), Diesel, and Gasoline fuels, Indian specifications. Alternate fuels (SI & CI engines)- Liquid fuels, gaseous fuels (LPG, NG, CNG), hydrogen and emulsified fuel. Air pollution due to IC engine, Engine emissions, Hydrocarbon emissions, (HC) & PM & Carbon monoxide emissions (CO), oxides of Nitrogen (NOx) Euro norms, Bharat stage norms, Introduction to EDC and IDC, Introduction to carbon credit, Emission control methods for SI and CI engines, electronic control module, Catalytic converters, EGR Concept of hybrid vehicles.	7L
7	**Cooling and Lubrication System:** Need for a cooling system. Types of cooling systems: Liquid-cooled system, Thermosyphon system, Pressure-cooling system. Lubrication systems: Mist, Wet sump, and dry sump. Properties of lubricants. Properties of coolants.	4L
8	**Performance characteristics & Testing of I.C. Engines:** Introduction to Indian. Standards for testing of I.C. Engine, mean effective pressure, indicated power, brake power, friction power, Methods to determine power and efficiencies, Variables affecting performance of engine, characteristic curves, heat balance sheet, Methods of improving engine performance; super & turbocharged engines.	4L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Know the basics of IC engines and the influence of the different parameters on the operational characteristics of IC Engines
2	Understand the fundamentals of various automotive Engine and their construction details.
3	Understand the operation of the automotive engine and the importance of the vehicle.

Learning Resources:	
1	V. Ganesan, *Internal Combustion Engines*, 3rd ed. New Delhi, India: Tata McGraw-Hill, 2007.
2	Edward F. Obert, *Internal Combustion Engines and Air Pollution*. New York, USA: Harper & Row, 1973.
3	Heinz Heisler, *Advanced Engine Technology*. London, UK: Edward Arnold, 1995.

4	John B. Heywood, *Internal Combustion Engine Fundamentals*. New York, USA: McGraw-Hill, 1989.
5	Philip M. Heldt, *High Speed Combustion Engines*. New Delhi, India: Oxford & IBH Publishing Co., 1985.
6	Martin W. Stockel, Thomas S. Stockel, and Chris Johanson, *Auto Fundamentals*. Illinois, USA: The Goodheart-Wilcox Co. Inc., 1996.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	IC Engines and Gas Turbines	Prof. Pranab K. Mondal, Prof. Vinayak N. Kulkarni	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/112103262		

Course Name:	**Machine Drawing**		
Course Code:	PC-AUE391	**Category:**	Professional Core courses
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	No prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Assembly and detailed drawings of a mechanical assembly, such as a simple gearbox, flange coupling, welded bracket joined by a stud bolt onto a structure, etc.
2	Practicing AutoCAD or similar graphics software and making orthographic and isometric projections of different components.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Schematic product symbols for standard components in mechanical, electrical, and electronic systems, welding symbols, and pipe joints;	6P
2	Orthographic projections of machine elements, different sectional views, full, auxiliary sections; Isometric projection of components;	6P
3	Assembly and detailed drawings of a mechanical assembly, such as a Plummer block, tool head of a shaping machine, tail stock of a lathe, simple gearbox,	6P
4	Flange coupling, welded bracket joined by a stud bolt onto a structure, welded pipe joints indicating work parts before welding, etc.	6P

5	Practicing AutoCAD or similar graphics software and making orthographic and isometric projections of different components.	12P
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe schematic product symbols for standard components in mechanical, electrical, and electronic systems, welding symbols, and pipe joints
2	Explain orthographic projections of machine elements, different sectional views, and the isometric projection of components.
3	Assemble different machine elements such as a Plummer block, the tool head of a shaping machine, the tailstock of a lathe, and welded pipe joints, indicating work parts before welding.

Learning Resources:	
1	K. L. Narayana and K. Kannaiah, *Textbook of Engineering Drawing*. New Delhi, India: Scitech Publications.
2	S. Pal and M. Bhattacharyya, *Mechanical Engineering Drawing and Design*.
3	N. D. Bhatt, *Machine Drawing*. New Delhi, India: Charotar Publishing House.
4	P. S. Gill, *Machine Drawing*. New Delhi, India: S. K. Kataria & Sons.
5	K. Venugopal, *Engineering Drawing and Graphics with AutoCAD*. New Delhi, India: New Age International.
6	D. A. Jolhe, *Engineering Drawing with an Introduction to AutoCAD*. New Delhi, India: Tata McGraw-Hill.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Engineering drawing and computer graphics	Prof. Rajaram Lakka Raju	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105294		
2	Computer-Aided Design and Manufacturing	Prof. Anoop Chawla, Prof. P.V. Madhusudan Rao	IIT Delhi
	Course Link: https://nptel.ac.in/courses/112102101		

Course Name:	**Manufacturing and Testing Laboratory**		
Course Code:	PC-AUE392	**Category:**	Professional Core Courses

Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	No prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To study the characteristics of material.
2	Interpret different engineering material properties.
3	Identify different manufacturing technique
4	Translate suitable testing for proper application.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Impact tests: Charpy or Izod tests.	3P
2	Fatigue test of a steel sample.	3P
3	Experiments on friction: determination of coefficient of friction.	3P
4	Determination of yield strength, ultimate strength, modulus of elasticity, percentage elongation and percentage reduction in areas.	3P
5	Macro hardness test (Rockwell and Brinell).	3P
6	Test for drawability of sheet metals through cupping test.	3P
7	Heat treatment and microstructure characterization of steel.	3P
8	Sand preparation and testing: specimen preparation for testing permeability, clay content, grain fineness number, moisture content, green compression strength, green shear strength, splitting strength, hardness, etc.	3P
9	Casting of metals after preparation of a suitable type mould; Experiments on properties of post casting, fettling, cleaning, deburring, and polishing operations	3P
10	Practicing smithy or forging of carbon steels and testing for its property changes;	3P
11	Laboratory experiments in Fabrication processes to observe effects of varying process parameters in GMAW	3P
12	Machining of Gear using milling machine.	3P
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	fulfill team roles assigned & communicate effectively.
2	compute stress, strains and deformation of engineering materials.
3	examine properties of mould material in casting.
4	attain basic knowledge on pattern, Gear making.

Learning Resources:	
1	Debabrata Nag and Abhijit Chanda, *Fundamentals of Strength of Materials*. New Delhi, India: Wiley India, 2010.
2	William D. Callister Jr., *Materials Science and Engineering: An Introduction*, 6th ed. New Delhi, India: Wiley India, 2006.
3	Serope Kalpakjian and Steven R. Schmid, *Manufacturing Processes for Engineering Materials*, 7th ed. India: Pearson India, 2014.
4	William F. Smith, *Materials Science and Engineering*, 4th ed. New Delhi, India: Tata McGraw-Hill, 2008.
5	Mikell P. Groover, *Fundamentals of Modern Manufacturing: Materials, Processes, and Systems*, 4th ed. New Delhi, India: Wiley, 2010.

Experiments that may be performed through Virtual Labs:		
Sl. No.	**Experiment Name**	**Experiment Link(s)**
1	Impact tests: Izod tests	https://sm-nitk.vlabs.ac.in/exp/izod-impact-test/
2	Impact tests: Charpy tests.	https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/
3	Brinell Hardness Test	https://sm-nitk.vlabs.ac.in/exp/brinell-hardness-test/
4	Rockwell Hardness Test	https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/
5	Determination of yield strength, ultimate strength, modulus of elasticity, percentage elongation and percentage reduction in areas.	https://sm-nitk.vlabs.ac.in/exp/tensile-test-mild-steel/ https://sm-nitk.vlabs.ac.in/exp/tensile-test-cast-iron/

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Basic Science Courses
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	10 + 2
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.

3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	2L
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste	7L
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	7L
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	8L
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	D. De & D. De, *Fundamentals of Environment and Ecology,* S Chand Publication
2	E. Bharucha, *Text Book of Environmental Studies,* Byju's

3	S. C. Sharma and M. P. Poonia, *Environmental Studies*, Khanna Book Publishing
4	M. Basu, *Environmental Studies,* Cambridge University Press
5	A. Vieira & D. Rosa, *Fundamentals of renewable energy processes*, Academic Press Inc
6	F. Kreith and J. F. Kreider, *Principles Solar Engineering,* CRC Press.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

Detailed Curriculum for Undergraduate Degree
B.Tech in Computer Science and Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Mathematics -III**		
Course Code:	BS-M301	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand probability distributions of random variables
2	To apply statistical techniques for data analysis and inference
3	To use Fourier analysis for signal and system representation

Course Contents:

Module No.	Description of Topic	Conduct Hrs.
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variables: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); (iii) Expectation, variance of random variables and their properties **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance (ii) **Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance	8
2	**Bivariate Probability Distribution, Correlation & Regression:** **Discrete bivariate distribution** (i) Joint probability distribution of two discrete random variables, marginal distribution;	8

	(ii) Expectation, variance, covariance; Independent random variables; **Continuous bivariate distribution** (i) Joint probability distribution of two continuous random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Correlation & Regression:** Karl Pearson's Correlation Coefficient, Rank Correlation, Regression lines	
3	**Statistics:** **Sampling distribution** (i) Population and sampling distribution; statistic, standard error and confidence interval; (ii) Point and interval estimation; unbiased and consistent estimator; maximum likelihood estimate; (iii) Chebyshev's inequality; **Test of hypothesis** (i) Simple and composite hypothesis. Critical region. Level of significance; (ii) Type I and Type II errors; (iii) One sample and two sample tests for means and proportions, t-test, χ^2-test for goodness of fit.	12
4	**Fourier Series and Fourier Transform:** **Fourier Series** (i) Periodic function and periodic extension of a function; Odd and even functions; (ii) Special wave forms: square wave, half wave rectifier, full wave rectifier, saw-toothed wave, triangular wave (graphical illustration only); (iii) Euler's formulae for Fourier series; Fourier series of functions of period 2π; Fourier series of functions of period 2L; Dirichlet's conditions (iv) Half range Sine and Cosine series (v) Parseval's identity (statement only) **Fourier Transform** (i) Definition of Fourier transform; Properties of Fourier transform: Linearity, Shifting, change of scale property; Fourier transform of some elementary functions; Fourier transform of derivatives; (ii) Fourier sine and cosine transform (iii) Inverse Fourier transform and convolution theorem.	8

Total	**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of probability distributions to model random phenomena and compute probabilities, moments, and expectations for discrete and continuous random variables.
2	Analyze bivariate distributions to determine marginal and conditional distributions, correlation, and apply regression analysis for modeling relationships between two variables.
3	Apply principles of inferential statistics to estimate population parameters, test statistical hypotheses, and interpret results using appropriate confidence levels and significance tests.
4	Analyze and solve problems using Fourier series and Fourier transforms and apply these techniques to represent periodic functions and analyze signals in engineering and scientific applications.

Learning Resources:	
1	"Advanced Engineering Mathematics" by Erwin Kreyszig, John Wiley & Sons.
2	"Advanced Engineering Mathematics" by Michael Greenberg, Pearson.
3	"Higher Engineering Mathematics" by B.S. Grewal, Khanna Publishers.
4	"Mathematical Methods of Science and Engineering" by Kanti B. Dutta, Cenage Learning.
5	"Advanced Engineering Mathematics" by Reena Garg, Chandrika Prasad, Khanna Publishers.
6	"Statistical Methods (Combined Volume)" by N.G. Das, Tata-McGraw Hill.
7	"A First Course in Probability" by S. Ross, Pearson Education India.
8	"An Introduction to Probability Theory and its Applications, Vol. 1" by W. Feller, Wiley.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Applied Multivariate Statistical Modeling	Prof. Jhareswar Maiti	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/111105091		
2	Probability –I with Examples Using R	Prof. Siva Athreya	ISI Bangalore
	Course Link: https://onlinecourses.nptel.ac.in/noc22_ma27/preview		

Course Name:	**Vedic Mathematics (Indian Knowledge System-II)**		
Course Code:	BS-M303	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on Śulba Sūtra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata, Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	3
2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and sub-sutras, Vedic sutras for addition- Purna puranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	3
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva–Tiryag bhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method,	5

	Vilokanam), and cubes (Yāvadunam).	
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya Samuccaya Gunita, Solution of quadratic equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat.	5
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4X4 using Urdhva Tiryag Sutra, Inverse of matrices using Vedic approaches.	3
6	**Vedic Geometry and Śulba Sūtra Concepts:** Geometrical ideas from Śulba Sūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	5
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and Śulba Sūtra texts.

Learning Resources:	
1	Bharati Krishna Tirthaji, Vedic Mathematics, Motilal Banarsidass, New Delhi.
2	Rajesh Kumar Thakur, Essentials of Vedic Mathematics, Rupa Publications.
3	Vandana Singhal, Vedic Mathematics for All Ages, Motilal Banarsidass.
4	Udayan S. Patankar & Sunil M. Patankar, Elements of Vedic Mathematics, TTU Press.
5	Dahaval Bathia, Vedic Mathematics Made Easy, Jaico Publishing House.
6	Ronak Bajaj, Vedic Mathematics: The Problem Solver, Black Rose Publications.
7	S. K. Kapoor, Vedic Geometry Course, Lotus Press.
8	S. N. Sen & A. K. Bag (Eds.), The Śulba Sūtras, Indian National Science Academy.
9	T. A. Sarasvati Amma, Geometry in Ancient and Medieval India, Motilal Banarsidass.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Mathematics in India - From Vedic Period to Modern Times	Prof.K.Ramasubramanian, Prof. M.D.Srinivas, Prof. M.S.Sriram	IIT Bombay
	Course Link: https://nptel.ac.in/courses/111101080		

Course Name:	**Digital Electronics**		
Course Code:	ES-EC301	**Category:**	Engineering Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To acquire the basic knowledge of digital logic gates and apply it to understand digital circuits.
2	To prepare students to perform the analysis and design of various combinational and sequential digital circuits.
3	To acquire knowledge of different logic family, A/D Converter, D/A Converter.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Number System and code:** Number System and Number Base Conversion, BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic.	4
2	**Boolean algebra and Logic Gates:** Boolean operations and functions, algebraic manipulation, minterms and maxterms, sum-of-products and product-of-sum representations, Digital Logic gates	4
3	**Simplification of Boolean functions:** K-map method, don't care conditions, prime implicants, Quine-McCluskey method.	5

4	**Combinational logic circuits:** Adders and subtractors, comparator, multiplexer, demultiplexer, decoder, encoder, parity generator etc. Design of different combinational circuits.	6
5	**Sequential Circuits:** Basic Flip-flop & Latch, Clocking and timing issues, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counter, design methodology of Synchronous and asynchronous counter, Introduction to FSM (Mealy and Moore Machine)	12
6	**Logic families:** TTL, ECL, MOS and CMOS - basic concepts	2
7	**A/D and D/A conversion techniques:** Basic concepts D/A: R-2-R only A/D: Successive Approximation, Monostable and Astable Circuit using 555 Timer.	3
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Solve problems involving number systems, basic gate operations and laws of Boolean algebra.
2	Design and implement of combinational logic circuits.
3	Design and implement of sequential logic circuits.
4	Explain A/D and D/A conversion and the basic concepts of Logic families.

Learning Resources:	
1	Morris Mano- Digital Logic and Computer Design- PHI
2	S. Salivahanan, S. Arivazhagan – Digital Circuits and Design
3	Leach & Malvino—Digital Principles & Application, 5/e, McGraw H
4	Floyed & Jain- Digital Fundamentals-Pearson.
5	A. Anand Kumar- Fundamentals of Digital Circuits-PHI
6	D. Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publisher
7	Tocci, Widmer, Moss- Digital Systems,9/e- Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Digital Circuits	Prof. Santanu Chattopadhyay	IIT Kharagpur

	Course Link: https://nptel.ac.in/courses/108105113		
2	Digital Electronic Circuits	Prof. Gautam Saha	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105132		

Course Name:	**Data Structures and Algorithms**		
Course Code:	PC-CS301	**Category:**	Professional Core
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	ES-CS101, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To enable students to explain the fundamental concepts of linear data structures and their associated operations.
2	To acquaint the students with an understanding of nonlinear data structures and their application areas.
3	To develop the ability to analyze the complexity of various sorting and searching algorithms.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction: Basic Terminologies:** Elementary Data Organizations, Array, Data Structure Operations: insertion, deletion, traversal etc. Analysis of Algorithm: Asymptotic Notations, Time-Space trade off. Recursion: Definition and types with examples of each types, Tower of Hanoi problem and its complexity analysis.	4
2	**Linear Data Structure:** Stacks and Queues: Stack as an ADT and its operations, Applications of Stacks: Expression Conversion and Evaluation – corresponding algorithms. **Types of Queues:** Linear Queue, Circular Queue, Operations on each type and their algorithms. Priority Queue and DEQUE	6
3	**Searching and Sorting (Searching, Sorting, and Hashing):** Searching: Linear Search and Binary Search algorithms and their	8

	complexity analysis, Interpolation Search algorithm. Sorting: Objective and properties of different sorting algorithms: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance analysis and comparison among all the methods; Hashing: Definition, Hash functions, Collision resolution techniques.	
4	**Linear Data Structure: Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Application of Linked list: representation of Polynomial and addition of two polynomials. Doubly linked list and Circular Linked List: Basic Concept and Operations.	6
5	**Non-Linear Data Structures:** Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, its properties, Complete and Strictly Binary Tree, Threaded Binary Tree, Binary Search Tree: insertion, deletion & traversal algorithms, AVL tree, Applications of Binary Trees. B Tree, B+ Tree: definitions and construction algorithms. Graph: Basic terminologies and Representations, Graph traversal algorithms (BFS and DFS), Minimal Spanning Tree algorithms (Prim's and Kruskal's).	12
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the fundamental concepts of data structures and interpret the time and space complexity of algorithms using asymptotic notations.
2	Analyze the complexity of various searching, sorting, and hashing algorithms.
3	Demonstrate the concepts of linear and nonlinear data structures and operations on them.
4	Apply appropriate linear and non-linear data structures to solve computational problems.

Learning Resources:	
1	"Data Structures with C" by Seymour Lipschutz, McGrawHill
2	"Data Structures Using C" by Reema Thareja, Oxford
3	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni
4	"Data Structures using C" by A N Tenenbaum, Y Langsam, M J Augenstein, Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Structure and Algorithms Using Java	Prof. Debasis Samanta	IIT Kharagpur
	Course Link: https://onlinecourses.nptel.ac.in/noc23_cs85/preview		

Course Name:	**Universal Human Values-II (Jeevan Kaushal-IV)**		
Course Code:	HM-HU301	**Category:**	Humanities and Social Sciences including Management Courses
Semester:	Third	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	None
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of Human reality and the rest of existence.
3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Contents:		
Module No.	**Description of Topic**	**Conduct Hrs.**
1	**Introduction to Value Education:** Basic Human Aspirations, Right Understanding, Value education, Self-exploration, Exploring Natural Acceptance, Continuous Happiness and Prosperity, Present Scenario: Problems due to lack of Values, Practice Sessions: Sharing about Oneself, Exploring Human Consciousness, Natural Acceptance	**5**
2	**Harmony in the Human Being:** Human beings as the Co-existence of the Self and the Body, Needs of the Self and the Body, Body as an Instrument of the Self, Understanding Harmony, Harmony of the Self with the Body. Practice Sessions: Exploring the	**5**

	Difference between Needs of Self and Body, Sources of Imagination in the Self, Harmony of Self with the Body	
3	**Harmony in the Family and Society:** Family as the Basic Unit of Human Interaction, Harmony in the Family, Trust as the Foundational Value in Relationships, Respect as Right Evaluation Affection, Care, Guidance, Gratitude, Reverence, Justice in Human-to-Human Relationship, Understanding Harmony in the Society and Universal Human Order. Practice Sessions: Exploring the Feeling of Trust, Feeling of Respect, Exploring Systems for Fulfilment of Human Goals	**5**
4	**Harmony in Nature/Existence:** Understanding Harmony in Nature, Interconnectedness, self-regulation and Mutual Fulfilment, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. Practice Sessions: Exploring the Four Orders of Nature, Co-existence in Existence.	**4**
5	**Implications of the Holistic Understanding – Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession. Practice Sessions: Exploring Ethical Human Conduct, Exploring Humanistic Models in Education, Steps for Transition towards Universal Human Order	**5**
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Become more self-aware and responsible towards self, family, society, and nature
2	Resolve life and professional problems through sustainable and ethical solutions. While keeping human relationships and human nature in mind.
3	Practice values-based decision making with improved critical ability and commitment.

Learning Resources:	
1	**A Foundation Course in Human Values and Professional Ethics** – R. R. Gaur, R. Asthana, G. P. Bagaria, 2nd Revised Edition, Excel Books, New Delhi.
2	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
3	**Human Values & Professional Ethics –** R. Subramanian
4	Small is Beautiful - E. F Schumacher.
5	Economy of Permanence - J C Kumarappa.

Corresponding NPTEL/SWAYAM Courses:			
Sl.	**Course Name**	**Instructor Name**	**Host Institute**

No.			

Course Name:	Digital Electronics Laboratory		
Course Code:	ES-EC391	Category:	Engineering Science Course
Semester:	Third	Credit:	2
L-T-P:	0-0-4	Pre-Requisites:	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To acquire the basic knowledge of digital logic gates and its application to understand digital circuits.
2	To prepare students to design various combinational and sequential circuits.
3	To know the working principle of A/D and D/A Converter.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Realization of Basic gates (AND, OR, NOT) from Universal Gates (NAND & NOR).	**4**
2	Implementation of the given Boolean function using logic gates in both sop and pos forms.	**4**
3	Design and Verify adder, subtractor Circuit	**8**
4	Implementation and Verification of Decoder, Encoder, Multiplexer, Demultiplexer Circuit	**8**
5	Verification of state tables of RS, JK, T and D flip-flops	**4**
6	Design of Shift Register	**4**
7	Design of Asynchronous Up-Down Counter	**4**
8	Design of Synchronous Up-Down Counter	**4**
9	Design of Ring/Johnson Counter	**4**
10	Study of D/A Converter and A/D Converter Circuit	**4**
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use basic gate operations and laws of Boolean algebra.
2	Implement combinational logic circuits.
3	Implement sequential logic circuits.
4	Demonstrate A/D converter and D/A converter circuits.

Learning Resources:	
1	Morris Mano- Digital Logic and Computer Design- PHI
2	S. Salivahanan, S. Arivazhagan – Digital Circuits and Design
3	Leach & Malvino—Digital Principles & Application, 5/e, McGraw H
4	Floyed & Jain- Digital Fundamentals-Pearson.
5	A. Anand Kumar- Fundamentals of Digital Circuits-PHI
6	D. Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publisher
7	Tocci, Widmer, Moss- Digital Systems, 9/e- Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**

Course Name:	**Data Structures Laboratory**		
Course Code:	PC-CS391	**Category:**	Professional Core
Semester:	Third	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	ES-CS101, ES-CS191
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To develop the ability to design and implement menu-driven programs to analyze and

	compare the performance of various sorting and searching techniques.
2	To familiarize students with the programming knowledge required to implement linear data structures and perform their fundamental operations.
3	To enable students to apply dynamic memory allocation concepts for implementing linear and non-linear data structures effectively.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Linear Data Structure: Basic data structure operations using Array	4
2	Linear Data Structure: a) Implementation of Stack operations using array; b) Implementation of Linear Queue operations using array; c) Implementation of Circular Queue operations using array	12
3	Application of Stack: a) Program to convert an infix expression to Postfix Expression; b) Program for Evaluating a Postfix Expression. (optional)	4
4	Searching and Sorting: a) Implementation of various Searching algorithms (Menu driven) b) Implementation of various Sorting algorithms (Menu driven)	12
5	Programs using Dynamic Memory Allocation: Implementation of Single Linked List and associated operations (menu driven) Application of Single Linked List: a) Implementation of Stack and Queue using Single Linked List. b) Program to add two Polynomials using Single Linked List (SLL).	12
6	Implementation of Non-Linear Data Structure a) Binary Search Tree: Construction and Traversal b) AVL tree: Construction and Traversal (optional)	4
Total		**48**

Course Outcomes:

After completion of the course, students will be able to:	
1	Implement linear data structures and perform fundamental operations using programming constructs.
2	Analyze and compare the performance of various searching and sorting algorithms through menu-driven program implementations.
3	Apply stack-based linear data structures to develop programs for expression conversion and evaluation.

4	Apply dynamic memory allocation concept to implement linear and nonlinear data structures and perform associated operations

Learning Resources:	
1	"Data Structures with C" by Seymour Lipschutz, McGrawHill
2	"Data Structures Using C" by Reema Thareja, Oxford
3	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni
4	"Data Structures using C" by A N Tenenbaum, Y Langsam, M J Augenstein, Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Python for Problem Solving Laboratory**		
Course Code:	PC-CS392	**Category:**	Professional Core
Semester:	Third	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Basic knowledge of programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To acquire a strong foundation in algorithmic thinking and problem-solving strategies using flowcharts and pseudocode.
2	To master the syntax and semantics of the Python programming language, including control structures and built-in data types.
3	To design and implement modular software solutions using functions, modules, and Object-Oriented Programming (OOP) principles.
4	To understand and implement advanced programming concepts such as exception handling, file manipulation, and concurrent programming.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction Python Basics:** History, features; variables, expressions, statements, precedence of operators, type conversion; operators; formatted input and output	4
2	**Conditional and Iterative statement in Python:** Boolean values, execution flow, simple if, if-else, elif, nested conditional statement; Loops: while loop, for loop, range () function, break, continue, pass.	8
3	**Datatypes and data structures in Python:** Integer, Float, Complex-number; Strings: String slicing, immutability, string methods, string formatting; Lists: List operations, slices, methods, list comprehension, mutability, cloning lists; Tuples: Tuple assignment, packing/ unpacking, immutability; Dictionaries & Sets: Creating dictionaries, keys/values, get(), dictionary methods, set operations (union, intersection).	8
4	**Modular Programming and Recursion:** Functions: Defining functions, parameters vs. arguments, return values, keyword arguments, default parameters, recursive functions; Scope: Local and global scope, the global keyword; Modules: Importing standard libraries (math, random, datetime), creating custom modules; Concept of decorator	8
5	**Object-Oriented Programming (OOPs):** Classes and Objects, attributes and methods, the self-parameter; Constructors: The __init__ method, instance variables vs. class variables; Encapsulation: Public, protected, and private members; Inheritance: Single, multiple, and multilevel inheritance, super() function, method overriding; Polymorphism: Operator overloading, magic methods (e.g., __str__, __add__).	8
6	**File Handling and Exception Handling:** Files: Opening files, file modes (r, w, a, b), reading/writing text and binary files, stricture (using with statement); Exception Handling: Concept of Runtime error try, except, else, finally blocks; Custom Exceptions: Raising exceptions (raise), defining user-defined exception classes	8
7	**Concurrent Programming and Advanced Topics:** Concurrency vs. Parallelism: Concepts, processes vs. threads, the Global Interpreter Lock (GIL); Threading: The threading module, creating threads, start() and join(), thread synchronization (Locks); Multiprocessing: The multiprocessing module, Process class, simple inter-process communication (Queues); Brief Overview of Standard Libraries:	4

	Introduction to os and sys modules for system interaction.	
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design algorithmic solutions to simple computational problems and translate them into Python programs.
2	Utilize Python's built-in data structures (lists, tuples, dictionaries, sets) effectively to manage and manipulate data.
3	Decompose complex problems into manageable functions and modules to promote code reusability.
4	Apply Object-Oriented Programming concepts (classes, objects, inheritance, polymorphism) to model real-world entities.
5	Implement robust programs by handling runtime errors and performing file I/O operations.
6	Develop efficient programs that utilize concurrent execution (multithreading/multiprocessing) to solve time-intensive tasks.

Learning Resources:	
1	Python Programming: A Modular Approach, Sheetal Taneja and Naveen Kumar, Pearson India
2	Python Programming using Problem Solving Approach, Reema Thareja, Oxford University Press
3	Introduction to Computing and Problem Solving with Python, Jeeva Jose, Khanna Book Publishing
4	Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5	Introduction to Computing and Problem-Solving Using Python, E. Balagurusamy, McGraw Hill Education India
6	Programming and Problem Solving with Python, Ashok Namdev Kamthane and Amit Ashok Kamthane, McGraw Hill Education India
7	Python Programming, Ch. Satyanarayana, M. Radhika Mani, and B. N. Jagadeesh, Universities Press

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**

	Course Link:		

Detailed Curriculum for Undergraduate Degree
B.Tech in Computer Science and Engineering (Data Science)
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Data Structures and Algorithms**		
Course Code:	PC-CS301	**Category:**	Professional Core Course
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	ES-CS101, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To enable students to explain the fundamental concepts of linear data structures and their associated operations.
2	To acquaint the students with an understanding of nonlinear data structures and their application areas.
3	To develop the ability to analyze the complexity of various sorting and searching algorithms.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction: Basic Terminologies:** Elementary Data Organizations, Array, Data Structure Operations: insertion, deletion, traversal etc. Analysis of Algorithm: Asymptotic Notations, Time-Space trade off. Recursion: Definition and types with examples of each types, Tower of Hanoi problem and its complexity analysis.	4
2	**Linear Data Structure:** Stacks and Queues: Stack as an ADT and its operations, Applications of Stacks: Expression Conversion and Evaluation – corresponding algorithms. **Types of Queues:** Linear Queue, Circular Queue, Operations on each type and their algorithms. Priority Queue and DEQUE	6

3	**Searching and Sorting (Searching, Sorting, and Hashing):** Searching: Linear Search and Binary Search algorithms and their complexity analysis, Interpolation Search algorithm. Sorting: Objective and properties of different sorting algorithms: Bubble Sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance analysis and comparison among all the methods; Hashing: Definition, Hash functions, Collision resolution techniques.	8
4	**Linear Data Structure: Linked Lists:** Singly linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list; Linked representation of Stack and Queue, Application of Linked list: representation of Polynomial and addition of two polynomials. Doubly linked list and Circular Linked List: Basic Concept and Operations.	6
5	**Non-Linear Data Structures:** Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, its properties, Complete and Strictly Binary Tree, Threaded Binary Tree, Binary Search Tree: insertion, deletion & traversal algorithms, AVL tree, Applications of Binary Trees. B Tree, B+ Tree: definitions and construction algorithms. Graph: Basic terminologies and Representations, Graph traversal algorithms (BFS and DFS), Minimal Spanning Tree algorithms (Prim's and Kruskal's).	12
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the fundamental concepts of data structures and interpret the time and space complexity of algorithms using asymptotic notations.
2	Analyze the complexity of various searching, sorting, and hashing algorithms.
3	Demonstrate the concepts of linear and nonlinear data structures and operations on them.
4	Apply appropriate linear and non-linear data structures to solve computational problems.

Learning Resources:	
1	"Data Structures with C" by Seymour Lipschutz, McGrawHill
2	"Data Structures Using C" by Reema Thareja, Oxford
3	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni

4	"Data Structures using C" by A N Tenenbaum, Y Langsam, M J Augenstein, Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Structure and Algorithms Using Java	Prof. Debasis Samanta	IIT Kharagpur
	Course Link: https://onlinecourses.nptel.ac.in/noc23_cs85/preview		

Course Name:	**Introduction to Data Science**		
Course Code:	PC-CS(D)301	**Category:**	Professional Core Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Knowledge of mathematics, Analytical & logical skills
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce the fundamental concepts, scope, and applications of Data Science in modern data-driven systems.
2	To provide an understanding of different types of data, data sources, and data collection methods.
3	To explain the importance of data preprocessing and data management techniques for preparing data for analysis.
4	To familiarize students with data visualization and exploratory data analysis for discovering patterns and trends in data & recommendation system.
5	To introduce basic statistical concepts and foundational ideas of data analytics and machine learning along with ethical considerations in data science.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Foundations of Data Science:** Definition and scope of Data Science	4

	Evolution of data-driven decision making Relationship between Data Science, Artificial Intelligence, Machine Learning, and Big Data Knowledge Discovery in Databases (KDD) Roles in a data science team Applications of data science in various domains (healthcare, finance, transportation, social media, e-commerce)	
2	**Types and Sources of Data and Data Preprocessing:** Types of data: structured, semi-structured, and unstructured, Qualitative and quantitative data Primary and secondary data sources data collection methods and technologies, Importance of data preprocessing, data cleaning concepts Handling missing and inconsistent data, noise and outlier detection concepts Data transformation and normalization, data integration and data reduction techniques	6
3	**Data Visualization and Exploratory Data Analysis** Importance of visualization in data analysis Principles of effective data visualization Types of visual representations (bar charts, line charts, histograms, scatter plots, box plots) Concept of exploratory data analysis (EDA) Identifying patterns, trends, and anomalies in data	6
4	**Statistical Foundations for Data Science:** Descriptive statistics: mean, median, mode, measures of dispersion: variance and standard deviation, Basic Probability Concepts (Conditional probability, Bayes' theorem, Independence of events, probability distribution) Similarity Measures (Cosine similarity, Euclidean distance, Manhattan distance, Minkowski distance Simple Matching Coefficient, Jaccard similarity) Correlation and covariance Vector operations: addition, subtraction, scalar multiplication, Dataset representation as matrices, Matrix operations Introduction to hypothesis testing and statistical inference	8
5	**Introduction to Data Analytics and Machine Learning Concepts:** Types of data analytics: descriptive, diagnostic, predictive, and prescriptive Overview of machine learning, Supervised, unsupervised and reinforcement learning concepts Training data and testing data Basic evaluation concepts in predictive models	8

	Discussions on privacy, security & ethics. Ethical and unethical data analysis: intruding in personal domain for data acquisition & analysis Social media analytics.	
6	**Recommendation System:** Introduction to Recommendation system, Recommendation Engine, Content-Based Recommendation, Collaborative Filtering	4
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the fundamental concepts, scope, and applications of Data Science and its relationship with Artificial Intelligence, Machine Learning, and Big Data.
2	Identify different types of data, data sources, and data preprocessing techniques used in data-driven systems.
3	Interpret and analyze data using data visualization techniques and basic statistical concepts.
4	Describe the basic concepts of data analytics, machine learning and recommendation system. along with ethical considerations in data science.

Learning Resources:	
1	Data Mining Concepts and Techniques, by Jiawei Han | Micheline Kamber | Jain Pei, MK
2	"Data Science from Scratch", by Joel Grus, O'Reilly
3	"An Introduction to Data Science", by Jeffrey S. Saltz, Jeffrey Morgan Stanton, SAGE Publications Inc.
4	"Data Science & Analytics", by V.K.Jain, Khanna Publishers
5	Machine Learning by S Sridhar (Author), M Vijayalakshmi (Author), Oxford University Press
6	"Doing Data Science: Straight Talk from the Frontline" , by Cathy O'Neil, Rachel Schutt, O'Reilly , Kindle edition available

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Science for Engineers	Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan	IIT Madras

	Course Link: https://onlinecourses.nptel.ac.in/noc21_cs69/preview		
2	Foundation of Data Science	Dinesh Kumar	IIM Bangalore
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb23_mg64		

Course Name:	**Digital Electronics**		
Course Code:	ES-EC301	**Category:**	Engineering Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To acquire the basic knowledge of digital logic gates and apply it to understand digital circuits.
2	To prepare students to perform the analysis and design of various combinational and sequential digital circuits.
3	To acquire knowledge of different logic family, A/D Converter, D/A Converter.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Number System and code:** Number System and Number Base Conversion, BCD, ASCII, EBDIC, Gray codes and their conversions; Signed binary number representation with 1's and 2's complement methods, Binary arithmetic.	4
2	**Boolean algebra and Logic Gates:** Boolean operations and functions, algebraic manipulation, minterms and maxterms, sum-of-products and product-of-sum representations, Digital Logic gates	4
3	**Simplification of Boolean functions:** K-map method, don't care conditions, prime implicants, Quine-McCluskey method.	5
4	**Combinational logic circuits:** Adders and subtractors, comparator, multiplexer, demultiplexer, decoder, encoder, parity generator etc. Design of different combinational circuits.	6

5	**Sequential Circuits:** Basic Flip-flop & Latch, Clocking and timing issues, Flip-flops -SR, JK, D, T and JK Master-slave Flip Flops, Registers (SISO, SIPO, PISO) Ring counter, Johnson counter Basic concept of Synchronous and Asynchronous counter, design methodology of Synchronous and asynchronous counter, Introduction to FSM (Mealy and Moore Machine)	12
6	**Logic families:** TTL, ECL, MOS and CMOS - basic concepts	2
7	**A/D and D/A conversion techniques:** Basic concepts D/A: R-2-R only A/D: Successive Approximation, Monostable and Astable Circuit using 555 Timer.	3
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Solve problems involving number systems, basic gate operations and laws of Boolean algebra.
2	Design and implement of combinational logic circuits.
3	Design and implement of sequential logic circuits.
4	Explain A/D and D/A conversion and the basic concepts of Logic families.

Learning Resources:	
1	Morris Mano- Digital Logic and Computer Design- PHI
2	S. Salivahanan, S. Arivazhagan – Digital Circuits and Design
3	Leach & Malvino—Digital Principles & Application, 5/e, McGraw H
4	Floyed & Jain- Digital Fundamentals-Pearson.
5	A. Anand Kumar- Fundamentals of Digital Circuits-PHI
6	D. Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publisher
7	Tocci, Widmer, Moss- Digital Systems,9/e- Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Digital Circuits	Prof. Santanu Chattopadhyay	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105113		
2	Digital Electronic Circuits	Prof. Gautam Saha	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105132		

Course Name:	**Mathematics -III**		
Course Code:	BS-M301	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand probability distributions of random variables
2	To apply statistical techniques for data analysis and inference
3	To use Fourier analysis for signal and system representation

Course Contents:

Module No.	Description of Topic	Conduct Hrs.
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variables: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); (iii) Expectation, variance of random variables and their properties **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance (ii) **Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance	8
2	**Bivariate Probability Distribution, Correlation & Regression:** **Discrete bivariate distribution** (i) Joint probability distribution of two discrete random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Continuous bivariate distribution** (i) Joint probability distribution of two continuous random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Correlation & Regression:**	8

	Karl Pearson's Correlation Coefficient, Rank Correlation, Regression lines	
3	**Statistics:** **Sampling distribution** (i) Population and sampling distribution; statistic, standard error and confidence interval; (ii) Point and interval estimation; unbiased and consistent estimator; maximum likelihood estimate; (iii) Chebyshev's inequality; **Test of hypothesis** (i) Simple and composite hypothesis. Critical region. Level of significance; (ii) Type I and Type II errors; (iii) One sample and two sample tests for means and proportions, t-test, χ^2-test for goodness of fit.	12
4	**Fourier Series and Fourier Transform:** **Fourier Series** (i) Periodic function and periodic extension of a function; Odd and even functions; (ii) Special wave forms: square wave, half wave rectifier, full wave rectifier, saw-toothed wave, triangular wave (graphical illustration only); (iii) Euler's formulae for Fourier series; Fourier series of functions of period 2π; Fourier series of functions of period 2L; Dirichlet's conditions (iv) Half range Sine and Cosine series (v) Parseval's identity (statement only) **Fourier Transform** (i) Definition of Fourier transform; Properties of Fourier transform: Linearity, Shifting, change of scale property; Fourier transform of some elementary functions; Fourier transform of derivatives; (ii) Fourier sine and cosine transform (iii) Inverse Fourier transform and convolution theorem.	8
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of probability distributions to model random phenomena and compute probabilities, moments, and expectations for discrete and continuous

	random variables.
2	Analyze bivariate distributions to determine marginal and conditional distributions, correlation, and apply regression analysis for modeling relationships between two variables.
3	Apply principles of inferential statistics to estimate population parameters, test statistical hypotheses, and interpret results using appropriate confidence levels and significance tests.
4	Analyze and solve problems using Fourier series and Fourier transforms and apply these techniques to represent periodic functions and analyze signals in engineering and scientific applications.

Learning Resources:	
1	"Advanced Engineering Mathematics" by Erwin Kreyszig, John Wiley & Sons.
2	"Advanced Engineering Mathematics" by Michael Greenberg, Pearson.
3	"Higher Engineering Mathematics" by B.S. Grewal, Khanna Publishers.
4	"Mathematical Methods of Science and Engineering" by Kanti B. Dutta, Cenage Learning.
5	"Advanced Engineering Mathematics" by Reena Garg, Chandrika Prasad, Khanna Publishers.
6	"Statistical Methods (Combined Volume)" by N.G. Das, Tata-McGraw Hill.
7	"A First Course in Probability" by S. Ross, Pearson Education India.
8	"An Introduction to Probability Theory and its Applications, Vol. 1" by W. Feller, Wiley.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Applied Multivariate Statistical Modeling	Prof. Jhareswar Maiti	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/111105091		
2	Probability –I with Examples Using R	Prof. Siva Athreya	ISI Bangalore
	Course Link: https://onlinecourses.nptel.ac.in/noc22_ma27/preview		

Course Name:	**Vedic Mathematics (Indian Knowledge System-II)**		
Course Code:	BS-M303	**Category:**	Basic Science Course
Semester:	Third	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic mathematics

Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on Śulba Sūtra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata, Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	3
2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and sub-sutras, Vedic sutras for addition- Purna puranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	3
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva–Tiryag bhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method, Vilokanam), and cubes (Yāvadunam).	5
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya Samuccaya Gunita, Solution of quadratic equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat.	5
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4X4 using Urdhva Tiryag Sutra, Inverse of	3

	matrices using Vedic approaches.	
6	**Vedic Geometry and Śulba Sūtra Concepts:** Geometrical ideas from Śulba Sūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	5
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and Śulba Sūtra texts.

Learning Resources:	
1	Bharati Krishna Tirthaji, Vedic Mathematics, Motilal Banarsidass, New Delhi.
2	Rajesh Kumar Thakur, Essentials of Vedic Mathematics, Rupa Publications.
3	Vandana Singhal, Vedic Mathematics for All Ages, Motilal Banarsidass.
4	Udayan S. Patankar & Sunil M. Patankar, Elements of Vedic Mathematics, TTU Press.
5	Dahaval Bathia, Vedic Mathematics Made Easy, Jaico Publishing House.
6	Ronak Bajaj, Vedic Mathematics: The Problem Solver, Black Rose Publications.
7	S. K. Kapoor, Vedic Geometry Course, Lotus Press.
8	S. N. Sen & A. K. Bag (Eds.), The Śulba Sūtras, Indian National Science Academy.
9	T. A. Sarasvati Amma, Geometry in Ancient and Medieval India, Motilal Banarsidass.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Mathematics in India - From Vedic Period to Modern Times	Prof.K.Ramasubramanian, Prof. M.D.Srinivas, Prof. M.S.Sriram	IIT Bombay

	Course Link: https://nptel.ac.in/courses/111101080

Course Name:	**Universal Human Values-II (Jeevan Kaushal-IV)**		
Course Code:	HM-HU301	**Category:**	Humanities and Social Sciences including Management Course
Semester:	Third	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	None
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To help the students appreciate the essential complementarily between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity which are the core aspirations of all human beings.
2	To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of existence.
3	To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behaviour and mutually enriching interaction with Nature.

Course Contents:		
Module No.	**Description of Topic**	**Conduct Hrs.**
1	**Introduction to Value Education:** Basic Human Aspirations, Right Understanding, Value education, Self-exploration, Exploring Natural Acceptance, Continuous Happiness and Prosperity, Present Scenario: Problems due to lack of Values, Practice Sessions: Sharing about Oneself, Exploring Human Consciousness, Natural Acceptance	5
2	**Harmony in the Human Being:** Human beings as the Co-existence of the Self and the Body, Needs of the Self and the Body, Body as an Instrument of the Self, Understanding Harmony, Harmony of the Self with the Body. Practice Sessions: Exploring the Difference between Needs of Self and Body, Sources of Imagination in the Self, Harmony of Self with the Body	5
3	**Harmony in the Family and Society:** Family as the Basic Unit of Human Interaction, Harmony in the Family, Trust as the Foundational Value in Relationships, Respect as Right Evaluation Affection, Care, Guidance, Gratitude, Reverence, Justice in	5

	Human-to-Human Relationship, Understanding Harmony in the Society and Universal Human Order. Practice Sessions: Exploring the Feeling of Trust, Feeling of Respect, Exploring Systems for Fulfilment of Human Goals	
4	**Harmony in Nature/Existence:** Understanding Harmony in Nature, Interconnectedness, self-regulation and Mutual Fulfilment, Realizing Existence as Co-existence at All Levels, The Holistic Perception of Harmony in Existence. Practice Sessions: Exploring the Four Orders of Nature, Co-existence in Existence.	4
5	**Implications of the Holistic Understanding – Professional Ethics:** Natural Acceptance of Human Values, Definitiveness of (Ethical) Human Conduct, A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order, Competence in Professional Ethics, Strategies for Transition towards Value-based Life and Profession. Practice Sessions: Exploring Ethical Human Conduct, Exploring Humanistic Models in Education, Steps for Transition towards Universal Human Order	5
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Become more self-aware and responsible towards self, family, society, and nature
2	Resolve life and professional problems through sustainable and ethical solutions. While keeping human relationships and human nature in mind.
3	Practice values-based decision making with improved critical ability and commitment.

Learning Resources:	
1	**A Foundation Course in Human Values and Professional Ethics** – R. R. Gaur, R. Asthana, G. P. Bagaria, 2nd Revised Edition, Excel Books, New Delhi.
2	The Story of My Experiments with Truth - by Mohandas Karamchand Gandhi.
3	**Human Values & Professional Ethics –** R. Subramanian
4	Small is Beautiful - E. F Schumacher.
5	Economy of Permanence - J C Kumarappa.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**

Course Name:	**Data Structures Laboratory**		
Course Code:	PC-CS391	**Category:**	Professional Core Course
Semester:	Third	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	ES-CS101, ES-CS191
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To develop the ability to design and implement menu-driven programs to analyze and compare the performance of various sorting and searching techniques.
2	To familiarize students with the programming knowledge required to implement linear data structures and perform their fundamental operations.
3	To enable students to apply dynamic memory allocation concepts for implementing linear and non-linear data structures effectively.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Linear Data Structure: Basic data structure operations using Array	4
2	Linear Data Structure: a) Implementation of Stack operations using array; b) Implementation of Linear Queue operations using array; c) Implementation of Circular Queue operations using array	12
3	Application of Stack: a) Program to convert an infix expression to Postfix Expression; b) Program for Evaluating a Postfix Expression. (optional)	4
4	Searching and Sorting: a) Implementation of various Searching algorithms (Menu driven) b) Implementation of various Sorting algorithms (Menu driven)	12
5	Programs using Dynamic Memory Allocation: Implementation of Single Linked List and associated operations (menu driven) Application of Single Linked List: a) Implementation of Stack and Queue using Single Linked List. b) Program to add two Polynomials using Single Linked List (SLL).	12
6	Implementation of Non-Linear Data Structure a) Binary Search Tree: Construction and Traversal b) AVL tree: Construction and Traversal (optional)	4

Total	**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement linear data structures and perform fundamental operations using programming constructs.
2	Analyze and compare the performance of various searching and sorting algorithms through menu-driven program implementations.
3	Apply stack-based linear data structures to develop programs for expression conversion and evaluation.
4	Apply dynamic memory allocation concept to implement linear and nonlinear data structures and perform associated operations

Learning Resources:	
1	"Data Structures with C" by Seymour Lipschutz, McGrawHill
2	"Data Structures Using C" by Reema Thareja, Oxford
3	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni
4	"Data Structures using C" by A N Tenenbaum, Y Langsam, M J Augenstein, Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Python for Problem Solving Laboratory**		
Course Code:	PC-CS392	**Category:**	Professional Core Course
Semester:	Third	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Basic knowledge of programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:

1	To acquire a strong foundation in algorithmic thinking and problem-solving strategies using flowcharts and pseudocode.
2	To master the syntax and semantics of the Python programming language, including control structures and built-in data types.
3	To design and implement modular software solutions using functions, modules, and Object-Oriented Programming (OOP) principles.
4	To understand and implement advanced programming concepts such as exception handling, file manipulation, and concurrent programming.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction Python Basics:** History, features; variables, expressions, statements, precedence of operators, type conversion; operators; formatted input and output	4
2	**Conditional and Iterative statement in Python:** Boolean values, execution flow, simple if, if-else, elif, nested conditional statement; Loops: while loop, for loop, range () function, break, continue, pass.	8
3	**Datatypes and data structures in Python:** Integer, Float, Complex-number; Strings: String slicing, immutability, string methods, string formatting; Lists: List operations, slices, methods, list comprehension, mutability, cloning lists; Tuples: Tuple assignment, packing/ unpacking, immutability; Dictionaries & Sets: Creating dictionaries, keys/values, get(), dictionary methods, set operations (union, intersection).	8
4	**Modular Programming and Recursion:** Functions: Defining functions, parameters vs. arguments, return values, keyword arguments, default parameters, recursive functions; Scope: Local and global scope, the global keyword; Modules: Importing standard libraries (math, random, datetime), creating custom modules; Concept of decorator	8
5	**Object-Oriented Programming (OOPs):** Classes and Objects, attributes and methods, the self-parameter; Constructors: The __init__ method, instance variables vs. class variables; Encapsulation: Public, protected, and private members; Inheritance: Single, multiple, and multilevel inheritance, super() function, method overriding; Polymorphism: Operator overloading, magic methods (e.g., __str__, __add__).	8
6	**File Handling and Exception Handling:** Files: Opening files, file	8

	modes (r, w, a, b), reading/writing text and binary files, stricture (using with statement); Exception Handling: Concept of Runtime error try, except, else, finally blocks; Custom Exceptions: Raising exceptions (raise), defining user-defined exception classes	
7	**Concurrent Programming and Advanced Topics:** Concurrency vs. Parallelism: Concepts, processes vs. threads, the Global Interpreter Lock (GIL); Threading: The threading module, creating threads, start() and join(), thread synchronization (Locks); Multiprocessing: The multiprocessing module, Process class, simple inter-process communication (Queues); Brief Overview of Standard Libraries: Introduction to os and sys modules for system interaction.	4
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design algorithmic solutions to simple computational problems and translate them into Python programs.
2	Utilize Python's built-in data structures (lists, tuples, dictionaries, sets) effectively to manage and manipulate data.
3	Decompose complex problems into manageable functions and modules to promote code reusability.
4	Apply Object-Oriented Programming concepts (classes, objects, inheritance, polymorphism) to model real-world entities.
5	Implement robust programs by handling runtime errors and performing file I/O operations.
6	Develop efficient programs that utilize concurrent execution (multithreading/multiprocessing) to solve time-intensive tasks.

Learning Resources:	
1	Python Programming: A Modular Approach, Sheetal Taneja and Naveen Kumar, Pearson India
2	Python Programming using Problem Solving Approach, Reema Thareja, Oxford University Press
3	Introduction to Computing and Problem Solving with Python, Jeeva Jose, Khanna Book Publishing
4	Core Python Programming, Dr. R. Nageswara Rao, Dreamtech Press
5	Introduction to Computing and Problem-Solving Using Python, E. Balagurusamy, McGraw Hill Education India

6	Programming and Problem Solving with Python, Ashok Namdev Kamthane and Amit Ashok Kamthane, McGraw Hill Education India
7	Python Programming, Ch. Satyanarayana, M. Radhika Mani, and B. N. Jagadeesh, Universities Press

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
	Course Link:		

Course Name:	**Digital Electronics Laboratory**		
Course Code:	ES-EC391	**Category:**	Engineering Science Course
Semester:	Third	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To acquire the basic knowledge of digital logic gates and its application to understand digital circuits.
2	To prepare students to design various combinational and sequential circuits.
3	To know the working principle of A/D and D/A Converter.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Realization of Basic gates (AND, OR, NOT) from Universal Gates (NAND & NOR).	4
2	Implementation of the given Boolean function using logic gates in both sop and pos forms.	4
3	Design and Verify adder, subtractor Circuit	8
4	Implementation and Verification of Decoder, Encoder, Multiplexer, Demultiplexer Circuit	8
5	Verification of state tables of RS, JK, T and D flip-flops	4
6	Design of Shift Register	4

7	Design of Asynchronous Up-Down Counter	4
8	Design of Synchronous Up-Down Counter	4
9	Design of Ring/Johnson Counter	4
10	Study of D/A Converter and A/D Converter Circuit	4
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use basic gate operations and laws of Boolean algebra.
2	Implement combinational logic circuits.
3	Implement sequential logic circuits.
4	Demonstrate A/D converter and D/A converter circuits.

Learning Resources:	
1	Morris Mano- Digital Logic and Computer Design- PHI
2	S. Salivahanan, S. Arivazhagan – Digital Circuits and Design
3	Leach & Malvino—Digital Principles & Application, 5/e, McGraw H
4	Floyed & Jain- Digital Fundamentals-Pearson.
5	A. Anand Kumar- Fundamentals of Digital Circuits-PHI
6	D. Ray Chaudhuri- Digital Circuits-Vol-I & II, 2/e- Platinum Publisher
7	Tocci, Widmer, Moss- Digital Systems, 9/e- Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**

Detailed Curriculum for Undergraduate Degree
B.Tech in Electrical Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Engineering Mechanics**		
Course Code:	ES-ME301	**Category:**	Engineering Sciences Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Physics (BS-PH-201), Mathematics (BS-M101, BS-M20)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Introduce essential mathematical tools required for the analysis of physical and mechanical systems.
2	Develop the ability to apply appropriate mathematical techniques for modeling and analyzing physical bodies.
3	Provide fundamental methods for the analysis of rigid body behavior.
4	To solve problem of general motion.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Fundamental Principles of Forces, Vectors, and Moments** Basic concepts: Definitions, Basic assumptions, Scalar & Vector quantities, Free, Forced and fixed vectors. Force System: Force, Classification & Representation, Force as a Vector, Composition of forces, Parallelogram Law, Resolution, Principle of Transmissibility of forces, Moment of a force, Vector representation, Moment for coplanar force system, Varignon's theorem.	**4L**
2	**Analysis of Force Systems, Couples, and Equilibrium in Statics**	**3L**

	Resolution of a force into a force and a couple. Force Systems: Coplanar Concurrent Force system and Coplanar Non-Concurrent force systems, Resultant of coplanar force system. Equilibrium of coplanar force system, Couple, Vector representation, Free body diagrams.	
3	**Kinematics of Rigid Body** Kinematics of rigid bodies: Dentition and motion of a rigid body; Rigid bodies as coordinate systems; Angular velocity of a rigid body, and its rate of change; Distinction between two- and three-dimensional rotational motion; Integration of angular velocity to find orientation; Motion relative to a rotating rigid body: Five term acceleration formula.	**6L**
4	**Kinetics of Rigid Bodies** Kinetics of rigid bodies: Angular momentum about a point; Inertia tensor: Dentition and computation, Principal moments and axes of inertia, Parallel and perpendicular axes theorems; Mass moment of inertia of symmetrical bodies, cylinder, sphere, cone etc., Area moment of inertia and Polar moment of inertia, Forces and moments; Newton-Euler's laws of rigid body motion.	**5L**
5	**General Motion of Rigid Bodies and Gyroscopic Phenomena** Examples and problems. General planar motions. General 3-D motions. Free precession, Gyroscopes, Rolling coin.	**9L**
6	**Shear Force and Bending Moment Analysis of Beams** Transverse loading on beams, shear force and bending moment in beams, analysis of cantilevers, simply supported beams and overhanging beams, relationships between loading, shear force and bending moment, shear force and bending moment diagrams.	**5L**
7	**Torsional Motion** Torsion of circular shafts, derivation of torsion equation, stress and deformation in circular and hollow shafts.	**2L**
8	**Friction** Concept of Friction, Laws of Coulomb friction, Angle of Repose and Coefficient of friction.	**3L**
9	**Vibrations** Free and forced vibration of undamped and damped single DOF systems, Effect of damping, Vibration Isolation, Critical Speed of Shafts.	**3L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand coordinate systems, three-dimensional rotation, and the basic kinematics and kinetics of rigid bodies.

2	Explain the principles of general motion, bending moment, torsional motion, and friction.
3	Construct free body diagrams for different mechanical systems and loading conditions.
4	Apply the laws of motion and friction to solve engineering problems involving rigid bodies.
5	Analyse bending moments and torsional behaviour in mechanical components.

Learning Resources:	
1	M. F. Beatty, "Principles of Engineering Mechanics", Springer Science & Business Media, 1986.
2	J. L. Meriam and L. G. Kraige, "Engineering Mechanics: Dynamics", Wiley, 2011.
3	Manoj K. Harbola, "Engineering Mechanics", Cengage Learning India Pvt. Ltd, 2018.
4	R.S. Khurmi, "Engineering Mechanics", S.Chand Publications.
5	R.K. Bansal, "Engineering Mechanics", Laxmi Publications.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Engineering Mechanics	By Prof. K. Ramesh	IIT Madras
	Course Link: https://onlinecourses.nptel.ac.in/noc21_me70/preview		
2	Engineering Mechanics - Statics and Dynamics	By Prof. Anubhab Roy	IIT Madras
	Course Link: https://onlinecourses.nptel.ac.in/noc25_me20/preview		

Course Name:	**Electrical Engineering Materials**		
Course Code:	ES-EE301	**Category:**	Engineering Science Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To introduce the fundamental concepts of atomic structure and bonding in solids relevant to electrical engineering materials.
2	To understand dielectric properties of materials under static and alternating electric fields.
3	To explain electrical conduction mechanisms in metals and semiconductors.
4	To analyze the characteristics and applications of magnetic and insulating materials used in electrical engineering systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Atomic Structure and Bonding in Solids:** Fundamentals of electrical engineering materials & its classification, Atomic structure and hydrogen atom model, quantum mechanical interpretation, electronic configuration of atoms, types of chemical bonds (ionic, covalent, metallic), classification of solids, crystal structure and atomic arrangements in solids.	**6L**
2	**Electrical Conduction in Metals:** Ohm's law and relaxation time of electrons, Relaxation time, collision time and mean free path, Electron scattering and the resistivity of metals, Heat developed in a current carrying conductor, Thermal conductivity of metals, Emission of electrons from metals, Effect of temperature on electrical conductivity of metals, High conductivity materials, Superconductors and hyper-conductors, Superconductors and hyper-conductors, Electrical conducting materials, Thermal properties, Specific heat of metals, Contributions of electrons to the heat capacity of metals. Conduction in Carbon, Tungsten, high resistive materials etc.,	**6L**
3	**Dielectric and Insulating Materials:** Introduction to dielectric materials, dielectric constant, polarization mechanisms, atomic interpretation of dielectric constant, dielectric behavior of monoatomic and polyatomic molecules, internal electric fields in solids and liquids, dielectric constant of solids, properties of ferroelectric materials, polarization, Piezoelectricity. Classification of dielectric materials, Gaseous dielectrics, petroleum oil, Synthetic liquid dielectrics, organic polymer, resins, vegetable oil, bitumen, waxy dielectrics, electrical varnishes and compounds, flexible materials, plastics, elastomers, glasses, ceramic dielectric materials, mica and mica materials, asbestos and asbestos materials, inorganic dielectric	**12L**

	films.	
4	**Electrical Conduction in liquids:** Electrolytic conduction, Electrons in electrolysis different, Experimental evidence for dissociation, Equivalent conductivity, Ionic velocities, Chemical cells and concentration cells, Irreversible and reversible cells, Practical cells, Electrolytic deposition, Uses of electrolytic depositions.	**5L**
5	**Magnetic Materials:** Classification of magnetic materials (diamagnetic, paramagnetic, ferromagnetic), magnetic dipole and dipole moment, Lenz's law, Diamagnetism, Paramagnetism and paramagnetic spin systems, Spontaneous magnetization and the Curie-Weiss law, magnetization curve, hysteresis loops, hysteresis and magnetic losses, Common magnetic materials, Anti-ferromagnetism, Ferrimagnetism, Magnetic resonance.	**6L**
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain atomic structure, bonding, and crystal arrangements in electrical engineering materials.
2	Analyze dielectric behavior of materials under static and alternating electric fields.
3	Evaluate electrical conduction mechanisms in metallic materials.
4	Understand semiconductor properties and their importance in electronic devices.
5	Classify magnetic and insulating materials and relate their properties to engineering applications.

Learning Resources:	
Text book	
1	**An Introduction to Electrical Engineering Materials** by C.S Indulkar and S. Thiruvengadam.
2	**Electrical Engineering Materials** by A.J. Dekker
Reference Book	
3	**Electrical Engineering Materials by** N. P. Bogoroditsky, V.V. Pasynkov and B. M. Tareev.
4	**Electrical and Radio Engineering Materials** by B. M. Tareev.
5	**Electrical and Electronics Materials** by D. P. Kothari, Mahima Join and Sheefali Jagwani.

Course Name:	**Network Analysis**		
Course Code:	PC-EE301	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Basic Electrical and Electronics Engineering (ES-EE 201) and Mathematics (BS-M101, BS-M201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the structure and properties of different type of electrical circuits, networks and sources.
2	To apply different mathematical tools and techniques for analyzing electrical networks.
3	To apply circuit analysis techniques to simplify electrical networks.
4	To solve problems of electrical circuits.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction**: Continuous and Discrete, Fixed and Time varying, Linear and Nonlinear, Lumped and Distributed, Passive and Active networks and systems. Independent and Dependent sources, Step, Ramp, Impulse, Sinusoidal, Square, Saw tooth signals.	**4L**
2	**Graph theory and Networks equations:** Concept of Tree, Branch, Tree link, Incidence matrix, Tie-set matrix and loop currents, Cut set matrix and node pair potentials, Duality, Related Problems.	**4L**
3	**Coupled circuits:** Magnetic coupling, Polarity of coils, Polarity of induced voltage, Concept of Self and Mutual inductance, Coefficient of coupling, Modeling of coupled circuits, Related Problems.	**3L**
4	**Laplace transforms:** Impulse, Step and Sinusoidal response of RL, RC, and RLC circuits, Transient analysis of different electrical circuits with	**8L**

	and without initial conditions, Concept of Convolution theorem and its application, Related Problems with DC and AC sources.	
5	**Fourier method of waveform analysis:** Application of Fourier series and Fourier Transform (in continuous domain only) in circuit analysis, related problems.	**5L**
6	**Network Theorems:** Formulation of network equations, Source transformation, Loop variable analysis, Node variable analysis, Network theorem: Superposition, Thevenin‟s, Norton‟s and Maximum power transfer theorem, Millman‟s theorem and its application in three phase unbalanced circuit analysis, Related Problems with DC and AC sources, Dependent and independent voltage and current source and numerical problems.	**8L**
7	**Two port networks analysis:** Open circuit Impedance and Short circuit Admittance parameter, Transmission parameters, Hybrid parameters and their inter relations, Related Problems.	**6L**
8	**Filter Circuits:** Analysis and synthesis of Low pass, High pass, Band pass, Band reject (first order only) filter, Related Problems.	**2L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the behavior of different signals and systems.
2	Apply Laplace and Fourier transforms for solving different electrical problems.
3	Analyze complicated Electrical network with the help of different network theorems
4	Solve different electrical problem in a simplified way by graph theory.
5	Determine different parameters from a given two port electrical network.
6	Understand the application of active filters for different electric circuit.

Learning Resources:	
Recommended Text books:	
1.	Network Analysis, M.E. Valkenburg, Pearson Education
2.	Circuit theory, Dr. Abhijit Chakrabarty, Dhanpat Rai and Co Pvt. Ltd
3.	Networks and Systems, D. Roy Chowdhury, New Age International Publishers
Alternative Text Books:	
4.	Circuit and Networks: Analysis and synthesis, A. Sudhakar and S.S. Palli4th edition. Tata

	Mc Graw Hill Education Pvt. Ltd.
5.	Networks and Systems, Ashfaq Husain, Khanna Book Publishing, New Delhi
6.	Problems and Solutions of Electric Circuit Analysis, R.K. Mehta and A.K. Mal, CBS, New Delhi
Reference Books:	
7.	Fundamental of Electric circuit theory, D. Chattopadhay and P.C. Rakshit, S. Chand
8.	Engineering Circuit Analysis, W.H. Hyat, J.E. Kemmerly and S.M. Durbin, The Mc Graw Hill Company
9.	Network Analysis and Synthesis, C.L. Wadhwa, New Age International Publishers

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Network Analysis	Prof. Tapas Kumar Bhattacharya	IIT Kharagpur
	Course Link: http://digimat.in/nptel/courses/video/108105159/L01.html		

Course Name:	**Electromagnetic Fields Theory**		
Course Code:	PC-EE302	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics Engineering (ES-EE 201), Mathematics (BS-M101, BS-M201) and Physics (BS-PH201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the basic mathematical tools to deal with electromagnetic field problem.
2	To understand properties and application of electric and magnetic field.

3	To analyze electromagnetic wave propagation.
4	To solve problem related to electromagnetic field.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Coordinate System:** Co-ordinate systems and transformation, Cartesian coordinates, circular cylindrical coordinates, Spherical coordinates & their transformation. Differential length, area and volume in different coordinate systems. Solution of problems.	**4L**
2	**Introduction to Vector calculus:** DEL operator, Gradient of a scalar, Divergence of a vector & Divergence theorem, Curl of a vector & Strokes theorem, Laplacian of a scalar, Classification of vector fields, Helmholtz's theorem, Solution of problems.	**4L**
3	**Electrostatic field:** Coulomb's law, Field intensity, Gauss's law, Electric Potential and Potential gradient, Relation between E and V, an Electric dipole and flux lines. Energy density in electrostatic field. Boundary conditions: Dielectric-dielectric, Conductor-dielectric, Conductor –free space. Poisson's and Laplace's equation, general procedure for solving Poisson's and Laplace's equation. Solution of problems.	**8L**
4	**Magneto static fields:** Biot-Savart law, Ampere's circuital Law, Magnetic flux density, Magnetic static and Vector potential, Forces due to magnetic field, Magnetic torque and moments, Magnetization in material, Magnetic boundary condition, Inductor and Inductances, Magnetic energy, Force on magnetic material. Solution of problems.	**8L**
5	**Electromagnetic fields:** Faraday's law, transformer and motional emf, Displacement current, Maxwell's equation, Time varying Potential, Time harmonic fields. Solution of problems.	**6L**
6	**Electromagnetic wave propagation:** Wave equation, Wave propagation in lossy dielectric, Plane waves in loss less dielectric, Plane wave in free space, Plane wave in good conductor, Skin effect, Skin depth, Power & Poynting vector, Reflection of a plane wave at normal incidence, Reflection of a plane wave at oblique incidence, Polarization. Solution of problems.	**6L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand concept of coordinate transformation with the knowledge of vector calculus and several theorems (Divergence theorem, Strokes theorem and Helmholtz's theorem)
2	Apply the knowledge of Biot-Savart's Law & Gauss's Law to solve boundary condition problems with the concept of Poisson's and Laplace's equation.
3	Apply the knowledge of Biot-Savart's Law and Ampere's circuital Law to solve problems related to magnetic circuits.
4	Determine the effects of Transformer EMF and Motional EMF, wave equation, skin effect, skin depth having the concept of Maxwell's equation and Pointing Theorem.

Learning Resources:	
Recommended Text Books:	
1	Engineering Electromagnetic, W.H. Hyat & J.A. Buck, 7th Edition, TMH
2	Elements of Electromagnetic, Mathew N.O. Sadiku, 4th edition, Oxford university press
Alternative Text Books:	
3	Electromagnetic Field Theory, S. P. Ghosh, Tata Mc Graw-Hill
Reference Books:	
4	Vector Analysis, Schaum Series, Murray R. Spiegel, McGraw-Hill
5	Theory and problems of Electromagnetic, Edminister, 2nd Edition, TMH
6	Electromagnetic field theory fundamentals, Guru & Hizroglu, 2nd edition, Cambridge University

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Electromagnetic Waves in Guided and Wireless Media	Prof. Pradeep Kumar K	IIT Kanpur
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee40/preview		

Course Name:	**Analog Electronics**		
Course Code:	PC-EE303	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical and Electronics Engineering (ES-EE 201) and Mathematics (BS-M101, BS-M201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the structure and properties of different components of analog electronics.
2	To explain principle of operation of analog electronics components and circuits.
3	To understand the application of operational amplifier
4	To solve problems of analog electronic components and circuits
5	To analyze amplifiers, oscillators and other analog electronic circuits.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Filters and Regulators:** Half wave and full wave rectifier with Capacitor filters, □-section filter, T-section filter, ripple factor, regulated power supply.	**3L**
2	**BJT circuits:** BJT as a switch. biasing circuits, BJT as an amplifier: small-signal model, biasing circuits, common-emitter, common-base and common-collector amplifiers; Multistage amplifier, Small signal equivalent circuits.	**8L**
3	**MOSFET circuits:** MOSFET structure and I-V characteristics. MOSFET as a switch. MOSFET as an amplifier: small-signal model and biasing circuits, common- source, common-gate and common-drain amplifiers; small signal equivalent circuits - gain, input and output impedances, trans- conductance.	**8L**

4	**Power amplifier:** Power Amplifier: Introduction to the Power Amplifiers, Classification of Power Amplifiers, Class A, Class B (Push-Pull), Class AB and Class C Power Amplifier. Applications	**2L**
5	**Feedback amplifier and Oscillators:** Concept of Feedback, Negative and Positive feedback, Voltage/Current, Series/Shunt feedback, Colpit, Hartley's, Phase shift, Wien bridge oscillators.	**4L**
6	**Review and Application of Operational Amplifiers:** Constant current source (Current mirror etc.), CMRR, Open and closed loop circuits, Voltage follower/Buffer circuits, Level shifter, Voltage to current and Current to Voltage converter, Adder, Differential amplifier, Integrator and Differentiator, Comparator, Log and Antilog amplifier, Schmitt Trigger, Transconductance amplifier, Multiplier/Divisor using OPAMP.	**9L**
7	**Multivibrator:** Monostable, Bistable multivibrator, Monostable and Astable operation using 555 timer, Introduction to VCO and PLL.	**2L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the operation of rectifier, filter and voltage regulator.
2	Analyze the operation of transistor circuits as analog building block.
3	Understand the operation of OPAMPs as different active linear circuits.
4	Interpret the operation of feedback in amplifiers and oscillators.
5	Understand amplifier-based circuits for different applications.

Learning Resources:	
Recommended Text Books:	
1	Malvino and Bates, Electronic Principles, McGraw-Hill Education
2	D Chattopadhyay, P C Rakshit, Electronics Fundamentals and Applications, New Age International Publisher
3	Ramakant A. Gayakwad -- Op-Amps and Linear Integrated Circuits, 4/e, Pearson-PHI
4	Microelectronic Circuits by SEDRA and SMITH, Oxford
5	A.K. Maini, Analog Electronics, Khanna Publishing House 2019
Alternative Text Books:	
5	Floyd, Electronic Devices, Pearson
6	David A. Bell, Electronic Devices and Circuits, Oxford
7	I.J. Nagrath, Electronics: Analog and Digital, PHI

8	Millman & Halkias – Integrated Electronics, Tata McGraw Hill
9	Boylestead, Nashelsky: & Kishore, Electronic Devices & Circuit theory, 1/e, PHI/Pearson
10	D. Roy Choudhury, Linear Integrated Circuits, New Age International Publisher
Reference Books:	
11	Maheshwari and Anand, Analog Electronics, PHI
12	Sundaram Natarajan, Microelectronics: Analysis & Design, 1/e 2005, TMH
13	Dipankar Nagchoudhuri, Microelectronic Devices, 1/e, Pearson Education, 2001
14	Mottershed, Electronics Devices & Circuits, Wiley Eastern

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Analog Electronic Circuit	Prof. Shouribrata chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		
2	Analog Electronic Circuits - IITM	Prof. Shanthi Pavan	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106188		

Course Name:	**Digital Electronics**		
Course Code:	PC-EE304	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics ES-EE101
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand number systems, binary arithmetic, Boolean algebra, and logic gate fundamentals for digital system analysis.
2	Develop the ability to design and minimize combinational logic circuits using K-map and Quine–McCluskey methods.
3	Analyze and design sequential circuits using flip-flops, registers, and counters for practical digital applications.
4	Explain the operation and performance characteristics of A/D and D/A converters

	used in digital systems.
5	Understand memory organization and programmable logic devices such as ROM, RAM, PLA and PAL.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Digital Systems and Binary numbers:** Binary, decimal, octal, hexadecimal number systems, number base conversions, complements, signed binary numbers, binary logic, binary arithmetic. **Boolean Algebra and Logic Gates:** Basic theorems and properties of Boolean algebra, Boolean functions, canonical and standard forms, digital logic gates, digital logic families and integrated circuits**.** Standard representation for logic functions, K-map representation, simplification of Logic functions using K-map, minimization of logical functions. Don't care conditions. Q-M method of function realization.	**10L**
2	**Combinational Digital Circuits:** Multiplexer, De-Multiplexer/Decoders, Adders, Subtractors, BCD arithmetic, carry look ahead adder, serial adder, ALU, digital comparator, parity checker/generator, codes and code converters, priority encoders, decoders/drivers for display devices.	**5L**
3	**Sequential circuit and systems:** **Flip-Flops:** A 1-bit memory, the circuit properties of Bistable latch, RS Flip flop, Clocked RS flip-flop, JK flip-flop, D and T-flip-flop, Conversion of flip-flops, applications of flip-flops. **Registers:** Shift Registers (Left shift and Right shift register), Universal shift register: SISO, SIPO, PISO, PIPO **Counters:** Ring counter, ripple(Asynchronous) counters, synchronous counters, counters design using flip flops, special counter IC's, asynchronous sequential counters, applications of counters. **Comparators & Converters:** Basic comparator & its characteristics, Serial to parallel converter, parallel to serial converter.	**7L**
4	**A/D and D/A Converters:** **Digital to analog converters:** weighted resistor/ converter, R-2R Ladder, D/A converter, specifications for D/A converters, examples of D/A converter, ICs.	**7L**

	Analog to digital converters: quantization and encoding, parallel comparator A/D converter, successive approximation A/D converter, counting A/D converter, dual slope A/D converter, A/D converter using voltage to frequency and voltage to time conversion, specifications of A/D converters, example of A/D converter ICs.	
5	**Semiconductor memories and Programmable logic devices:** Memory organization and operation, expanding memory size, classification and characteristics of memories, sequential memory, read only memory (ROM), read and write memory (RAM), commonly used memory chips, ROM as a PLD, Programmable logic array, Programmable array logic.	**6L**
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand number system conversions and Boolean algebra principles to simplify and analyze digital logic circuits.
2	Design and implement combinational circuits such as adders, subtractors, multiplexers, decoders, comparators, and ALU.
3	Design and analyze sequential circuits using flip-flops, registers, and counters for specified applications.
4	Evaluate and compare different A/D and D/A conversion techniques based on their specifications and performance.
5	Explain the organization and working of semiconductor memories and programmable logic devices and apply them in basic digital system design.

Learning Resources:	
Recommended Text Books	
1	Modern Digital Electronics, 4th Edition, R.P. Jain. Tata Mc Graw Hill Company Limited
2	Digital Logic Design, M. Morries Mano, Pearson Education, 2002.
Alternative Text Books	
3	Digital Electronics, R. Anand, Khanna Publishing House (2018).
4	Digital Integrated Electronics, H. Taub & D. Shilling, Mc Graw Hill Company.
5	Digital Electronics, Principles, Devices and Applications, Anil K. Maini,Jhon Wiley & Sons, Ltd, 2007.
Reference Books	
6	Digital fundamentals, Floyd, Thomas L, 10/e. Pearson Education India, 2011.

7	Digital Electronics, Gothmann, William H. PHI, New Delhi, Second Edition 2000.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Digital Electronic Circuits	Prof. Goutam Saha	Indian Institute of Technology Kharagpur
	Course Link: https://onlinecourses.nptel.ac.in/noc22_ee55/preview		
2	Digital Circuits	Prof. Santanu Chattopadhyay	Indian Institute of Technology Kharagpur
	Course Link: https://www.youtube.com/watch?v=X7M3rUxUpOc&list=PLbRMhDVUMngePP5JcezxImF-FzOC9wstz		

Course Name:	**Network Analysis Laboratory**		
Course Code:	PC-EE391	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To simulate electrical circuit experiments using suitable software.
2	To determine different electrical circuit parameters using hardware.
3	To get frequency response of different filters using simulation and hardware technique.
4	To verify different network theorems.

Course Contents: (Choose 8 experiments from the following)		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Transient response of R-L and R-C network: simulation with software and hardware	**3P**
2	Transient response of R-L-C series and parallel circuit: simulation with software and hardware	**3P**

3	Determination of Impedance (Z) and Admittance (Y) parameter of two port network: simulation and hardware.	**3P**
4	Frequency response of LP and HP filters: simulation and hardware	**3P**
5	Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using simulation software in both discrete and analog form.	**3P**
6	Determination of Laplace transform and Inverse Laplace transform using simulation software	**3P**
7	Fourier series analysis of different waveforms.	**3P**
8	Amplitude and Phase spectrum analysis of different signals using simulation software.	**3P**
9	Verification of network theorems using software and hardware.	**3P**
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate transient response of different electrical circuit.
2	Calculate different parameters from a two port network.
3	Demonstrate frequency response of different active filter circuit.
4	Simulate different operation of signals for output waveform using MATLAB
5	Calculate Laplace and inverse Laplace transform of different functions using MATLAB
6	Analyze different network theorems.

Course Name:	**Analog and Digital Electronics Laboratory**		
Course Code:	PC-EE393	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make the students concept about to design, experiment, analyze, interpret in the core field.
2	To provide knowledge based on the needs of society and industry by providing hands

	on experience.
3	To provide the clear concept of theoretical knowledge's by providing practical experiments.

Course Contents: (Choose 10 experiments from the following)		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Study of ripple and regulation characteristics of full wave rectifier with and without capacitor filter.	**2P**
2	Study of Zener diode as voltage regulator.	**2P**
3	Study of timer circuit using NE555 and configuration for Monostable and Astable Multivibrator	**2P**
4	Construction of a simple function generator using IC.	**2P**
5	Realization of a V-to-I and I-to-V converter using Op-Amps.	**2P**
6	Realization of basic gates using Universal logic gates.	**2P**
7	Construction of simple Decoder & Multiplexer circuits using logic gates.	**2P**
8	Design of combinational circuit for BCD to decimal conversion to drive 7-segment display using multiplexer	**2P**
9	Realization of RS-JK & D flip-flops using Universal logic gates.	**2P**
10	Realization of Synchronous Up/Down counter	**2P**
11	Study of A-D and D-A converter.	**2P**
Total		**20P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Construct a full wave rectifier circuit and voltage regulator using discrete components and study their performance.
2	Construct the different circuits using amplifier, waveform generator using 555 timer and study their performance.
3	Realize RS-JK and D flip flop, logic gates using universal gates and synchronous up/down counters.
4	Construct different combinational circuits using logic gates with appropriate instruments and precaution.

Detailed Curriculum for Undergraduate Degree
B. Tech in Information Technology
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Analog and Digital Electronics**		
Course Code:	ES-EC301	**Category:**	Engineering Science
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Knowledge of Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To provide students with conceptual foundation in simple analog electronic circuits, essential for modern computing and communication systems.
2	To enable students to comprehend the principles of digital electronics, including number systems, Boolean algebra, logic gates, and simplification techniques.
3	To enable students to design and demonstrate combinational and sequential logic circuits using standard digital components such as adders, multiplexers, decoders, flip-flops, counters, and registers.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Revision of Basic Electronics**: (i) Introduction to Diodes and functionality of BJT & FET. VI Characteristics and Working Principles of PN Junction Diode & BJT only. (ii) Types of Transistor Biasing, Load Line, Q Point and Applications of Transistors.	3L
2	**Amplifiers and Oscillators**: (i)Concept of Amplification-Different Classes of Power Amplifiers – (Class-A, B, AB and C – basic concepts with power, efficiency Calculations only). (ii) Concept of Positive Feedback & Negative Feedback. Advantages of Negative Feedback. Simple Numerical Problems on Feedback. (iii) Basics of Oscillations- Criteria for Oscillation-Working Principles of Crystal Oscillator, Wien Bridge Oscillator, Hartley Oscillator, Colpitt Oscillator. (Without Mathematical Derivations). (iv) Basics of IC 555 Timer and Applications of IC 555 Timer only.	8L

3	**Introduction to Digital Electronics:** (i) Concept of Number System, Basic Logic Gates and Universal Logic Gates, Truth Table, BCD, EBCDIC, ASCII, Gray Code, Excess-3 Code, Boolean Algebra, De-Morgan's Theorem and Proof, Canonical Representation of SOP, POS. (ii) Minimization of Logic Expression- By Boolean Algebra and K –map Simplification up to 4 Variables only- Don't-Care Conditions	10L
4	**Combinational Circuits:** (i) Adders- Half Adder& Full Adder, Code Conversion, Decoder, Encoder, Multiplexer, De Multiplexer, Magnitude Comparator.	4L
5	**Sequential Circuits:** (i)Difference between Combinational & Sequential Circuits. Concept of Storage Elements-Latch and Flip Flop. Concept of Clock Pulse &Triggering. (ii) Flip- Flops- JK, D, SR, T, Master Slave Flip Flop, Working Principle with Truth Table, Excitation Table and State Table. (iii) Registers- Working Principles of SISO, SIPO, PISO, PIPO. (iv) Concept of Counter- Asynchronous, Synchronous, Design of MOD N Counter, Construction of state diagram. Concepts of Ring Counter, Up Down Counter.	8L
6	**Converter and Logic Families** (i) A/D and D/A Converter- Basic Concepts of R-2R Ladder, Successive Approximation Type Only. (ii) Logic Families- Performance Comparison of Different Logic Families-TTL, CMOS, RTL, ECL – and Basic Concepts of Propagation Delay Time, Noise Margin, Fan-in, Fan Out, Power Dissipation.	3L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the operation and characteristics of basic analog electronic devices such as diodes, BJTs, FETs, and Oscillators, amplifiers.
2	Understand the number systems, simplifying methods of Boolean algebra, and logic simplification techniques to solve digital logic problems.
3	Design Combinational logic circuits using logic gates, multiplexers, decoders, and encoders for given specifications
4	Design Sequential logic circuits using flip-flops, counters, and registers.

Learning Resources:	
1	Microelectronics Circuits by A.S. Sedra & K.C. Smith Oxford University Press Publication.
2	Electronic devices and Circuits by Jacob Millman and C.C. Halkias TMH Publications.
3	Fundamentals of Digital Electronics by Anad Kumar, PHI Publication.

4	Digital Integrated Electronics by David H. Taub & D. Shilling, Tata McGraw Hill Publications.
5	Modern Digital Electronics by R.P. Jain, Tata McGraw Hill Publication.
6	Digital Circuits and Systems by Douglas-Hall, Tata McGraw Hill.
7	Digital Fundamentals by Thomas L. Floyd, Pearson Prentice Hall Publication.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Digital Electronic Circuits	Prof. Goutam Saha	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105132		
2	Analog Electronic Circuit	Prof. Shouribrata Chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		

Course Name:	**Data Structure and Algorithms**		
Course Code:	PC-IT301	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	ES-CS201(Programming for Problem Solving)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn the basics of abstract data types.
2	To learn the principles of linear and nonlinear data structures.
3	To build an application using sorting and searching

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Basic Terminologies: Abstract Data Type, Elementary Data Organizations, Array Data Structure Operations: insertion, deletion, traversal etc.; Analysis of an Algorithm, Asymptotic Notations; Basic Algorithms using array: Searching (linear and binary search) and their complexity analysis.	6L
2	Stacks and Queues: ADT Stack and its operations: Algorithms and their complexity analysis, Applications of Stacks: Expression Conversion and evaluation – corresponding algorithms and complexity analysis. ADT	8L

	queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each Type of Queues: Algorithms and their analysis.	
3	Sorting and Hashing: Objective and properties of different sorting algorithms: Selection Sort, Bubble Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Performance and Comparison among all the methods, Hashing: Hash Functions, Separate Chaining, Open Addressing, Rehashing, Extendible Hashing, Hash Indices.	8L
4	Linked Lists: Singly linked lists, Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into linked list, Deletion from linked list; Doubly linked list: operations on it and algorithmic analysis; Circular Linked Lists: all operations their algorithms and the complexity analysis. Linked representation of Stack and Queue.	8L
5	Trees and Graph: Basic Tree Terminologies, Different types of Trees: Binary Tree, Binary Search Tree, AVL Tree, Threaded Binary Tree; Tree operations on each of the trees and their algorithms with complexity analysis. Applications of Binary Trees. B Tree, B+ Tree: definitions, Heap Sort, algorithms and analysis. Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis.	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the fundamental concepts of arrays, different ADTs and algorithm analysis, including searching techniques and asymptotic notations.
2	Apply stack and queue ADTs to implement operations and solve expression-processing problems.
3	Analyze and compare sorting and hashing techniques and select suitable methods for efficient problem solving.
4	Understand and implement linked list data structures and analyze their operations.
5	Apply tree and graph data structures to model and solve computational problems.

Learning Resources:	
1	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson - freed.
2	"Data Structures in C" by Aaron M. Tenenbaum.
3	"Data Structures" by S. Lipschutz.
4	"Data Structures Using C" by Reema Thareja.
5	"Data Structures through C" by Yashwant Kanitkar, BPB House

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Programming, Data Structures and Algorithms using Python	Prof. Madhavan Mukund	Chennai Mathematical

			Institute
	Course Link: https://nptel.ac.in/courses/106106145		
2	Data Structures and Algorithms	Prof. Naveen Garg	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102064		

Course Name:	**Computer Organization and Architecture**		
Course Code:	PC-IT302	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop understanding of number systems, data representation (fixed and floating point), and the fundamental organization and operation of a stored-program computer including instruction execution cycle and system software roles.
2	To enable students to design and analyze arithmetic circuits and understand CPU organization, instruction formats, and addressing modes in both RISC and CISC architectures.
3	To provide knowledge of memory systems, including RAM, ROM, cache, and virtual memory, and to understand memory hierarchy and CPU–memory interfacing techniques.
4	To introduce control unit and pipelining concepts, parallel architectural classifications, performance evaluation techniques, and I/O operations such as interrupts and DMA.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basic Computer Organization:- Commonly used number systems. Fixed- and floating-point representation of numbers, Overflow, Underflow. Floating point - IEEE 754 standard. Basic organization of the stored program computer and operation sequence for execution of a program. Role of operating systems and compiler/assembler. Fetch, decode and execute cycle, Concept of operator, operand, registers and storage and Instruction format.	6L
2	Design of some Arithmetic unit:-Ripple carry adder, Serial Adder and Carry Look Ahead Adder, Binary Adder-Subtractor. Binary Incrementer Circuit, Binary Decrementer Circuit, Arithmetic Circuit, Arithmetic Logic Shift Unit Design of ALU, Fixed point multiplication -Booth's algorithm, Fixed point division - Restoring and non-restoring algorithms CPU Organization: Single Accumulator Based CPU Organization, Stack Organization, General Register Organization, Instruction Length, Addressing Modes, Instruction Set, RISC & CISC Characteristics.	10L

3	Memory Organization: Basic Concepts, Semiconductor RAM Memories, Read Only Memories, Speed, Size, and Cost Static and dynamic memory, Memory hierarchy,CPU-memory interfacing. Associative memory. Cache memory-Cache Mapping Associative Mapping, Direct Mapping, Set Associative Mapping, Virtual memory, Paging, Segmentation and Page replacement Algorithm.	10L
4	Design of control unit - hardwired and micro programmed control. I/O operations - Concept of handshaking, Polled I/O, interrupt and DMA.	4L
5	Pipelining & parallel Architectural Classification: Basic Concepts, Instructions and Arithmetic Pipeline, Data Hazards, Control Hazards and Structural Hazards. Parallel Architectural Classification-Flynn's Classification, Feng's Classification, Handler's Classification. ILP,TLP, Speed –up Performance Laws-Amdahl's Law, Gustrfson's Law, Sun and Ni's Law.	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain number systems, data representation (fixed and floating point including IEEE 754), and analyze the basic organization of a stored-program computer along with instruction execution cycle and role of system software.
2	Design and analyze arithmetic circuits (adders, subtractors, ALU, Booth's multiplication, division algorithms) and interpret different CPU organizations, instruction formats, and addressing modes including RISC and CISC architectures.
3	Analyze memory systems including RAM, ROM, cache, and virtual memory, and evaluate memory hierarchy, mapping techniques, and page replacement algorithms for efficient CPU–memory interaction.
4	Explain control units (hardwired and micro programmed) and analyze I/O techniques including handshaking, polled I/O, interrupts, and DMA.
5	Explain pipelining concepts, hazard handling, parallel architectural classifications, and evaluate system performance using speed-up laws.

Learning Resources:	
1	Mano, M.M., "Computer System Architecture", PHI.
2	Hayes J. P., "Computer Architecture & Organisation", McGraw Hill
3	Hamacher, "Computer Organisation", McGraw Hill
4	William Stallings "Computer Organization and Architecture Designing for Performance", Prentice Hall of India
5	Computer organization and Architecture – T. K Ghosh

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Computer Organization and Architecture	Prof. Jatindra Kumar Deka	IIT Guwahati

	Course Link: https://nptel.ac.in/courses/106103068

Course Name:	**Mathematics-III**		
Course Code:	BS-M301	**Category**	Basic Science Course
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	High School Mathematics, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand probability distributions of random variables
2	To apply statistical techniques for data analysis and inference
3	To use Fourier analysis for signal and system representation

Course Contents:

Module No.	Description of Topic	Conduct Hrs.
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variables: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); (iii) Expectation, variance of random variables and their properties **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance (ii) **Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance	8L
2	**Bivariate Probability Distribution, Correlation & Regression:** **Discrete bivariate distribution** (i) Joint probability distribution of two discrete random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Continuous bivariate distribution** (i) Joint probability distribution of two continuous random variables, marginal distribution; (ii) Expectation, variance, covariance; Independent random variables; **Correlation & Regression:** Karl Pearson's Correlation Coefficient, Rank Correlation, Regression lines	8L
3	**Statistics:** **Sampling distribution**	12L

	(i) Population and sampling distribution; statistic, standard error and confidence interval; (ii) Point and interval estimation; unbiased and consistent estimator; maximum likelihood estimate; (iii) Chebyshev's inequality; **Test of hypothesis** (i) Simple and composite hypothesis. Critical region. Level of significance; (ii) Type I and Type II errors; (iii) One sample and two sample tests for means and proportions, t-test, χ^2-test for goodness of fit.	
4	**Fourier Series and Fourier Transform:** **Fourier Series** (i) Periodic function and periodic extension of a function; Odd and even functions; (ii) Special wave forms: square wave, half wave rectifier, full wave rectifier, saw-toothed wave, triangular wave (graphical illustration only); (iii) Euler's formulae for Fourier series; Fourier series of functions of period 2π; Fourier series of functions of period 2L; Dirichlet's conditions (iv) Half range Sine and Cosine series (v) Parseval's identity (statement only) **Fourier Transform** (i) Definition of Fourier transform; Properties of Fourier transform: Linearity, Shifting, change of scale property; Fourier transform of some elementary functions; Fourier transform of derivatives; (ii) Fourier sine and cosine transform (iii) Inverse Fourier transform and convolution theorem.	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of probability distributions to model random phenomena and compute probabilities, moments, and expectations for discrete and continuous random variables.
2	Analyze bivariate distributions to determine marginal and conditional distributions, correlation, and apply regression analysis for modeling relationships between two variables.
3	Apply principles of inferential statistics to estimate population parameters, test statistical hypotheses, and interpret results using appropriate confidence levels and significance tests.
4	Analyze and solve problems using Fourier series and Fourier transforms, and apply these techniques to represent periodic functions and analyze signals in engineering and scientific applications.

Learning Resources:	
1	"Advanced Engineering Mathematics" by Erwin Kreyszig, John Wiley & Sons.
2	"Advanced Engineering Mathematics" by Michael Greenberg, Pearson.
3	"Higher Engineering Mathematics" by B.S. Grewal, Khanna Publishers.
4	"Mathematical Methods of Science and Engineering" by Kanti B. Dutta, Cenage Learning .
5	"Advanced Engineering Mathematics" by Reena Garg, Chandrika Prasad, Khanna Publishers.
6	"Statistical Methods (Combined Volume)" by N.G. Das, Tata-McGraw Hill.
7	"A First Course in Probability" by S. Ross, Pearson Education India.
8	"An Introduction to Probability Theory and its Applications, Vol. 1" by W. Feller, Wiley.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Applied Multivariate Statistical Modeling	Prof. Jhareswar Maiti	IIT Kharagpur
2	Probability –I with Examples Using R	Prof. Siva Athreya	ISI Bangalore

Course Name:	**Analog and Digital Electronics Laboratory**		
Course Code:	ES-EC393	**Category:**	Engineering Science
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Knowledge of Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To acquire the basic knowledge of analog and digital electronic componentsthrough hands-on experimentation and observation.
2	To implement digital circuits including combinational and sequential logic circuits, using standard ICs and Components.
3	To illustrate different electronic circuit and their application in practice.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Realization of Basic Gates using Universal Logic Gates.	3P
2	Implementation of the given Boolean function using logic gates in both SOP and POS forms.	3P

3	Construction of Half Adder & Full Adder Circuit using Logic Gates and verify its output.	3P
4	Constructions of simple Decoder & Multiplexer circuits using logic Gates and verify its output.	3P
5	Realization of RS / JK / D flip flops using logic gates.	3P
6	Design a Shift Register using D Flip Flop and verification of truth table.	3P
7	Realization of Synchronous Up/ Down Counter.	3P
8	Realization of MOD N Counter.	3P
9	Design a BCD to Seven Segment Decoder.	3P
10	Study of Timer circuit using NE555 and configuration of Mono-stable and astable Multi-vibrator.	3P
11	Study of Oscillator with frequency of Oscillation Measurement.	3P
12	Design a Binary to Gray Code Converter or Design of a Magnitude Comparator.	3P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the operation of basic important analog electronic Circuits.
2	Understand and design various combinational and sequential Circuits.
3	Understand the basic digital circuits and to verify their operation.
4	Develop skill to build, and troubleshoot digital circuits.

Learning Resources:	
1	Introduction to Analog & Digital Circuits Lab Manual by Brian Dean, Kendall Hunt Pub Co.
2	Analog And Digital Electronics,, by Charles H. Roth, Jr., Larry L. Kinney | Raghunandan G. H
3	Hands on Electronics by Kalpan Daniel M Cambridge University Press

Course Name:	**Data Structure and Algorithms Laboratory**			
Course Code:	PC-IT391	**Category:**	Professional Core Courses	
Semester:	Third	**Credit:**	1.5	
L-T-P:	0-0-3	**Pre-Requisites:**	ES-CS291(Programming for Problem Solving)	
Full Marks:	100			
Examination Scheme:	Semester Examination:60	Continuous Assessment:35	Attendance: 05	

Course Objectives:	
1	To develop skills to design and analyze simple linear and nonlinear data structures

2	To strengthen the ability to identify and apply the suitable data structure for the given real world problem
3	To gain knowledge in practical applications of data structures

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Lab 1: Implementation of array operations with searching techniques	8P
2	Lab 2: Implementation of stacks including operations- insertion, deletion, expression- prefix, infix, postfix, their evaluation and conversion. Lab 3: Implementation of different queues like Simple Queue, Circular Queue, Priority Queue including operations- insertion, deletion.	12P
3	Lab 4: Implementation of sorting techniques. Lab 5: Implementation of hash tables.	8P
4	Lab 6: Implementation of linked lists: Singly Linked Lists, Circular Linked Lists, Doubly Linked List including insertion, deletion and reversal a linked list Lab 6: Implementation of stacks & queues using linked lists	8P
5	Lab 7 : Recursive traversal of Trees Lab 8: Threaded binary tree traversal Lab 9 : AVL tree implementation	9P
6	Lab 10: Hash tables implementation Lab 11: Sorting techniques	12P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement array operations and apply searching techniques to solve basic computational problems.
2	Apply stack and queue data structures, including circular queues, to perform insertion, deletion, and expression evaluation operations.
3	Implement and analyze sorting and hashing techniques for efficient data organization and retrieval.
4	Apply tree data structures, including recursive traversal, threaded binary trees, and AVL trees, to solve hierarchical data problems.
5	Implement and analyze hashing and sorting techniques for efficient data organization and retrieval.

Learning Resources:	
1	"Fundamentals of Data Structures of C" by Ellis Horowitz, Sartaj Sahni, Susan Anderson - freed.
2	"Data Structures in C" by Aaron M. Tenenbaum.
3	"Data Structures" by S. Lipschutz.

4	"Data Structures Using C" by Reema Theraja.
5	"Data Structures through C" by Yashwant Kanitkar, BPB House

Course Name:	**Computer Organization and Architecture Laboratory**		
Course Code:	PC-IT392	**Category:**	Professional Core Courses
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Concept of Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives: This course will enable students to	
1	Design Adder/Subtractor composite unit.
2	Design a BCD adder.
3	Design a composite ALU
4	Design of a 'Carry-Look-Ahead' Adder circuit
5	Cascade two RAM ICs

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Familiarity with IC-chips, e.g. a) Multiplexer b) Decoder, c) Encoder b) Comparator Truth Table verification and clarification from Data-book.	9P
2	Design an Adder/Subtractor composite unit.	3P
3	Design a BCD adder.	3P
4	Design a 2 bit Carry Look Ahead (CLA) Adder	3P
5	Use a multiplexer and 4-bit Parallel binary adder unit to design a 4-bit Arithmetic Unit.	3P
6	Use a multiplexer unit to design a composite ALU.	3P
7	Use ALU chip for multibit arithmetic operation	3P
8	Implement read write operation using RAM IC.	3P
9	Cascade two RAM ICs for vertical expansion.	3P
10	Cascade two RAM ICs for horizontal expansion.	3P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand and verify the functionality of basic digital ICs such as Multiplexer, Decoder, Encoder, and Comparator through truth tables and data book analysis.
2	Design and analyze combinational circuits including Adder–Subtractor units, BCD

	adders, and arithmetic units using multiplexers and parallel binary adders.
3	Develop and implement composite Arithmetic Logic Unit (ALU) using multiplexers and perform multi-bit arithmetic operations using ALU ICs.
4	Apply memory interfacing concepts by performing read/write operations using RAM ICs and implementing memory expansion techniques (horizontal and vertical cascading of RAM).

Learning Resources:	
1	Laboratory Manual

Course Name:	**IT Workshop using Python**		
Course Code:	PC-IT393	**Category:**	Professional Core
Semester:	Third	**Credit:**	2.5
L-T-P:	1-0-3	**Pre-Requisites:**	Knowledge of Programming Logic and Programming Experience with any high level language(Preferable)
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Understand about the details of Scripting languages.
2	Make students learn to use SciLab, MATLAB, R and Python and its libraries to provide the solutions for the real life problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Lab1: Familiarization with Python environment with simple computational problems using different operators, expressions. Lab 2: Problems involving using Conditional Statements (if-else, nested if-else), Iterative problems using while, do-while, for loops, and using switch-case and nested loop.	8P
2	Lab 3: Concepts of Lists/Array/Vectors and problems using 1-D and 2-D array, use of Tuple and Dictionaries, String manipulation, and use of functions and modules, and Object-Oriented concepts. Lab 4: Concepts of Data Manipulation and related problems, and Problems involving Exception handling, File handling operations and plotting of data. Lab 5: Familiarization with Python environment for problems and use	12P

	cases, involving regression, classification, and clustering models and data science related problems.	
3	Lab 6 & 7: **Data Acquisition and Data Cleaning and Preparation for a real-life problem**: Gather relevant raw data in CSV files from various sources in the internet. Fix errors in the dataset, handle missing values (imputation), remove duplicates, and manage outliers.	8P
4	Lab 8: **Exploratory Data Analysis (EDA)**: Use statistical tests and Python visualization libraries (like Seaborn or Matplotlib) to find patterns and relationships, using regression, classification, or clustering. Lab 9: **Feature Engineering and Model Development**: Select, transform, and create new features that improve model performance. Choose and train a model for regression, classification, or clustering. Lab 10: **Model Evaluation and Deployment**: Assess performance on a separate validation set using metrics appropriate, and implement the validated model on a web application using frameworks like Flask or Streamlit.	12P
5	Lab 11: Mini-projecton real-life data science related problems. Lab 12: Mini-projecton real-life data science related problems.	8P
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the details of Scripting languages
2	Design real life problems and think creatively about solutions
3	Develop Solutions for advanced applications using R/Matlab/Python

Learning Resources:	
1	Python Programming: Using Problem Solving Approach" by Reema Thareja
2	Data Structure and Algorithmic Thinking with Python" by Narasimha Karumanchi
3	Michael J. Crawley. Statistics: An Introduction using R. Wiley, 2nd edition, 2014. ISBN 978-1-118-94109-6.
4	Sarah Stowell. Using R for Statistics. Apress, 2014. ISBN 978-1484201404
5	http://www.mathworks.com/help/releases/R2014b/pdf_doc/matlab/getstart.pdf
6	https://www.scilab.org/sites/default/files/Scilab_beginners.pdf

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Programming, Data Structures And Algorithms Using Python (8 Weeks course)	Prof. Madhavan Mukund	Chennai Mathematical Institute
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs79/preview]		
2	Python for Data Science (4 Weeks course)	Prof. Ragunathan Rengasamy	IIT Madras

	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs80/preview]		
3	The Joy of Computing using Python (12 Weeks course)	Prof. SudarshanIyengar	IIT Ropar
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs84/preview]		
4	Data Analytics with Python (12 Weeks course)	Prof. A Ramesh	IIT Roorkee
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_cs86/preview]		
5	Scientific Computing using Python (In Hindi) (12 Weeks course)	Prof. Mani Mehra, Prof. Vivek K. Aggarwal	IIT Delhi, Delhi Technological University
	Course Link: [https://onlinecourses.nptel.ac.in/noc26_ma26/preview]		

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Audit Course
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	10 + 2
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	2L
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution,	7L

	E- waste, Plastic waste	
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	7L
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	8L
Total:		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	"Fundamentals of Environment and Ecology" by D. De & D. De, S Chand Publication
2	"Text Book of Environmental Studies" by E. Bharucha, Byju's
3	"Environmental Studies" by S. C. Sharma and M. P. Poonia, Khanna Book Publishing
4	"Environmental Studies" by M. Basu, Cambridge University Press
5	"Fundamentals of renewable energy processes" by A. Vieira & D. Rosa, Academic Press Inc
6	"Principles Solar Engineering" by F. Kreith and J. F. Kreider, CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science - Fundamental	Prof. Brajesh K Dubey	IIT Kharagpur

	and Sustainability Concepts		
	Course Link: https://nptel.ac.in/courses/127105018		

Detailed Curriculum for Undergraduate Degree
B.Tech in Mechanical Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Materials Engineering**		
Course Code:	ES-ME301	**Category:**	Engineering Science
Semester:	Third	**Credit:**	3.0
L-T-P:	3-0-0	**Pre-Requisites:**	NIL
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Broad understanding of different types of engineering materials and their applications
2	Various methods to quantify the mechanical integrity of materials and their failure criteria
3	Interpretation of equilibrium phase diagrams of alloys
4	Different heat treatment methods to tailor the properties of Fe-C alloys.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Engineering Materials and Classification: Metals, plastics, ceramics and composites; Relevant properties (physical, mechanical, thermal, electrical, chemical), Range of applications; Material designation and standards; Ashby diagrams; Selection criteria and process.	**6L**
2	Mechanical Properties and Testing: Tensile, compression, torsion, fatigue, fracture and wear tests; Young's modulus; Relations between true and engineering stress-strain curves; Generalized Hooke's law; Yielding and yield strength; ductility, resilience, toughness and elastic recovery; Hardness measurement their relation.	**6L**
3	Metal and Alloys: Iron and steel; Stainless steel and tool steels; Copper & its alloys – brass, bronze & cupro-nickel; Aluminium & Al-Cu-Mg alloys; Nickel based superalloys & Titanium alloys; Phase diagrams	**6L**

	and interpretation of microstructure; Iron Iron-carbide phase diagram and cooling (TTT) diagrams.	
4	Heat Treatment: Heat treatment of Steel; Annealing, tempering, normalizing, spheroidising, austempering, martempering, case hardening, carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, vacuum and plasma hardening.	**6L**
5	Polymers, Ceramics and Composites: Polymers – Classification and applications; Polymerization techniques; Ceramics – Oxide ceramics, ceramic insulators, bio-ceramics and Glasses; Composites – Reinforcement, matrix, metal matrix composites, ceramic composites, polymer composites; Other advanced materials – biomaterials, optical materials, high temperature materials, energy materials, and nanomaterials.	**6L**
6	Electrical and Magnetic Materials: Conducting and resisting materials – types, properties and applications; Semiconducting materials – properties and applications; Magnetic materials – Soft and hard magnetic materials and applications; Superconductors and dielectric materials – properties and applications; Smart materials; Sensors and actuators; Piezoelectric, magneto strictive and electro strictive materials.	**6L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Know the range of engineering materials, their mechanical properties and applications
2	Know various methods to measure the mechanical properties of materials
3	Learn how to improve the properties of ferrous alloys through various heat treatments

Learning Resources:	
1	W. D. Callister, "Materials Science & Engineering," Wiley India, 2014
2	K. G. Budinski and M.K. Budinski, "Engineering Materials", PHI India, 2002
3	V. Raghavan, "Material Science and Engineering', PHI India, 2015
4	U. C. Jindal, "Engineering Materials and Metallurgy", Pearson, 2011
5	M.F. Ashby and D.R.H. Jones, Engineering Materials 1 - An Introduction to Properties, Applications and Design, Butterworth-Heinemann, USA, 2011

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Basics of Materials Engineering	Prof. Ratna Kumar Annabattula	IIT Madras
	Course Link: https://onlinecourses.nptel.ac.in/noc22_me90/preview		

Course Name:	**Engineering Mechanics**		
Course Code:	ES-ME302	**Category:**	Engineering Sciences
Semester:	Third	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.
2	A working knowledge of statics and dynamics with emphasis on force equilibrium and free body diagrams provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction to Engineering Mechanics covering Force Systems: Basic concepts, Particle equilibrium in 2-D & 3-D, Rigid Body equilibrium, System of Forces, Coplanar Concurrent Forces, Components in Space-Resultant-Moment of Forces and its Application, Couples and Resultant of Force System. Equilibrium of System of Forces, Free body diagrams, Equations of Equilibrium of Coplanar Systems and Spatial Systems, Static Indeterminacy, Tutorials of Free body diagrams various systems including block-pulley.	**4L**
2	Friction covering types of friction, Limiting friction, Laws of Friction. Static and Dynamic Friction, Motion of Bodies, wedge friction. Numerical on Static and Dynamic Friction, Tutorials to find coefficient of friction	**8L**

	between various materials on inclined plane, Numerical on ladder problems.	
3	Basic Structural Analysis covering Equilibrium in three dimensions. Method of Sections, Method of Joints, How to determine if a member is in tension or compression, Simple Trusses, Zero force members, Beams & types of beams, Frames & Machines. Simple truss problems.	**6L**
4	Centroid and Centre of Gravity covering Centroid of simple figures from first principle, centroid of composite sections, Centre of Gravity and its implications. Numericals and tutorials based on Centroid and Centre of Gravity problems of standard and composite sections. Area moment of inertia - Definition, Moment of inertia of plane sections from first principles, Theorems of moment of inertia, Moment of inertia of standard sections and composite sections, Mass moment inertia. Numerical and tutorials based on moment of inertia.	**9L**
5	Virtual Work and Energy Method - Virtual displacements, principle of virtual work for particle and ideal system of rigid bodies, degrees of freedom. Active force diagram, systems with friction, mechanical efficiency. Conservative forces and potential energy (elastic and gravitational), energy equation for equilibrium. Applications of energy method for equilibrium. Stability of equilibrium.	**3L**
6	Review of particle dynamics - Rectilinear motion, Plane curvilinear motion (rectangular, path, and polar coordinates). 3-D curvilinear motion, Relative and constrained motion, Newton's 2nd law (rectangular, path, and polar coordinates). Work-kinetic energy, power, potential energy. Impulse-momentum (linear, angular), Impact (Direct and oblique).	**5L**
7	Introduction to Kinetics of Rigid Bodies covering basic terms, general principles in dynamics, Types of motion, Instantaneous centre of rotation in plane motion and simple problems. D'Alembert's principle and its applications in plane motion and connected bodies, Work energy principle and its application in plane motion of connected bodies, Kinetics of rigid body rotation.	**5L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe different types of forces and their effect on rigid bodies.
2	Employ basic laws of vector algebra.
3	Analyze system of forces and condition of equilibrium.
4	Recognize laws of friction and solve problems related to it, basic concepts of center of

	gravity and moment of inertia.
5	Identify laws of dynamics and solve related problems.
6	Solve simple truss problems and study of virtual work.

Learning Resources:	
1	Irving H. Shames (2006), Engineering Mechanics, 4th Edition, Prentice Hall.
2	F. P. Beer and E. R. Johnston (2011), Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, 9th Ed, Tata McGraw Hill.
3	R. C. Hibbler (2006), Engineering Mechanics: Principles of Statics and Dynamics, Pearson Press.
4	J. L. Meriam and L. G. Kraige (2006), Engineering Mechanics: Statics- Vol. 1 and Dynamics - Vol. 2, Wiley India Private Limited.
5	P. K. Nag, S. Pati and T. K. Jana (2013), Engineering Mechanics, McGraw Hill Education.
6	Hibler and Gupta (2010), Engineering Mechanics (Statics, Dynamics) by Pearson Education.
7	B. Bhattacharyya and S. C. Bera (2009), Basic Mechanics, New Age International Private Limited.
8	Bansal R. K. (2010), A Text Book of Engineering Mechanics, Laxmi Publications.
9	Dr. D. S. Kumar (2013), Engineering Mechanics (Statics & Dynamics), S.K. Kataria & Sons.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Engineering Mechanics	Prof. K. Ramesh, Prof. Tarkes Dora Pallicity	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106286		
2	Engineering Mechanics	Prof. U.S. Dixit, Dr. G. Saravana Kumar	IIT Guwahati
	Course Link: https://nptel.ac.in/courses/112103108		

Course Name:	**Thermodynamics**		
Course Code:	PC-ME301	**Category:**	Professional Core
Semester:	Third	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Nil

Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn about work and heat interactions, and balance of energy between system and its surroundings.
2	To learn about application of laws to various energy conversion devices.
3	To evaluate the changes in properties of substances in various processes.
4	To understand the difference between high grade and low grade energies and II law limitations on energy conversion.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Fundamentals - System & Control volume; Property, State & Process; Exact & Inexact differentials; Work-Thermodynamic definition of work; examples; Displacement work; Path dependence of displacement work and illustrations for simple processes; electrical, magnetic, gravitational, spring and shaft work.	**5L**
2	Temperature, Definition of thermal equilibrium and Zeroth law; Temperature scales; Various Thermometers- Definition of heat; examples of heat/work interaction in systems- First Law for Cyclic & Non-cyclic processes; Concept of total energy E ; Demonstration that E is a property; Various modes of energy, Internal energy and Enthalpy.	**5L**
3	First Law for Flow Processes - Derivation of general energy equation for a control volume; Steady state steady flow processes including throttling; Examples of steady flow devices; Unsteady processes; examples of steady and unsteady I law applications for system and control volume.	**5L**
4	Second law - Definitions of direct and reverse heat engines; Definitions of thermal efficiency and COP; Kelvin-Planck and Clausius statements; Definition of reversible process; Internal and external irreversibility; Carnot cycle; Absolute temperature scale.	**5L**
5	Clausius inequality; Definition of entropy (S) ; Demonstration that entropy (S) is a property; Evaluation of S for solids, liquids, ideal gases and ideal gas mixtures undergoing various processes; Determination of s from steam tables- Principle of increase of entropy; Illustration of processes in T-s coordinates; Definition of Isentropic efficiency for	**8L**

	compressors, turbines and nozzles- Irreversibility and Availability, Availability function for systems and Control volumes undergoing different processes, Lost work. Second law analysis for a control volume. Exergy balance equation and Exergy analysis.	
6	Definition of Pure substance, Ideal Gases and ideal gas mixtures, Real gases and real gas mixtures, Compressibility charts, Properties of two phase systems - Const. temperature and Const. pressure heating of water; Definitions of saturated states; P-v-T surface; Use of steam tables and R134a tables; Saturation tables; Superheated tables; Identification of states & determination of properties, Mollier's chart.	**8L**
7	Thermodynamic cycles - Basic Rankine cycle; Basic Brayton cycle; Basic vapor compression cycle and comparison with Carnot cycle.	**4L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	apply energy balance to systems and control volumes, in situations involving heat and work interactions.
2	evaluate changes in thermodynamic properties of substances.
3	evaluate the performance of energy conversion devices.
4	differentiate between high grade and low grade energies.

Learning Resources:	
1	Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2	Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India
3	Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4	Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Basic Thermodynamics	Prof. S. K. Som	IIT Kharagpur
	https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8		

2	Engineering Thermodynamics	Prof. Jayant K. Singh	IIT Kanpur
	https://onlinecourses.nptel.ac.in/noc26_me43/preview		
3	Thermodynamics	Prof. S. R. Kale	IIT Delhi
	https://onlinecourses.nptel.ac.in/noc26_me10/preview		

Course Name:	**Basic Manufacturing Processes**		
Course Code:	PC-ME302	**Category:**	Professional Core
Semester:	Third	**Credit:**	4.0
L-T-P:	4-0-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To motivate and challenge students to understand and develop an appreciation of theprocesses in correlation with material properties which change the shape, size and form of the raw materials into the desirable product by conventional or unconventional manufacturing methods.
2	To learn about application of different manufacturing processes.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to manufacturing processes:** Importance of Manufacturing, Economics and Technological Definition, Classification and Selectionof Manufacturing Processes.	**1L**
2	**Conventional manufacturing processes:** Patterns, types of patterns, material used for patterns and allowances. Mould making procedure; definition & meaning of different terms, cope & drag and gating system, properties of moulding sand. Metal casting processes and equipment, different types of casting, defects in sand casting and remedies.	**10L**
3	**Forming process:** Introduction to bulk and sheet metal forming, plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk forming (forging, rolling, extrusion, drawing) and sheet forming (shearing, deep drawing, bending).	**12L**
4	**Joining/fastening processes:** Welding definition, arc welding, gas	**10L**

	welding, shielded metal arc welding; GMAW (MIG) and GTAW (TIG); Brazing and soldering; Solid state joining; Adhesive bonding.	
5	**Machining process:** Basic principle of machining, purpose, definition and requirements. Different material removal process (Turning, Drilling, Milling and other finishing processes).	**7L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the different conventional manufacturing methods employed for making different products.
2	Acquire working knowledge of moulding and casting processes.
3	Familiarize with different forming processes and their specific applications.
4	Know about different solid and liquid state joining processes and also select the proper welding process for manufacturing a product.
5	Apply the basic knowledge of principle of machining.

Learning Resources:	
1	Kalpakjian and Schmid, Manufacturing Processes for Engineering Materials (5th Edition)-Pearson India, 2014
2	Mikell P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley Publication.
3	Degarmo, Black & Kohser, Materials and Processes in Manufacturing, Wiley Publication.
4	Ghosh A. & Mallick A. K., Manufacturing Science, East-West Press Pvt. Ltd.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Manufacturing Process Technology I & II	Prof. Shantanu Bhattacharya	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/112104195		

Course Name:	**Mathematics-III**		
Course Code:	BS-M301	**Category**	Basic Science Course
Semester:	Third	**Credit:**	3.0

L-T-P:	2-1-0	**Pre-Requisites:**	High School Mathematics, BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand probability distributions and their applications.
2	To apply basic statistical methods and regression analysis for data interpretation.
3	To use complex differentiation and integration techniques in engineering problems
4	To study Bessel and Legendre functions and their applications in physical systems.
5	To solve partial differential equations related to heat, wave, and Laplace equations.

Course Contents:

Module No.	Description of Topic	Conduct Hrs.
1	**Probability Distribution:** (i) Introduction to probability theory (ii) Discrete and continuous random variable: Probability mass function (p.m.f.) and probability density function (p.d.f.) of single random variable; Cumulative distribution function (c.d.f.); Applications; (iii) Expectation and variance of random variable; **Some special types of distributions** (i) **Discrete probability distribution:** Binomial and Poisson distributions; Mean and variance; (ii) **Continuous probability distribution:** Uniform, Exponential and Normal distributions; Mean and variance.	**8L**
2	**Statistics:** **Measure of Central Tendency & Dispersion** (i) Statistical data and frequency distribution; (ii) Mean, Median and Mode (iii)Variance and standard deviation **Correlation & Regression** (i) Introduction to bivariate data; Scatter diagram; (ii) Correlation and Correlation Coefficient, Rank Correlation; (iii) Linear Regression and properties (iv) Introduction to non-linear regression.	**6L**
3	**Calculus of Complex Variables:** (i) Function of complex variable; Limit, continuity and differentiability; (ii) Analytic function; Cauchy-Riemann equations (Statement only); Sufficient conditions for a function to be analytic; Harmonic function	**10L**

	and Conjugate Harmonic function; Milne-Thomson Method; (iii) Zeros and singularities (iv) Cauchy's Theorem (statement only), Cauchy-Goursat Theorem (statement only); Cauchy's Integral Formula; (v) Taylor's and Laurent's series; (vi) Residues of a given function; Cauchy's Residue Theorem (statement only); evaluation of definite integrals involving sine and cosine.	
4	**Series Solution of Ordinary Differential Equations:** (i) Introduction to Series solution; Ordinary and Singular points; (ii) Bessel's equation; Bessel's function; Recurrence relations of Bessel's function of first kind; (iii) Legendre's equation; Legendre's Polynomials; Generating function and Orthogonal Properties; Recurrence relations; Rodrigue's Formula (statement only).	**6L**
5	**Solution of Partial Differential Equations:** (i) Brief introduction to PDEs; Types of PDEs; Solutions of PDE by Lagrange's Method; (ii) Solution of Boundary Value Problems by Method of Separation of Variables; (a) Two dimensional Laplace equation; (b) One dimensional heat conduction equation; (c) One dimensional wave equation.	**6L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply the concepts of probability distributions to model random variables and solve engineering and scientific problems involving uncertainty.
2	Analyze data using basic statistical measures and regression analysis to interpret relationships between variables and support data-driven decision making.
3	Apply techniques of complex differentiation and integration to solve problems involving analytic functions and engineering applications.
4	Analyze and solve problems involving Bessel and Legendre functions, and apply these special functions in boundary-value and physical system problems.
5	Solve partial differential equations associated with heat, wave, and Laplace equations using appropriate analytical methods for engineering applications.

Learning Resources:	
1	"Advanced Engineering Mathematics" by Erwin Kreyszig, John Wiley & Sons.
2	"Advanced Engineering Mathematics" by Michael Greenberg, Pearson
3	"Higher Engineering Mathematics" by B.S. Grewal, Khanna Publishers
4	"Statistical Methods (Combined Volume)" by N.G. Das, Tata-McGraw Hill
5	"A First Course in Probability" by S. Ross, Pearson Education India

6	"An Introduction to Probability Theory and its Applications, Vol. 1" by W. Feller, Wiley
7	"A text book of Engineering Mathematics" by N.P. Bali and Manish Goyal, Laxmi Publications
8	"Advanced differential equation" by M. D. Raisinghania, S. Chand Publication.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor Name**	**Host Institute**
1	Introduction to Probability Theory and Statistics	Prof. S Dharmaraja	IIT Delhi
	Course Link: https://onlinecourses.nptel.ac.in/noc23_ma77/preview		
2	Probability and Statistics	Prof. Somesh Kumar	IIT Kharagpur
	Course Link: https://onlinecourses.nptel.ac.in/noc21_ma74/preview		
3	First Course on Partial Differential Equations – I	Prof. P.S. Datti, Prof. A. K. Nandakumaran	IISc Bangalore
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ma11/preview		

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Audit Courses
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	NIL
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 05

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	**2L**
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste.	**7L**
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	**7L**
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth. Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	**8L**
Total		**24L**

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

1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	"Fundamentals of Environment and Ecology" by D. De & D. De, S Chand Publication
2	"Text Book of Environmental Studies" by E. Bharucha, Byju's
3	"Environmental Studies" by S. C. Sharma and M. P. Poonia, Khanna Book Publishing
4	"Environmental Studies" by M. Basu, Cambridge University Press
5	"Fundamentals of renewable energy processes" by A. Vieira & D. Rosa, Academic Press Inc
6	"Principles Solar Engineering" by F. Kreith and J. F. Kreider, CRC Press.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor Name**	**Host Institute**
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science – Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

Course Name:	**Basic Manufacturing Processes Laboratory**		
Course Code:	PC-ME391	**Category:**	Professional Core
Semester:	Third	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To have real time experience of different conventional manufacturing processes.
2	To gain knowledge about manufacturing processes.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1	Pattern Making, Moulding and Casting.	**6P**
2	Smithy Shop: Forge Welding	**3P**
3	Welding Shop: Gas Welding, Spot Welding, MMAW and GMAW	**9P**
4	Fitting Shop	**3P**
5	Sheet Metal Shop	**3P**
6	Machine Shop: Lathe (Eccentric turning, Taper Turning), Straight & Angular Drilling, Boring, Shaping (Straight & Dovetail) and Milling operations (Gear Cutting).	**12P**
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the idea for selecting materials for patterns. Types and allowances of patternsused in casting and analyze the components of mould.
2	Understand the application of arc and gas welding in industries.
3	Know how casting, drilling, shaping, milling are done and demonstrate primary workingskills on lathe.
4	To know and implement different safety precautions to be taken during manufacturingprocesses.

Learning Resources:	
1	Laboratory Manual.

Detailed Curriculum for Undergraduate Degree
B.Tech in Electronics and Communications Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Electronic Devices**		
Course Code:	PC-EC301	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of semiconductor physics.
2	To impart knowledge of p n junction and different diodes.
3	To impart knowledge of BJT and MOSFET.
4	To impart knowledge about characteristics of diodes and transistors
5	To develop an insight into the construction and working of opto electronic devices

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	**Energy Bands & Current Carriers in Semiconductors:** Introduction- Energy Band Theory. Elemental and Compound Semiconductors, Direct and Indirect bandgap semiconductors, Fermi-Level, Intrinsic and Extrinsic Semiconductors, Effective mass, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of charge carriers, Generation and recombination of carriers; continuity equation. Quasi Fermi Energy level, Degenerate and Non-Degenerate semiconductors, Hall effect	10L
2.	**P-N junction:** P-N junction physics, I-V characteristics, junction capacitance, Avalanche breakdown, Zener diode, Zener breakdown, ohmic contacts, Schottky diode, Tunnel Diode, Gunn diode, IMPATT Diode, Varactor diode. Basic device technologies for fabrication of a p-n	10L

3.	junction, **Bipolar Junction Transistor**: Basic Construction, I-V characteristics, Ebers-Moll Model. **FET**: JFET-Basic construction, principle of operation, Drain and Transfer characteristics. MOSFET- Basic construction, Depletion and Enhancement type, I-V characteristics, FET parameters, MOS capacitor, C-V characteristics, flat band voltage and threshold voltage and small signal models of MOS transistor	8L
4.	**Opto–Electronics**: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction) Integrated circuit: fabrication process.	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe semiconductor physics, semiconductor types and carrier transport phenomena
2	Describe working principle of various diodes, BJT, MOSFET, solar cell and opto electronic devices
3	Characterize diodes, BJT and MOSFETs
4	Calculate various device related parameters.

Learning Resources:	
1	Neamen- Semiconductor Physics and Devices TMH
2	Streetman Banerjee-Solid State Devices-PHI
3	Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
4	Milman & Halkias - Electronics Devices and Circuits- TMH
5	Bhattacharya & Sharma- Solid State Electronic Devices- Oxford

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Semiconductor Devices	Dr. G.S. Visweswaran	IIT Delhi

	Course Link: https://nptel.ac.in/courses/117102061

Course Name:	**Analog Electronic Circuits**		
Course Code:	PC-EC302	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics ES-EE 101
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concept of diode circuits and transistor biasing.
2	To impart knowledge about low frequency and high frequency transistor models, using such models for estimation of transistor performance parameters.
3	To understand the different feedback topologies and amplifier classes.
4	To understand the basic principle of operation of various oscillators.
5	To develop an insight into the construction and working of OPAMPS and its applications.
6	To explain design aspects of simple circuits.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Diode Circuits and BJT Amplifier**: Rectifiers & Filters, Clipper, Clamper. Biasing schemes for BJT amplifiers, bias stability, small signal analysis (h-parameter analysis of CE and CC configurations), low frequency transistor models, estimation of voltage gain and current gain, input impedance, output impedance, design procedure of CE amplifier for particular specifications, Darlington Pair. High frequency transistor models, frequency response of single stage amplifiers, CE Short Circuit current gain, Concept of Gain &	10L

	bandwidth product. Multi Stage Amplifier - RC Coupled, Transformer Coupled and direct coupled, Frequency response - effect of coupling and bypass capacitor. Current source biasing (Current mirror circuits: Widler current source, Wilson current source etc.).	
2	**MOSFET Amplifier:** Biasing scheme of MOSFET Amplifiers, CS/CD configurations and their analysis	4L
3	**Amplifier Models and Feedback Topologies:** Voltage series, current series, voltage shunt, current shunt, effect of feedback on gain, bandwidth, I/P & O/P impedance, Amplifier models: Voltage amplifier, current amplifier, trans-conductance amplifier and trans resistance amplifier.	6L
4	**OPAMP**: Basic structure and characteristics, Differential amplifier: Basic structure and principle of operation, frequency response of OPAMP, Application of Current Mirror biasing in OPAMP, Output Stage, Single pole model. Open-loop configurations. OP-AMP applications: Inverting and non-inverting amplifiers, Integrator and differentiator, summing amplifier, Log-Antilog amplifiers, Comparator, Schmitt trigger and its applications. Active filters: Low pass, high pass, band pass and band stop. Instrumentation amplifier, precision rectifier.	10L
5	**Oscillators & Power Amplifiers**: Review of the basic concept, Barkhausen criterion, RC oscillators (phase shift, Wien bridge etc.), LC oscillators (Hartley, Colpitt, Clapp etc.), Multivibrators (Monostable, Astable and Bistable), Study on 555 timer ICs. Various classes of operation (Class A, B, AB, C etc.), Harmonic distortion, Power Output, Push-Pull Amplifier, Complementary Symmetry circuits.	10L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the operation of simple circuits with transistor, op-amp, amplifiers, oscillators.
2	Design of simple circuits with op-amp, amplifiers and oscillators.

3	Solve simple design based problems related to circuits using diodes, transistors and OPAMPS.
4	Analyze simple circuits with transistor and op-amps.

Learning Resources:	
1	Boylestade & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
2	Millman & Halkias - Electronics Devices and Circuits- TMH
3	Sedra & Smith-Microelectronic Circuits- Oxford UP
4	Malvino—Electronic Principles , 6/e , McGraw Hill
5	Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e, McGraw Hill
6	Schilling & Belove—Electronic Circuit:Discrete & Integrated , 3/e , McGraw Hi

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Analog Electronic Circuits	Prof. Shanthi Pavan	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106188		
2	Analog Electronic Circuits	Prof. Shouribrata Chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		
3	**Analog Circuits**	Prof. Jayanta Mukherjee	IIT Bombay
	Course Link: https://nptel.ac.in/courses/108101094		
4	**Analog Electronic Circuits**	Prof. Pradip Mandal	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105158		
5	**Analog Circuits**	Prof. Nagendra Krishnapura	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106084		

Course Name:	**Signals and Systems**		
Course Code:	PC-EC303	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Engineering Mathematics, Fundamentals of Electrical Circuits
Full Marks:	100		
Examination Scheme:	Semester Examination:70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop a clear understanding of fundamental concepts and mathematical modeling of signals and systems.
2	To apply mathematical transformation techniques such as Fourier and Laplace transforms to solve Electronics Engineering problems.
3	To utilize modern computational and simulation tools for effective analysis and visualization of signals and systems.
4	To analyze the behavior of continuous-time and discrete-time systems in time and frequency domains for practical engineering applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to signal:** Standard Continuous Time Signals, Classification of Continuous Time Signals (Periodic and Nonperiodic Signals, Symmetric and Antisymmetric Signals, Energy and Power Signals, Causal, Noncausal and Anti-causal Signals), Mathematical Operations on Continuous Time Signals (Scaling, Folding, Time Shifting, Addition, Multiplication, Differentiation and Integration), Properties of Impulse Signal.	6L
2	**Introduction to System:** Overview of System, Classification of Continuous Time Systems (Static and Dynamic, Time Invariant and Time Variant, Linear and Non-linear, Causal and Noncausal, Stable and Unstable), LTI System, Linear and Circular Convolution, Properties of Convolution, Unit Step Response using Convolution, Inverse System, Interconnections of Continuous Time Systems.	6L
3	**Laplace Transform:** Introduction to Laplace Transform, Region of Convergence (ROC), Properties of Laplace Transform, Initial and Final value Theorem, Convolution Theorem using Laplace Transform, Representation of Poles and Zeros in 'S' Plane, Inverse Laplace Transform by Partial Fraction Expansion Method, Inverse Laplace Transform using Convolution Theorem, Convolution and De-convolution using Laplace Transform and Inverse Laplace Transform.	6L
4	**Fourier Series:** Introduction to Fourier Series, Conditions for Existence of Fourier Series, Properties of Fourier Series, Gibbs Phenomenon, Trigonometric Form of Fourier Series, Exponential Form of Fourier Series.	6L
5	**Fourier Transform:** Introduction to Fourier Transform, Properties of Fourier Transform, Relation Between Fourier and Laplace Transform, Discrete time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Overview of FFT algorithm, Parseval's Theorem, Analysis of LTI Continuous Time System Using Fourier Transform.	6L

6	**Sampling Theorem:** Representation of Continuous Time Signals by its Samples, Sampling theorem (Nyquist Sampling Criterion), Concept of Sampling in Time Domain, Aliasing Effect, Frequency Domain Analysis of Sampled Signals.	4L
7	**Z-Transforms**: Introduction to Z- Transformation, Properties of Z-transform, Relationship between Z- transform and Fourier Transform, Region of Convergence (ROC), Representation of Poles and Zeros in z-plane, Inverse Z-Transform, Analysis of LTI Discrete Time System Using Z-Transform, Convolution and Deconvolution Using Z-Transform, Structure realization of LTI discrete Time Systems in Z-Domain.	6L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Classify and analyze various types of continuous-time and discrete-time signals.
2	Model and represent systems in time and frequency domains using appropriate mathematical transforms.
3	Evaluate system properties such as stability, causality, and linearity for engineering applications.
4	Apply sampling principles and signal reconstruction techniques for accurate signal processing.

Learning Resources:	
1	A.Nagoor Kani- Signals and Systems- McGraw Hill
2	P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech
3	A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals & Systems, Pearson
4	S.Haykin & B.V.Veen, Signals and Systems- John Wiley
5	V. Krishnaveni and A. Rajeswari -Signals and Systems, Wiley

Course Name:	**Network Theory**		
Course Code:	PC-EC304	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Engineering Mathematics, Basic Electrical and Electronics Engineering.
Full Marks:	100		
Examination Scheme:	Semester Examination:70	Continuous Assessment: 25	Attendance: 05

Course Objectives:

1	To develop a strong foundation in the analysis of DC and AC electrical networks using fundamental laws and principles.
2	To apply various network theorems and systematic methods for solving complex electrical circuits.
3	To understand and transform two-port network parameters for modeling interconnected systems.
4	To analyze transient and steady-state responses of RC, RL, and RLC circuits.
5	To design and synthesize passive filter networks and driving-point functions for practical applications.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Basic Circuit Analysis and Network Topology:** Basic circuit Elements, Independent and Dependent Voltage & Current Sources, Series, Parallel, Star and Delta Connections, Mesh and Node analysis, Ohm's Law, KCL and KVL analysis, Super node Analysis.	6L
2	**Network Theorems for DC and AC Circuits:** Network reduction Techniques, Voltage and Current Division Rules, Thevenin's, Norton's, Superposition, Millman's, Maximum Power Transfer Theorem, Reciprocity and Tallegen's Theorem.	6L
3	**AC Circuits, Resonance and Coupled Circuits:** Voltage-Current Relation of R, L and C in Various Domains, Resonance Frequency of Series RLC Circuit, Q-Factor (Quality Factor), Bandwidth and Selectivity of Series RLC Circuit, Resonant Frequency of Parallel RLC Circuits, Coupled Circuits (Self-Inductance and Mutual Inductance).	8L
4	**Transient Analysis:** Introduction to Transient Response (Natural and Forced Response), Transient Analysis Using Laplace Transform, Transient Response of RL Circuit, Transient Response of RC Circuit, Transient Response of RLC Circuit (Initial and Final Conditions in RLC Circuit), Complete Response of Circuits Excited by Sinusoidal Source.	8L
5	**Two-Port Networks:** Introduction to Two Port Network, Parameters of a Two-Port Network, Impedance Parameters (or Z-Parameters), Admittance Parameters (or Y-Parameters), Transmission Parameters (or ABCD-Parameters), Hybrid Parameters (or h-Parameters), Properties of Two-Port Networks, Inter-Connection of Two-Port Networks, T and π Networks.	8L
6	**Graph Theory:** Basic Network Terminology of graph theory (Trees, Link, Twig and Cotree), Network Analysis using Incidence Matrix, Node Analysis Using Cut-Set Matrix, Mesh Analysis Using Tie-Set Matrix, Duality of Network.	4L
Total		**40L**

Course Outcomes:

After completion of the course, students will be able to:	
1	**Apply fundamental circuit laws and analytical techniques** such as mesh, nodal, and topology-based methods to analyze DC and AC electrical networks.
2	**Utilize network theorems and reduction techniques** to simplify and solve complex electrical circuits efficiently.
3	**Analyze steady-state and transient behaviour of RLC circuits**, including resonance characteristics using Laplace transform methods.
4	**Model and evaluate two-port networks and graph-theoretic representations** for systematic analysis of interconnected electrical systems.

Learning Resources:	
1	M. E. Van Valkenburg, *Network Analysis*, Prentice Hall of India (PHI).
2	J. A. Edminister, *Theory and Problems of Electric Circuits*, McGraw-Hill Company.
3	Sudhakar: —Circuits & Networks: Analysis & Synthesis 2/e TMH
4	Ravish R. Singh - Circuit Theory and Networks Analysis and Synthesis-McGraw-Hill
5	A. Nagoor Kani - Circuit Analysis-McGraw-Hill Education

Course Name:	**Data Structure and Algorithm**		
Course Code:	PC-EC305	**Category:**	Professional Core
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of data structures and algorithms.
2	To understand the concepts of searching and sorting techniques.
3	To understand basic concepts of stack, queue, list, tree and graph.
4	To develop capability of writing algorithm to solve a given problem with the help of fundamental data structures.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: Basic Terminologies, Elementary Data Organizations Data Structure Operations: insertion, deletion, traversal etc. and	6L

	application of these on arrays. Analysis of an Algorithm, Asymptotic Notations, Time-Space trade off. Searching: Linear Search and Binary Search Techniques and their complexity analysis.	
2	Stack and its operations: Algorithms and their complexity analysis. Applications of Stacks: Evaluation of arithmetic expressions. Queue, Types of Queue: Simple Queue, Circular Queue, Priority Queue; Operations on each type of Queues: Algorithms and their complexity analysis.	8L
3	Linked List: Singly, Doubly and Circular linked lists: Representation in memory, Algorithms of several operations: Traversing, Searching, Insertion into, Deletion from linked list. Linked representation of Stack and Queue.	8L
4	Trees: Basic Tree Terminologies, Different types of Trees: Binary Tree, Threaded Binary Tree, Header nodes. Binary Search Tree, AVL Tree, Operations on each of the Trees, Application of Binary Trees, B Tree, B+ Tree: definitions, algorithms and analysis.	12L
5	Sorting: Objective and properties of different sorting algorithms and their complexity analysis: Bubble sort, Selection Sort, Insertion Sort, Quick Sort, Merge Sort, Heap Sort.	6L
6	Graph: Basic Terminologies and Representations, Graph search and traversal algorithms and complexity analysis, Shortest path algorithms. Hashing: Objective, Different methods of hashing, Collision: Different collision resolution methods, Application of hashing.	8L
Total		**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze an algorithm to determine its computational complexity.
2	Understand the concept of data storing and retrieval using array and linked list and compare their relative advantages and disadvantages.
3	Apply appropriate technique to solve a given sorting or searching problem.
4	Understand the concept of stack and queue and apply it to solve complex engineering problems.
5	Understand the concept of tree and apply it to solve engineering problems.

6	Understand the concept of graph and apply it to solve real life problems.

Learning Resources:	
1	Data Structure Using C, Reema Thereja, Oxford University Press, 2nd Edition, 2014
2	Data Structure using C++, A. Tanenbaum, Pearson, 2nd Edition, 2015
3	Data Structure through C, Seymour Lipschutz, Schaum's Outline Series, McGraw Hill, 2017
4	Data Structure and Program Design in C, R. L. Kruse, B. P. Leung, C. L. Tondo, Prentice Hall of India, 1st Edition, 1990
5	Data Structure through C language, Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, BPB Publications, 2010
6	Data Structures & Algorithms using C, R.S. Salaria, Khanna Publishing House, New Delhi, 5th Edition, 2018

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Structures And Algorithms	Prof. Naveen Garg	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102064		
2	Data Structures and Algorithms Design	Prof. Nitin Saxena	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/106104697		

Course Name:	**Numerical Techniques**		
Course Code:	ES-EC301	**Category**	Engineering Science Course
Semester:	3rd	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Some concepts from basic math algebra, geometry, pre-calculus
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To understand sources of numerical errors and analyze their effect on computational accuracy.
2	To apply numerical techniques to solve systems of linear and non-linear equations.

3	To develop the ability to apply finite difference calculus, interpolation techniques, and curve fitting methods for numerical approximation of discrete data.
4	To enable the application of numerical integration techniques and numerical methods for solving ordinary differential equations in engineering applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Approximation in Numerical Computation:** Truncation and rounding errors, Fixed and floating-point arithmetic, Propagation of errors.	3L
2	**Numerical Solution of a System of Linear Equations:** Gauss Elimination Method, Gauss-Seidel Iterative Method, LU Factorization Method.	4L
3	**Numerical Solution of Non-Linear Equation:** Bisection Method, Regula-Falsi Method, Newton-Raphson Method	3L
4	**Finite Differences and Interpolation Techniques:** Introduction to finite difference calculus, forward, backward and central differences, Divided differences, Newton's Forward and Backward interpolation, Lagrange's interpolation, Newton's divided difference interpolation.	5L
5	**Curve Fitting by Method of Least Square:** Fitting a straight line of the form $y = a + bx$, Fitting a curve of the form $y = ax + bx^2$, $y = ab^x$, $y = ae^{bx}$, $y = ax^b$.	2L
6	**Numerical Integrations:** General quadrature formula, Trapezoidal rule, Simpson's 1/3 rule.	3L
7	Numerical Solution of Ordinary Differential Equations: Euler's method, Runge-Kutta method of order four, Predictor-Corrector methods, Finite difference method	4L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze truncation and rounding errors and assess numerical accuracy in computational problems.
2	Apply numerical methods to solve non-linear equations and system of linear equations.
3	Apply finite difference calculus, interpolation techniques, and curve fitting methods to obtain numerical approximations from discrete data.
4	Solve definite integrals and ordinary differential equations using numerical methods with error estimation.

Learning Resources:	
1	"C Language and Numerical Methods" by C. Xavier, New Age International Publishers.
2	"Numerical Methods-A Programming Based Approach" by A. K. Jalan and Utpal Sarkar, Orient Blackswan Private Ltd.
3	"Numerical Methods (Problems and Solution)" by Jain, Iyengar, & Jain, New Age International Publishers.
4	"Numerical Methods" by Balagurusamy, Scitech.
5	"Numerical Methods" by Baburam, Pearson Education.
6	"Computer Programming & Numerical Analysis" by N. Dutta, Universities Press.
7	"Numerical Methods" by Soumen Guha & Rajesh Srivastava, Oxford University Press.
8	"Numerical Methods" by Srimanta Pal, Oxford University Press.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Numerical Analysis	Prof. S. Baskar	IIT Bombay
2	Numerical Methods for Engineers	Prof. Niket Kaisare	IIT Madras
3	Numerical Methods	Prof. Ameeya Kumar Nayak & Prof. Sanjeev Kumar	IIT Roorkee

Course Name:	**Environmental Science**		
Course Code:	AU-BS371	**Category:**	Basic Science Courses
Semester:	Third	**Credit:**	0
L-T-P:	2-0-0	**Pre-Requisites:**	Class XII Physical & Bio Science
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	2L
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste	7L
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	7L
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	8L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.

4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	"Fundamentals of Environment and Ecology" by D. De & D. De, S Chand Publication
2	"Text Book of Environmental Studies" by E. Bharucha, Byju's
3	"Environmental Studies" by S. C. Sharma and M. P. Poonia, Khanna Book Publishing
4	"Environmental Studies" by M. Basu, Cambridge University Press
5	"Fundamentals of renewable energy processes" by A. Vieira & D. Rosa, Academic Press Inc
6	"Principles Solar Engineering" by F. Kreith and J. F. Kreider, CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

Course Name:	**Electronic Devices laboratory**		
Course Code:	PC-EC391	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electronics Engineering Lab
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 40	Attendance: 00

Course Objectives:	
1	To impart basic concept of constructing circuits on breadboard with diodes, BJT, LDR and SCR.
2	To impart knowledge about CE amplifier design.
3	To impart knowledge as how to perform the experiments in sequential steps for

	characterizing the devices.
4	To impart knowledge as how to determine various device parameters and amplifier bandwidths.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	Study of line and load regulation of a Zener Diode.	2
2.	Study characteristics of LED & LDR.	2
3.	Common Emitter Bipolar Junction Transistor Characteristics: To plot the Input and Output characteristics of a transistor connected in Common Emitter Configuration and to find the h–parameters from the characteristics.	4
4.	MOSFET Drain & Transfer characteristics (common source): To plot Drain and Transfer characteristics. To find r_d, g_m, and μ from the characteristics.	4
5.	Study characteristics of Photo transistor.	2
6.	CE Amplifier Design, study of frequency response and determination of bandwidth.	4
7.	Study of frequency response of a JFET common source amplifier and determination of bandwidth.	2
8.	Resistive triggering of SCR.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Construct electronic circits on bread board.
2	Characterize BJT, MOSFET, LED. LDR
3	Experimentally determine device parameters
4	Design amplifier circuits, implement them practically & determine bandwidth from graph.

Learning Resources:	
1	Boylestade & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
2	Millman & Halkias - Electronics Devices and Circuits- TMH
3	Sedra & Smith-Microelectronic Circuits- Oxford UP

4	Malvino—Electronic Principles , 6/e , McGraw Hill
5	Laboratory Manual

Course Name:	**Analog Electronic Circuits Laboratory**		
Course Code:	PC-EC392	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical & Electronics lab ES-EE191
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart concept of constructing circuits on breadboard with diodes, BJT and OPAMPs
2	To impart knowledge about amplifier and oscillator design.
3	To impart practical knowledge on OPAMP characteristics and application.
4	To be able to perform the experiments in sequential steps for determining various circuit parameters.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Conduct experiment to test diode clipping (single/double ended) and clamping circuits (positive/negative).	2
2	Design and set up the following rectifiers with and without filters and to determine ripple factor and rectifier efficiency: (a) Center Tap Full wave Rectifier (b) Bridge Rectifier	4
3	Study of Zener Regulator	2
4	Design a two-stage R-C coupled amplifier & determine of it‘s gain & Bandwidth.	4
5	Study the working of a class A and class B amplifier and calculate the efficiency.	2
6	Study of OPAMP741and industrial OPAMP: characteristics-input bias current, input offset current, output offset voltage, offset null, CMRR, Slew Rate.	4
7	Study on OPAMP applications - summing amplifier, subtractor, active	6

	first order low pass and high pass filter.	
8	Design a Wien Bridge Oscillator and determine the frequency of oscillation.	2
Total		**26**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain application and demonstrate diode as a clipper, clamper and regulator.
2	Experimentally determine efficiency and ripple factor of rectifiers.
3	Design amplifier and oscillator circuits, implement them practically & determine parameters from graph or calculation.
4	Characterize practical OPAMP and apply it to operational and filter circuits

Learning Resources:	
1	Boylestade & Nashelsky- Electronic Devices and Circuit Theory- Pearson/PHI
2	Millman & Halkias - Electronics Devices and Circuits- TMH
3	Sedra & Smith-Microelectronic Circuits- Oxford UP
4	Malvino—Electronic Principles , 6/e , McGraw Hill
5	Franco—Design with Operational Amplifiers & Analog Integrated Circuits , 3/e, McGraw Hill
6	Schilling & Belove—Electronic Circuit: Discrete & Integrated , 3/e , McGraw Hill
7	Handbook of Analog Circuit Design Paperback .

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Analog Electronic Circuits	Prof. Shanthi Pavan	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106188		
2	Analog Electronic Circuits	Prof. Shouribrata Chatterjee	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102112		
3	**Analog Circuits**	Prof. Jayanta Mukherjee	IIT Bombay
	Course Link: https://nptel.ac.in/courses/108101094		
4	**Analog Electronic Circuits**	Prof. Pradip Mandal	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105158		

5	**Analog Circuits**	Prof. Nagendra Krishnapura	IIT Madras
	Course Link: https://nptel.ac.in/courses/108106084		

Course Name:	**Network Theory Laboratory**		
Course Code:	PC-EC394	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical & Electronics Engineering, Analog Circuit Fundamentals, Engineering Mathematics.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand and analyze basic DC and AC circuits using passive and active components through practical implementation.
2	To apply network theorems and two-port network parameters for systematic analysis and design of electrical networks.
3	To design, construct, and test circuits on breadboards and simulation platforms using modern simulation tools.
4	To measure and evaluate electrical quantities including voltage, current, power, and three-phase parameters for real-world applications.

Course Contents:

Module No.	Description of Topic/ Experiment	Contact Hrs.
1	Generation of Periodic, Exponential, Sinusoidal, Damped Sinusoidal, Step, Impulse, Ramp signal using Simulation Tool.	2
2	a) Verification of KCL & KVL for any network. b) Apply Mesh & Nodal Analysis techniques for solving electrical circuits.	2
3	Verification of Network theorems (Thevenin's, Norton and Superposition) using software/ hardware with AC & DC source.	2
4	Determination of Laplace transform and Inverse Laplace transform using Simulation Tool.	2
5	Determination of Impedance (Z) and Admittance (Y) parameter of two- port network: simulation/ hardware.	2
6	Transient response of R-L and R-C network: simulation with software/ hardware.	2
7	Transient response of R-L-C series and parallel circuit: simulation with software/hardware.	2
8	Design and Determine the Frequency response of LP and HP filters: simulation & hardware.	2

9	Design and Determine the Frequency response of BP and BR filters: simulation/ hardware.	2
Total		**18**

Course Outcomes:	
After completion of the course, students will be able to:	
1	**Generate and analyze different electrical signals** using Simulation Tool and laboratory instruments for circuit studies.
2	**Apply circuit analysis techniques and network theorems** (KCL, KVL, mesh, nodal, Thevenin, Norton, and superposition) to solve practical AC and DC networks.
3	**Determine system parameters and transient responses** of R, L, and C circuits using simulation tools and hardware implementation.
4.	**Design and evaluate frequency response of basic filters and two-port networks** through software simulation and experimental verification.

Learning Resources:	
1	Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers by Rudra Pratap (Author)
2	Getting Started with MATLAB 7 by Rudra Pratap
3	Spice Circuits Electronics Pspice Paperback – Import, 1 October 1989 by M.H. Rashid
4	Lab Manual

Course Name:	**Data Structure Laboratory**		
Course Code:	PC-EC395	**Category:**	Professional Core
Semester:	Third	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Programming for Problem Solving Lab
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To impart basic concepts of data structures and algorithms.
2	To understand the concepts of searching and sorting techniques.
3	To understand basic concepts of stack, queue, list, tree and graph.
4	To develop capability of writing algorithm to solve a given problem with the help of fundamental data structures.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Insert, delete and display an array and find the maximum and minimum elements of it.	2
2	Representing sparse matrix in 3-tupple format.	2
3	Linear search and binary search using array.	2
4	Sorting elements of an array using bubble sort, selection sort, insertion sort, quick sort and merge sort algorithms.	2
5	Insert, delete and display elements of a singly linked list.	2
6	Insert, delete and display elements of a doubly linked list.	2
7	Implementing stack (push, pop and display operations) using linked list.	2
8	Convert infix to postfix expression using stack.	2
9	Evaluate postfix expression using stack.	2
10	Implementing linear queue using linked list	2
11	Implementing circular queue using array.	2
12	Creating Binary Search Tree and traverse it in in-order, pre-order and post-order fashion.	2
13	Creating AVL Tree and traverse it in in-order, pre-order and post-order fashion.	2
14	Implementing Hash table incorporating collision resolution method.	2
Total		**28**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement menu driven application using array and matrix.
2	Implement different sorting and searching techniques using array.
3	Implement menu driven applications using linked list.
4	Apply the concept of stack and queue and apply it to solve engineering problems.
5	Create and traverse Binary Search Tree and AVL tree.
6	Generate Hash table using hash function incorporating collision resolution methods.

Learning Resources:	
1	Data Structure Using C, Reema Thereja, Oxford University Press, 2nd Edition, 2014

2	Data Structure using C++, A. Tanenbaum, Pearson, 2nd Edition, 2015
3	Data Structure through C, Seymour Lipschutz, Schaum's Outline Series, McGraw Hill, 2017
4	Data Structure and Program Design in C, R. L. Kruse, B. P. Leung, C. L. Tondo, Prentice Hall of India, 1st Edition, 1990
5	Data Structure through C language, Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, BPB Publications, 2010
6	Data Structures & Algorithms using C, R.S. Salaria, Khanna Publishing House, New Delhi, 5th Edition, 2018

Course Name:	**Numerical Techniques Laboratory**		
Course Code:	ES-EC391	**Category**	Engineering Science Course
Semester:	3rd	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Knowledge of C Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment:35	Attendance: 05

Course Objectives:	
1	To apply numerical algorithms through C programming to solve non-linear equations and system of linear equations.
2	To apply interpolation and curve fitting techniques using C programs to analyze discrete and experimental data.
3	To use numerical integration methods implemented in C to approximate definite integrals.
4	To solve ordinary differential equations using standard numerical methods through C programming and analyze the accuracy of the solutions.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Assignments on Numerical Solution of a System of Linear Equations:** Gauss Elimination Method, Gauss-Seidel Method.	4
2	**Assignments on Solution of Non-Linear Equations:** Bisection Method, Regula-Falsi Method, Newton-Raphson Method.	4
3	**Assignments on Interpolation:** Newton's Forward and Backward Interpolation, Lagrange's Interpolation.	6
4	**Curve Fitting by the Method of Least Squares:** Fitting a straight line of the form $y = a + bx$, Fitting a curve of the form $y = ae^{bx}$.	4
5	**Assignments on Numerical Integration:** Trapezoidal Rule, Simpson's 1/3 Rule.	2

6	**Assignments on Numerical Solutions of ODEs:** Euler's Method, Runge-Kutta Method of Order Four.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Build and execute C programs to solve non-linear equations and system of linear equations using numerical methods.
2	Construct and apply C programs for interpolation and least squares curve fitting to estimate functional values from given data.
3	Apply numerical integration techniques using C programs to evaluate approximate values of definite integrals.
4	Develop C programs for solving 1st order ordinary differential equations using numerical methods.

Learning Resources:	
1	"C Language and Numerical Methods" by C. Xavier, New Age International Publishers.
2	"Numerical Methods-A Programming Based Approach" by A. K. Jalan and Utpal Sarkar, Orient Blackswan Private Ltd.
3	"Numerical Methods (Problems and Solution)" by Jain, Iyengar, & Jain, New Age International Publishers.
4	"Numerical Methods" by Balagurusamy, Scitech.
5	"Numerical Methods" by Baburam, Pearson Education.
6	"Computer Programming & Numerical Analysis" by N. Dutta, Universities Press.
7	"Numerical Methods" by Soumen Guha & Rajesh Srivastava, Oxford University Press.
8	"Numerical Methods" by Srimanta Pal, Oxford University Press.

Detailed Curriculum for Minor Degree under Department of Automobile Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

No Minor paper in 3rd Semester

Detailed Curriculum for Minor Degree under Department of Computer Science and Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

No Minor paper in 3rd Semester

Detailed Curriculum for Minor Degree under Department of Electrical Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

A. Minor Degree in Power Engineering

Course Name:	**Thermal Power Generation**		
Course Code:	MN-EE301A	**Category:**	Minor
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop an understanding of thermodynamic cycles used in thermal power plants, including Rankine, reheat, and regenerative cycles.
2	To provide detailed knowledge of steam generators, fuel-firing systems, boiler components, and emission control techniques.
3	Explain the working principles and performance characteristics of steam turbines and associated components.
4	To introduce students to overall thermal power plant layout, operation, efficiency improvement techniques, and environmental considerations.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	Analysis of Steam cycle - Rankine cycle, mean temperature of heat addition, effects of variation of steam condition on thermal efficiency, Reheat cycle, Regenerative cycle, Optimum degree of reheat and regeneration, supercritical pressure cycle.	**5L**
2.	**Steam Generator** -- Classification, Layout of power plant steam generators, Fuel firing methods, Pulverized coal firing system, Coal	**10L**

	burners and their arrangements, Oil firing in coal-fired steam generators, oil guns, Boiler furnace, Boiler pressure parts: economiser, evaporator, superheaters, reheaters, steam drum and drum internals, circulation, introduction to supercritical steam generators, steam temperature control, air preheater, introduction to emission control technologies: NOx, SOx and particulate emission control, steam generator performance.	
3.	**Steam turbine** - Ideal and Actual flow of compressible fluid through nozzle, critical pressure ratio, maximum rate of discharge, Nozzle efficiency & velocity coefficient of nozzles. Classification of steam turbine, Flow through simple impulse turbine blading, velocity diagram, blade efficiency, Gross stage efficiency, net stage efficiency, optimum velocity ratio. Degree of admission. Multistaging or compounding of impulse turbine, velocity compounding, pressure compounding, velocity and pressure compounding, Reheat factor, internal efficiency, state point locus etc. in relation to steam turbine. Flow through Reaction turbine, velocity diagram, Degree of reaction, blade height, stage efficiency, optimum velocity ratio, axial thrust in reaction turbine. Comparisons of impulse & reaction turbine, Losses in turbines, Principle of turbine governing. Condensers - Requirement and Types of condenser, Surface condenser construction and functioning, air-cooled condenser.	**10L**
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	Explain the thermodynamics cycles of the thermal power generation and their variations.
2.	Classify steam generators and illustrate the different components in them
3.	Classify steam turbines and analyze the flow and energy transfer in them
4.	Classify power plant condensers and analyze their operation and performance

Learning Resources:	
Recommended Text Books	
1.	Power Plant Engineering" by P.K. Nag, 3rd Edition, Tata McGraw Hill Publishing Company Limited, 2008.
2.	A Textbook of Power Plant Engineering, by R.K. Rajput Laxmi Publications, 2016.
Alternative Text Books	

3.	Power Plant Engineering" by Dr. P.C. Sharma, S.K. Kataria & Sons,2001
Reference Books	
4.	Power Plant Engineering, by Black & Veatch, Springer, 1996

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Power Plant System Engineering	Prof. Niranjan Sahoo	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc24_me57/preview		
2	Power Plant System Engineering	Prof. Niranjan Sahoo	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc24_me57/preview		

B. Minor Degree in High Voltage Engineering

Course Name:	**Fundamental of High Voltage Engineering**		
Course Code:	MN-EE301B	**Category:**	Minor
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce the fundamental concepts of high voltage generation techniques for AC, DC, impulse, and switching surges used in laboratory and power system applications.
2	To develop an understanding of various measurement and testing methods for high voltages and currents, including modern digital techniques.
3	To study the behavior of different insulating materials (solid, liquid, and gaseous) and analyze breakdown mechanisms under high electric stress.
4	To provide knowledge of high voltage cable construction, insulation requirements, fault analysis, and testing methods in power systems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	**Generation of High Voltages:** Requirements of HV generation in laboratory, Generation of High voltages, AC voltages: Testing transformers-Series resonance circuits; DC voltages: symmetric and asymmetric voltage doubler circuits-electrostatic machines. Generation of Impulse voltages and currents: single stage and multistage circuits-wave shaping- modelling of impulse generator circuit-triggering and control of impulse generators. Generation of switching surge voltage and currents. Simulation of AC, DC and Impulse Voltage/Current generation circuits.	**09**
2.	**Measurement and Testing:** Measurement of high voltages: Sphere gaps, factors affecting sphere gap measurements, correction factors. Measurement of high AC voltage: Capacitance voltage dividers, Chubb-Fortescue method, CVT, electrostatic voltmeters. Measurement of high DC voltage: Resistive voltage dividers, Generating voltmeter. Measurement of impulse voltage: Capacitance divider, Impedance matching. Measurement of transient currents: Resistive shunt, Magnetic coupling, Hall Effect current transducers Integrating and differentiating type Rogowski coils. Digital techniques in HV measurements, DSO.	**10**
3.	**Insulation materials and Breakdown:** Introduction to solid, liquid and gaseous insulators used in power equipment. Classifications of insulation based on temperature withstand limits, dielectric losses, ageing of insulation materials (paper–press board) and remaining life analysis. Applications of nanofilled materials for outdoor and indoor insulation. Introduction to solid, liquid and gaseous dielectrics. Breakdown in gas and gas mixtures-breakdown in uniform and non uniform fields- Paschen's law-Townsends criterion-streamer mechanism-corona discharge-breakdown in electro negative gases. Breakdown in liquid dielectrics-suspended particle mechanism. Breakdown in solid dielectrics - intrinsic, streamer and thermal breakdown.	**10**
4.	**High voltage cables** Classification of High Voltage Underground cables, insulation materials for cables, general construction of a single core UG cable, 3 core,3 1/2 core and 4 core cables. Essential properties required for insulating material of Underground cables. Methods of laying Underground cables. Faults in Underground cable. Testing of cables.	**06**
Total		

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe and analyze various generation and measurement techniques for high Voltages and Currents.
2	Understand the breakdown phenomenon in different insulating mediums.
3	Identify the over voltages in power systems and outline the principles of insulation coordination for various parts of power system.
4	Understand the construction and applications of high voltage cables.

Learning Resources:	
Recommended Text Books	
1	Kuffel and Zaengl , High Voltage Engineering Fundamentals, 2nd ed., Newness, 2002.
2	M. S. Naidu, V. Kamaraju, High Voltage Engineering, 3rd ed., McGraw-Hill,1995.
Alternative Text Books	
3	M. Khalifa, High Voltage Engineering: Theory and Practice, Dekker, 1990.
4	H. M. Ryan, High Voltage Engineering and Testing, IEE 2001.
5	Kuffel and Abdullah.M, High Voltage Engineering, Pergamon press,1978.
Reference Books	
6	Wadhwa C L, High Voltage Engineering, New Age International, New Delhi,1994
7	Relevant IS standards and IEC standards.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	High Voltage Engineering	Prof. Ravindra Arora	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/108104048		

Detailed Curriculum for Minor Degree under Department of Electronics and Communications Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

A. Minor Degree in IoT

Course Name:	**Introduction to Internet of Things**		
Course Code:	MN-EC301A	**Category:**	Minor
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Networking Programming for Problem Solving
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the terminology, technology and its applications
2	To understand the function of Sensors : Backbone of IoT
3	To understand the concept of M2M (Machine to Machine) with necessary protocols
4	To learn the Python Scripting Language used in many IoT devices and applications.
5	To understand a comprehensive study of the interlinked challenges of securing IoT ecosystems and protecting user privacy

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1.	Introduction to Internet of Things: Definition and characteristics of IoT, Physical design of IoT- Things in IoT, IoT Protocols, Logical Design of IoT- IoT communication models, Iot Communication APIs, IoT enabled technologies-Wireless sensor networks, Cloud computing, Big Data Analytics, Communication protocols, Embedded systems, IoT levels and deployment templates	10L

2.	Sensors: Working Principles: Different types; Selection of Sensors for Practical Applications Introduction of Different Types of Sensors such as Capacitive, Resistive, Pressure, Humidity etc.	6L
3.	IoT and M2M Introduction, M2M-Difference between IoT and M2M, SDN and NFV for IoT Software Defined Networking, Network Function Virtualization. Difference between SDN and NFV for IoT. Basics of IoT System Management with NETCONF.	6L
4.	Introduction to Python: Language features of Python, Data types, Data structures, Control of flow, functions, modules, packaging, data/time operations, classes.	8L
5.	Internet of Things Privacy: Security and Governance Introduction, Overview of Governance, Privacy and Security Issues, Security, Privacy and Trust in IoT-Data-Platforms for Smart Cities, First Steps Towards a Secure Platform, Smart Approach. Data Aggregation for the IoT in Smart Cities, Security.	6L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the definition and usage of the term —Internet of Things in different contexts
2	Explain function of Sensors and relation with IoT
3	Differentiate between the levels of the IoT stack and be familiar with the key technologies and protocols employed at each layer of the stack
4	Build and test a IoT system involving prototyping, programming and data analysis

Learning Resources:	
1	Internet of Things - A Hands-on Approach, Arshdeep Bahga and Vijay Madisetti, Universities Press, 2015.
2	IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things, David Hanes, Gonzalo Salgueiro, Patrick Grossetete, Robert Barton, Jerome Henry, Pearson Education, 2017.
3	Internet of Things, K.G. Srinivasa, G.M. Siddesh, R.R. Hanumantha, CENGAGE Leaning India, 2018
4	Getting Started with Raspberry Pi, Matt Richardson & Shawn Wallace, O'Reilly (SPD), 2016.
5	Nitesh Dhanjani, Abusing the Internet of Things, Shroff Publisher/O'Reilly Publisher.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Introduction To Internet of Things	Prof. Sudip Misra	IIT Kharagpur
	Course Link: https://onlinecourses.nptel.ac.in/noc22_cs53/preview		

B. Minor Degree in VLSI Design and Technology

Course Name:	**Electronic Materials and Devices**		
Course Code:	MN-EC301B	**Category:**	Minor
Semester:	Third	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic concepts of semiconductor physics and electronic materials
2	To impart knowledge of p n junction and different diodes.
3	To impart knowledge of BJT and MOSFET.
4	To impart knowledge about characteristics of diodes and transistors
5	To develop an insight into the construction and working of opto electronic devices

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	**Brief introduction to Electronic Materials:** Metals, Insulators/Dielectric materials, Semiconductors - Elemental and Compound Semiconductors, Direct and Indirect bandgap semiconductors, Fermi-Level, Intrinsic and Extrinsic	12L

	Semiconductors, Effective mass, Concept of Holes, Carrier Concentration. and Mobility, diffusion and drift of charge carriers, Degenerate and Non-Degenerate semiconductors, Hall effect, magnetic materials, optoelectronic materials, superconducting materials, organic electronic materials.	
2. 3.	**P-N junction:** P-N junction physics, I-V characteristics, junction capacitance, Avalanche breakdown, Zener diode, Zener breakdown, ohmic contacts, Schottky diode, Tunnel Diode, Gunn diode, IMPATT Diode. **Bipolar Junction Transistor**: Basic Construction, I-V characteristics. **FET**: JFET-Basic construction, principle of operation, Drain and Transfer characteristics. MOSFET- Basic construction, Depletion and Enhancement type, I-V characteristics, FET parameters, MOS capacitor, C-V characteristics, flat band voltage and threshold voltage.	8L 8L
4.	**Opto–Electronics**: Optical absorption in semiconductors, photovoltaic effects, solar cells (p-n junction), Photoconductors, Photodiode, PIN photodiode, Avalanche photodiode, Phototransistor, LED, Semiconductor Laser (p-n junction).	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Describe semiconductor physics, semiconductor types and basics of electronic materials.
2	Describe working principle of various diodes, BJT, MOSFET, solar cell and opto electronic devices
3	Characterize diodes, BJT and MOSFETs
4	Calculate various device related parameters.

Learning Resources:	
1	Neamen- Semiconductor Physics and Devices TMH
2	Streetman Banerjee-Solid State Devices-PHI
3	Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
4	Milman & Halkias - Electronics Devices and Circuits- TMH
5	Bhattacharya & Sharma- Solid State Electronic Devices- Oxford

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Semiconductor Devices	Dr. G.S. Visweswaran	IIT Delhi
	Course Link: https://nptel.ac.in/courses/117102061		

Detailed Curriculum for Minor Degree under Department of Information Technology (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

No Minor paper in 3rd Semester

MCKV INSTITUTE OF ENGINEERING

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Approved by AICTE & affiliated to Maulana Abul Kalam Azad University of Technology, West Bengal
243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India
Ph: +91 33 26549315/17 Fax: +91 33 26549318 Web: www.mckvie.edu.in/

Detailed Curriculum for Minor Degree under Department of Mechanical Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

No Minor paper in 3rd Semester

Annexure-IIIB

Detailed Curriculum for Undergraduate Degree
B.Tech in Automobile Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Leadership Skill and Management**		
Course Code:	HM-HU 401	**Category:**	Management Science
Semester:	4th	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concept of Management
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1.	To develop effective leadership skills such as communication, motivation, decision-making, and emotional intelligence for managing individuals and teams.
2.	To understand leadership theories and managerial practices and apply them to real-world organizational situations.
3.	To enhance team management and conflict resolution abilities, enabling leaders to build high-performing and cohesive teams.
4.	To foster ethical, strategic, and adaptable leadership, preparing learners to lead organizations responsibly in a dynamic and competitive environment.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1.	**Introduction to Leadership & Management:** Meaning, nature, and levels of leadership; Leadership vs Management; Importance of leadership in professional and personal contexts; Leadership traits, roles, and responsibilities; Leadership and Life Skills synergy (NEP 2020).	4L
2.	**Leadership Theories and Styles:** Great Man Theory; Trait Theory; Behavioral Theories (Ohio State, Michigan); Contingency Theories (Fiedler, Path-Goal); Leadership styles: Transformational, Transactional, Servant, Situational.	4L
3.	**Core Leadership Skills Development:** Effective Communication; Active Listening; Emotional Intelligence & Self-awareness; Decision-making and Problem-solving; Time Management and Priority Setting; Creativity and Critical Thinking.	6L
4.	**Team Leadership & People Management:** Team building fundamentals; Motivation: Theories and workplace application; Conflict resolution & negotiation skills; Coaching & mentoring approaches; Cultural sensitivity and diversity in teams.	4L
5.	**Ethical Leadership & Social Responsibility:** Ethical decision-making; Corporate Social Responsibility & sustainability in leadership; Personal values and ethical dilemmas; Building trust and accountability	3L
6.	**Practical Leadership Application & Case Studies:** Case studies of successful leaders; Leadership challenges in startups and corporate environments; Group activities: role-plays, simulations, reflection logs; Personal leadership action plan	3L
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	To develop leadership and teamwork skills required for managing technical teams, projects, and multidisciplinary work environments.

2.	To enhance communication, decision-making, and problem-solving abilities, enabling students to lead technical tasks and projects effectively.
3.	To build ethical, professional, and responsible leadership qualities, essential for engineers in organizational and societal contexts.
4.	To prepare students for managerial and leadership roles in the engineering profession, fostering adaptability, innovation, and lifelong learning in a rapidly changing technological landscape

Learning Resources:	
1	Richard L. Hughes, Robert C. Ginnett, and Gordon J. Curphy, *Leadership*, 9th Indian ed. New Delhi, India: McGraw-Hill.
2.	Gary Yukl, *Leadership in Organizations*. New Delhi, India: Pearson Education.
3.	L. M. Prasad, *Organisational Behaviour*. New Delhi, India: Sultan Chand & Sons.
4.	Paul Guggenheimer and Mary Diana Szulc, *Understanding Leadership Competencies*. New Delhi, India: Viva Books.

Course Name:	**Fluid Mechanics and Hydraulic Machines**		
Course Code:	ES-AUE401	**Category:**	Engineering Science Courses
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	No-prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn about the application of mass and momentum conservation laws for fluid flows.
2	To obtain the velocity and pressure variations in various types of simple flows
3	To understand the importance of dimensional analysis
4	To analyze the flow in water pumps and turbines

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Properties of Fluids:** Definition of fluid, fluid Mechanics, Hydraulics, statics, kinematics, real fluid, ideal fluid, Properties of fluids- mass density, specific weight, specific volume, specific gravity, viscosity, Newton's law of viscosity, Newtonian vs non-Newtonian Fluids. Rheological diagram for classification of fluids.	2L

2	**Fluid Static:** Pascal's law and Hydrostatic Law, pressure and pressure measurement, atmospheric pressure, gauge pressure, vacuum pressure, and absolute pressure. Use of a simple manometer, a differential manometer. Hydraulic forces on vertical, horizontal, inclined, and curved surfaces in static fluid.	6L
3	**Kinematics and Dynamics of Fluid Flow:** Fluid flow and classifications. Continuity equation in 1D and 3D. Potential flow and Stream function; types of flow lines. Motion of a fluid particle, Fluid deformation. Surface and body forces. Euler's and Bernoulli's equations for flow along a streamline. Application of Bernoulli's equation- Venturi meter, Orifice meter, Pitot tube. The Momentum Equation and Its Application to the Force on a Pipe Bend. Basic principle for flow through orifices, notches and weirs (rectangular-v).	6L
4	**Flow Through Pipes and Open Channel Flow:** Flow through pipes, Major and minor losses through pipes, Darcy-Weisbach equation, friction factor, Moody's diagram. Pipe in series and pipe in parallel. Hydraulic gradient line and total energy line. Flow through a syphon. Flow through open channels; use of Chezy's formula.	5L
5	**Dimensional and Model Analysis:** Dimensional Analysis & Model Investigation applied to flow systems, including methods of dimensional analysis. Types of similitude. Model analysis. Dimensionless numbers in fluid flow. Similarity laws.	4L
6	**Hydraulic Turbine:** Impact of Jet, Classification of water turbines, heads and efficiencies, velocity triangles, Axial, radial and mixed flow turbines, Pelton wheel, Francis turbine and Kaplan turbines, working principles. Draft tube. Specific speed, unit quantities, and performance curves for turbines.	7L
7	**Centrifugal Pumps and Reciprocating Pumps:** Components, working principle, head & efficiency of centrifugal Pump. Multistage Centrifugal pumps. Pump characteristics, NPSH, and Cavitation. Components and Principles, Classification, discharge, work done, and power requirement for the reciprocating pump	6L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	learn about the properties of fluids and analyze the forces in static fluid and forces acting on submerged surfaces.
2	learn about the application of mass and momentum conservation laws and Bernoulli's equation to fluid flow problems.
3	understand the importance of dimensional & model analysis.
4	analyze the flow in hydraulic turbines and pumps.

Learning Resources:	
1	R. K. Bansal, *A Textbook of Fluid Mechanics and Hydraulic Machines in SI Units*, 10th ed. New Delhi, India: Laxmi Publications, 2018.
2	R. K. Rajput, *A Textbook of Fluid Mechanics and Hydraulic Machines in SI Units*, 6th ed. New Delhi, India: S. Chand & Company, 2018.

3	D. S. Kumar, *Fluid Mechanics and Fluid Power Engineering (SI Units)*. New Delhi, India: S. K. Kataria & Sons, 2013.
4	S. Pati, *A Textbook on Fluid Mechanics and Machines*, 1st ed. New York, USA: McGraw-Hill, 2017.
5	S. K. Som, Gautam Biswas, and S. Chakraborty, *Introduction to Fluid Mechanics and Fluid Machines*, 3rd ed. New York, USA: McGraw-Hill, 2017.
6	C. S. P. Ojha, R. Berndtsson, and P. N. Chandramouli, *Fluid Mechanics and Machinery*. Oxford: Oxford University Press, 2010.
7	P. M. Modi and S. M. Seth, *Hydraulics and Fluid Mechanics*, 22nd ed. New Delhi, India: Standard Book House, 2019.
8	Yunus A. Çengel and John M. Cimbala, *Fluid Mechanics: Fundamentals and Applications*, 4th ed. New York, USA: McGraw-Hill, 2019.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Fluid Mechanics	Prof. Sanjay Mittal	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/101104808		
2	Introduction to Fluid Mechanics	Prof. Suman Chakraborty	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105269		

Course Name:	**Biology for Engineers**		
Course Code:	BS-BIO401	**Category:**	Basic Science Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Physics, Chemistry and Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the specific engineering application in biological domain.
2	Evaluate the human physiological system from the perspective of mechanical engineering
3	To analyze biological system from the engineering perspectives for a specific solution.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Biology:** Biology as an important scientific discipline, Role of Biology in Next Generation Technology Development, Biomimetic, Nature inspired designs, Photosynthesis: Photovoltaic cells & bionic leaf, Five kingdoms of classification.	2L
2	**Cell Biology & Biomolecules:** Cell-Basic unit of life; Gene as code of life (Concept of DNA, RNA and Gene expression), Bio-membrane, Transport across cell membranes; Cell potential, Bio Signals, Signal Transduction Biomolecules, Applications of biomolecules: bio-filters, bioplastics, vaccines, SCP, biodiesel, bio-detergents, biochips.	5L
3	**Human Organ Systems and Bio Designs:** Human organ system-basics; Brain as a CPU system, Signal transmission, EEG; Eye as a camera, bionic eye; Heart as a pump system, heart related issues & ECG, stents, pacemakers, defibrillators; Lungs as purification system, Heart-Lung machine, Ventilators: Kidney as a filtration system, Dialysis systems; Musculoskeletal System, Gait Analysis: Introduction to human movement analysis, gait cycle phases, and gait in health/disease. Kinematics: Linear and angular kinematics of movement (position, velocity, acceleration). Kinetics: Forces, moments, work, energy, and power in joints (Spine, Hip, Knee, Ankle). Bioengineering solution for musculoskeletal disorders, biomechanics in prosthetics and robotics.	6L
4	**Human body and Thermodynamics:** Human body as thermodynamics system, cellular respiration and metabolic heat production, thermoregulation and thermal comfort.	5L
5	**Bio-heat transfer:** Bio-heat models, Pennes Bioheat Equation, and applications	3L
6	**Bio-fluid engineering:** Biological fluids and basic principles, fluid dynamics of blood, joint lubrication and cardiovascular system.	3L

Total	**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Elucidate the basic biological concepts via relevant engineering applications and case studies.
2	Evaluate the principles of design and development, for exploring novel bioengineering projects
3	Corroborate the concepts of biological thermodynamics for specific requirements
4	Think critically towards exploring innovative engineering solutions for biomedical application socially relevant problems
5	Analyze bio-inspired systems and demonstrate their relevance to mechanical and computational engineering.

Learning Resources:	
1	A. T. Johnson, *Biology for Engineers*. CRC Press.
2	C. Kleinstreuer, *Biofluid Dynamics: Principles and Selected Applications*. CRC Press.
3	A. K. Vishwakarma and J. Karp, *Biology and Engineering of Stem Cell Niches*. Academic Press.
4	D. A. Vaccari, P. F. Storm, and J. E. Alleman, *Environmental Biology for Engineers and Scientists*. Wiley-Interscience.
5	S. Thyagarajan, N. Selvamurugan, M. P. Rajesh, R. A. Nazeer, R. W. Thilagaraj, and S. Barathi, *Biology for Engineers*. McGraw Hill
6	G. K. Suraishkumar, *Biology for Engineers*. Oxford University Press

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Biology for engineers and other non-biologists	Prof. G.K. Suraishkumar & Prof. Madhulika Dixit	IIT Madras

	Course Link: https://nptel.ac.in/courses/121106008		
2	Biological Engineering	Prof. Abhishek Suresh Dhoble	IIT (BHU) Varanasi
	Course Link: https://nptel.ac.in/courses/102106673		

Course Name:	**Vedic Mathematics (Indian Knowledge System-II)**		
Course Code:	BS-M401	**Category:**	Basic Science Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on Śulba Sūtra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata,	3L

	Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	
2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and subsutras, Vedic sutras for addition- Purna puranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	3L
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva–Tiryag bhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method, Vilokanam), and cubes (Yāvadunam).	5L
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya Samuccaya Gunita, Solution of quadratic equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat,	5L
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4 × 4 using Urdhva Tiryag Sutra, Inverse of matrices using Vedic approaches.	3L
6	**Vedic Geometry and Śulba Sūtra Concepts:** Geometrical ideas from Śulba Sūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	5L
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and

	determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and Śulba Sūtra texts.

Learning Resources:	
1	B. K. Tirthaji, *Vedic Mathematics*. Motilal Banarsidass Publishing.
2	R. K. Thakur, *Essentials of Vedic Mathematics*. Rupa Publications.
3	V. Singhal, *Vedic Mathematics for All Ages*. Motilal Banarsidass Publishing.
4	U. S. Patankar and S. M. Patankar, *Elements of Vedic Mathematics*. TTU Press.
5	D. Bathia, *Vedic Mathematics Made Easy*. Jaico Publishing House.
6	R. Bajaj, *Vedic Mathematics: The Problem Solver*. Black Rose Publications.
7	S. K. Kapoor, *Vedic Geometry Course*. Lotus Press.
8	S. N. Sen and A. K. Bag, Eds., *The Śulba Sūtras*. Indian National Science Academy.
9	T. A. Sarasvati Amma, *Geometry in Ancient and Medieval India*. Motilal Banarsidass Publishing.

Course Name:	**Strength of Materials**		
Course Code:	PC-AUE401	**Category:**	Professional Elective Courses
Semester:	Fourth	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Knowledge of Engineering Mechanics (ES-AUE301).
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know the behavior of the material at various loading conditions in compression and tension. Analysis and recognition of principle stresses.
2	Understand and analyze shear force and bending moment in various loading conditions.
3	To know the phenomenon of bending and deflection of different sections and their analysis.
4	To understand various column sections and geometric analysis.
5	Concepts of strain energy, thin cylinder, torsion, and numerical analysis

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Stress-Strain Relations and Elastic Constants (Deformation in solids)-** Hooke's law, stress and strain- tension, compression and shear stresses – elastic constants and their relations, volumetric, linear and shear strains - principal stresses and principal planes - Mohr's circle.	9L+3T
2	**Beams: Loading and Bending Analysis-** Beam types of transverse loading on beams- shear force and bend moment diagrams - Types of beams supports, simply supported and overhanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads	8L+2T
3	**Beam Deflection and Column Buckling -** Deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Buckling of columns, Euler's theory, critical loads for different types of constraints.	8L+2T
4	**Torsion in Shafts and Springs**- Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.	6L+2T
5	**Stresses in Pressure Vessels**- Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.	5L+3T
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain stress, strain, and establish a relationship between them, and apply concepts of stress and strain to solve numerical problems.
2	Compute shear force and bending moment for determinate beams and draw shear force and bending moment diagrams for various loading conditions.
3	Determine the various stresses and draw stress diagrams using the principles of bending and shear. Ability to solve numerical problems of deflection.
4	Explain the theory of column failure with different support conditions, and develop numerical ability to solve numerical problems.
5	Solve numerical problems by applying knowledge of strain energy, torsion, and thin cylinders and spherical shells.

Learning Resources:	
1	R. K. Rajput, *Strength of Materials*, 6th ed. New Delhi, India: S. Chand & Company, 2015.
2	D. S. Bedi, *Strength of Materials*, 6th ed. New Delhi, India: Khanna Publishing House, 2019.
3	U. C. Jindal, *Strength of Materials*, 2nd ed. New Delhi, India: Asian Books Pvt. Ltd., 2013.
4	R. Subramanian, *Strength of Materials*, 3rd ed. Oxford: Oxford University Press, 2016.
5	R. K. Bansal, *Strength of Materials*, 6th ed. New Delhi, India: Laxmi Publications, 2018.
6	Ferdinand P. Beer, E. Russell Johnston Jr., John T. DeWolf and David. F. Mazurek, *Mechanics of Materials*. New Delhi, India: Tata McGraw-Hill, 2005.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Strength Of Materials	Prof. K. Ramesh, Prof. Hariprasad	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106319		
2	Mechanics of Solids	Prof. Priyanka Ghosh	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/105104160		

Course Name:	**Automotive Chassis**		
Course Code:	PC-AUE402	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Engineering Mechanics, Strength of Materials
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the construction and functions of automotive chassis systems
2	To apply engineering mathematics in analyzing suspension, steering, and braking systems.
3	To analyze vehicle ride, handling, and stability using fundamental vehicle dynamics
4	To introduce advanced chassis technologies with analytical and numerical approaches

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Automotive Chassis:** Chassis layout and functions; types of frames- ladder, backbone, space frame, monocoque; loads acting on chassis;	6L

	chassis materials; manufacturing considerations. Load distribution calculations, bending moment basics, factor of safety.	
2	**Suspension System:** Objectives and requirements of suspension system; types of suspension - dependent, independent, semi-independent; springs - leaf, coil, torsion bar, air spring; shock absorbers; suspension geometry basics. Spring stiffness and deflection calculations, Natural frequency of suspension, Damping ratio and logarithmic decrement	7L
3	**Steering System:** Types of Front Axles and Stub Axles, Front Wheel Geometry, Castor, Camber, King Pin Inclination and Toe-in, Condition for True Rolling. Motion of Wheels during Steering, Ackerman's and Davis Steering Mechanisms, Steering Error Curve, Steering Linkages, Different Types of Steering gear boxes, Hydraulic, Electric power steering and electrohydraulic power steering, steering damper- basic steering system kinematics	7L
4	**Braking System:** Need for Brake systems, Stopping Distance, Time and Braking Efficiency, Effect of Weight Transfer during Braking, Classification of brakes, Braking Torque, Drum Brake and Disc Brake Theory, Types and Construction of Hydraulic Braking System, Mechanical Braking System, Pneumatic Braking System, Power-Assisted Braking System, Servo Brakes, Retarders - Antilock Braking Systems (ABS) and electronic brake distribution (EBD). Traction control and yaw control braking –Exhaust and Transmission braking systems	6L
5	**Wheels and Tyres:** Functions and types of wheels; tyre construction and terminology; tyre characteristics - rolling resistance, slip, cornering force; tyre wear; radial and bias-ply tyres. Slip ratio and slip angle, Rolling resistance calculations, Tyre force-velocity relationships.	5L
6	**Ride, Handling and Advanced Chassis Systems:** Ride comfort and road holding; vehicle stability during cornering and braking; introduction to vehicle dynamics; active and semi-active suspension systems; chassis safety systems and recent trends in chassis technology	5L
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain automotive chassis layout, frame construction, and load distribution using basic analytical methods
2	Apply mathematical models to analyze suspension and steering systems for ride and handling performance

3	Evaluate braking, wheel, and tyre performance using kinematic and dynamic relations
4	Analyze vehicle ride, handling, and stability using mathematical formulations and modern chassis concepts.

Learning Resources:	
1	N. K. Giri, *Automobile Mechanics*. New Delhi, India: Khanna Publishers.
2	Kirpal Singh, *Automobile Engineering - Volume I*. New Delhi, India: Standard Publishers Distributors Pvt. Ltd.
3	Heinz Heisler, *Advanced Vehicle Technology*. Oxford, UK: Butterworth-Heinemann.
4	J. Reimpell, H. Stoll, and J. Betzler, *The Automotive Chassis: Engineering Principles*. Oxford, UK: Butterworth-Heinemann.
5	Thomas D. Gillespie, *Fundamentals of Vehicle Dynamics*. USA: SAE International.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Fundamentals of Automotive Systems	Prof. C. S. Shankar Ram	IIT Madras
	Course Link: https://nptel.ac.in/courses/107106088		

Course Name:	**Mechanics of Machines**		
Course Code:	PC-AUE403	**Category:**	Professional Elective Courses
Semester:	Fourth	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Engineering Mechanics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart knowledge of the kinematics and dynamics of planar single-degree-of-freedom mechanisms
2	To develop skills for interpreting and analyzing linkages, cams, gears, flywheels, and governors.
3	To enable students to analyze the dynamic forces, balancing, and vibration of mechanical systems

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Mechanisms**: Terminology and definitions, degree of freedom, mobility. Grashoff's law. Mechanical advantage. Transmission angle. Description of common mechanisms, introduction to four bar spatial mechanisms. Kinematic inversions – Four bar chain, slider crank chain, applications of mechanisms.	5L+1T
2	**Kinematics:** Displacement, velocity and acceleration analysis of simple mechanisms, graphical method, velocity and acceleration polygons, instantaneous center method. Velocity and acceleration analysis using loop closure equations, kinematic analysis of simple mechanisms- slider crank mechanism, coincident points Coriolis component of acceleration.	6L+2T
3	**Cams:** Classification of cams and followers-Terminology and definitions Displacement diagrams- Uniform velocity, simple harmonic constant acceleration & deceleration, and cycloidal motions- derivatives of follower motions.	8L+2T
4	**Gears:** Spur gear terminology and definitions. Fundamental law of gearing and conjugate action, spur gear contact ratio and interference/ undercutting. Helical, bevel, worm, rack and pinion gears (basics only). Gear trains, epicyclic gear trains, differentials.	5L+1T
5	**Force Analysis of Mechanism, flywheel and governors:** Dynamic force analysis of slider crank mechanism. Piston and crank effort, inertia, torque, turning moment diagrams, fluctuation of energy, fly wheel. Governors: Use and classification; Study and analysis of Porter, Proell and Wilson Hartnell governors; Sensitiveness, stability, isochronism, hunting, effort and power of governors.	5L+2T
6	**Balancing:** Balancing of Reciprocating and Rotating Masses- Static balancing, Unbalance of force or moment, Dynamic balancing of rotating masses- graphical and analytical methods; Swaying couple; Hammer blow.	4L+2T
7	**Vibration:** Basic features of vibratory Systems-Elements, degrees of freedom, single degree of freedom system. Undamped free vibration, equation of motion, natural frequency. Damped free vibration, equation of motion, logarithmic decrement, critical speed of shaft.	3L+2T
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Distinguish between various mechanisms along with their inversions
2	Explain and compute displacement, velocity, and acceleration for various mechanisms and cam profiles for various followers.
3	Distinguish and analyze the working of various gears, gear trains, governors, flywheels and dynamic forces acting on mechanical systems.
4	Determine the balancing of masses for rotating and reciprocating machine elements
5	Interpret the various principles of vibrations of different systems

Learning Resources:	
1	S. S. Rattan, *Theory of Machines*, 4th Edition, Tata McGraw-Hill, New Delhi, 2014.

2	Robert L. Norton, *Kinematics and Dynamics of Machinery*, McGraw-Hill Education (India), 2010.
3	Thomas Bevan, *The Theory of Machines*, 3rd Edition, Pearson Education, 2009.
4	John J. Uicker Jr., Gordon R. Pennock & Joseph E. Shigley, *Theory of Machines and Mechanisms*, SI Edition, International Version, 2009.
5	R. K. Bansal & J. S. Brar, *A Textbook of Theory of Machines in SI Units*, 5th Edition, Laxmi Publications, 2016.
6	Sadhu Singh, *Theory of Machines: Kinematics and Dynamics*, 3rd Edition, Pearson Education, 2011.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Theory Of Mechanisms	Prof. Sujatha Srinivasan	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106270		
2	Kinematics of Mechanisms and Machines	Prof. Anirvan Dasgupta	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105268		
3	Kinematics of Machines	Prof. Ashok K Mallik	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/112104121		

Course Name:	**Automobile Engineering Laboratory-I (Automotive Components Laboratory)**		
Course Code:	PC–AUE 491	**Category:**	Professional Core courses
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	No prerequisite
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To train the students to know the details of different automobile components.
2	To dismantle, assemble, inspect, measures and testing of components.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Dismantling, measurement, inspection, and assembling of different modern engines [like Multipoint fuel injection (MPFI) and Common rail injection (CRI) engines and Digital twin spark ignition (DTSI), etc.] engines for passenger car, commercial vehicle, and two-wheeler engines.	3P
2	Study of fuel supply system (SI and CI) and structure and testing of common rail high-pressure injectors.	3P

3	Dismantling, assembling, and testing of different types of Fuel injection Pumps such as distributor type, high-pressure pump.	3P
4	Electronic ignition and battery ignition system with accessories. 3	3P
5	Study of cooling and lubrication.	3P
6	Study and testing of the automotive air conditioning system.	3P
7	Dismantling and assembling of different types of clutches.	3P
8	Dismantling and assembling of different types of Gear.	3P
9	Dismantling and assembling of different Steering system and study of the driver's seat.	3P
10	Study of Frames used for Heavy commercial vehicles (HCV), Car, two & Three Wheelers and dismantling and assembling of Suspension system.	3P
11	Dismantling and assembling of the braking system, Brake adjustment and brake bleeding.	3P
12	Dismantling and assembling of Wheels and Tyres. Dismantling and assembling of Propeller Shaft, Universal Joints, and Differential.	3P
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Dismantle, assemble, inspect, measure and testing the automobile engine components.
2	Gain experimental knowledge about various automotive chassis components.

Learning Resources:	
1	William H. Crouse and Donald L. Anglin, *Automotive Mechanics*, 10th ed. New York, USA: McGraw-Hill

Course Name:	**Fluid Mechanics and Heat Transfer Laboratory**		
Course Code:	PC-AUE492	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Engineering Thermodynamics, Fluid Mechanics and Hydraulic Machines, Heat Transfer
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the principles and performance characteristics of flow and thermal devices.
2	To know about the measurement of the fluid and thermal properties.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**

1	Determination of the coefficient of discharge of a given orifice meter	3P
2	Determination of the coefficient of discharge of a given Venturi meter	3P
3	Determination of the coefficient of friction factor for flow through pipes, considering the major loss only.	3P
4	Determination of the efficiency of the Centrifugal pump and drawing the characteristic curve.	3P
5	Determination of the velocity of air and drawing the velocity profile in a duct using a pitot tube.	3P
6	Determination of the efficiency of the Pelton Wheel.	3P
7	Determination of thermal conductivity of a metal rod.	3P
8	Determination of heat transfer coefficient in forced convection of air in a tube.	3P
9	Determination of heat transfer coefficient in natural convection of air flowing through a vertical surface.	3P
10	Measurement of emissivity in a test surface.	3P
11	Determination of the overall heat transfer coefficient in a parallel flow and counter flow heat exchanger.	3P
12	Determination of the temperature distribution over a pin fin and to determine the fin efficiency.	3P
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Measure various properties of fluids and characterize the performance of fluid machinery.
2	Measure various properties of thermal and characterize the performance of thermal machinery.

Learning Resources:	
1	R. K. Bansal, *A Textbook of Fluid Mechanics and Hydraulic Machines in SI Units*, 10th ed. New Delhi, India: Laxmi Publications, 2018.
2	R. K. Rajput, *Heat and Mass Transfer*. New Delhi, India: S. Chand & Company, 2010.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Fluid Mechanics	Prof. Sanjay Mittal	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/101104808		
2	Introduction to Fluid Mechanics	Prof. Suman Chakraborty	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105269		
3	Conduction And Convection Heat Transfer	Prof. Suman Chakraborty and Prof. Sankar Kumar Som	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/112105271		

4	Convective Heat Transfer	Prof. Arup Kumar Das	IIT Roorkee
	Course Link: https://nptel.ac.in/courses/112107211		
5	Heat Transfer	Prof. Ganesh Viswanathan	IIT Bombay
	Course Link: https://nptel.ac.in/courses/103101137		

Experiments that may be performed through Virtual Labs:		
Sl. No.	**Experiment Name**	**Experiment Link(s)**
1	Measurement of the coefficient of discharge of a given orifice meter	https://fm-iitk.vlabs.ac.in/exp/orifice/
2	Measurement of the coefficient of discharge of a given Venturi meter	https://fm-iitk.vlabs.ac.in/exp/venturi-meter/ https://fm-nitk.vlabs.ac.in/exp/venturimeter/
3	Determination of the coefficient of friction factor for flow through pipes.	https://fm-iitk.vlabs.ac.in/exp/friction-coefficients/ https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/
4	Determination of the performance characteristics of a centrifugal pump.	https://fmc-nitk.vlabs.ac.in/exp/centrifugal-pump/
5	Determination of the performance characteristics of the Pelton Wheel.	https://fm-iitk.vlabs.ac.in/exp/pelton-wheel/ https://fmc-nitk.vlabs.ac.in/exp/pelton-turbine/
6	Determination of the thermal conductivity of a metal rod	https://ht-nitk.vlabs.ac.in/exp/thermal-conductivity-metal-rod/
7	Heat transfer through forced convection.	https://ht-nitk.vlabs.ac.in/exp/forced-convection/
8	Heat transfer through natural convection from a vertical surface.	https://ht-nitk.vlabs.ac.in/exp/natural-convection/
9	Measurement of emissivity in a test surface.	https://ht-nitk.vlabs.ac.in/exp/emissivity-of-surface/
10	Experiment with a parallel flow and a counter flow heat exchanger.	https://ht-nitk.vlabs.ac.in/exp/heat-exchangers/

Course Name:	**Project-I (Mini Project)**		
Course Code:	PW-AUE481	**Category:**	Project Work, Seminar and Internship
Semester:	Fourth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	No prerequisite
Full Marks:	100		

Examination Scheme:	Semester Examination: 100
Course Objectives:	
1	To acquaint with the process of undertaking literature survey/industrial visit and identifying the problem.
2	To familiarize the process of solving the problem in a group.
3	To acquaint with the process of applying basic engineering fundamental in the domain of practical application.
4	To inculcate the process of research.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	The project work could be done in the form of a summer project or internship in the industry or even a minor practical project in the college. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or product could be encouraged under this course.	48
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Fulfill team roles assigned & communicate effectively.
2	Solve engineering problems involving current issues using modern tools and technique.
3	Demonstrate the ability to apply the knowledge gained in the program.

Detailed Curriculum for Undergraduate Degree
B.Tech in Computer Science and Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Basics of Indian Astronomy (Indian Knowledge System-III)**		
Course Code:	BS-M403	**Category**	Basic Science Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	HM-HU202, BS-M303
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce the Vedic origins, historical development, and numeral systems of ancient Indian astronomy.
2	To describe foundational astronomical concepts, calendrical systems, and early models of celestial motion.
3	To analyze classical Siddhāntic texts to understand planetary motion, eclipses, and celestial phenomena.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Basic Astronomy** • Astronomy in the Vedic period: origins, concepts, and observational traditions. • Mathematical and astronomical sūtras of Āryabhaṭa, Bhāskara, • Brahmagupta, Pāṇini, Bharata Muni, and other scholars. • Period-wise survey of astronomical achievements in ancient India. • Mathematical methods and measurement systems used in ritual and astronomy.	8

2	**Foundations of Ancient Indian Astronomy** • Introduction to ancient Indian astronomical traditions and • Siddhāntic systems. • Vedāṅga Jyotiṣa: calendrical systems, nakṣatras, timereckoning, and empirical observations. • Āryabhaṭīya: Earth's rotation, lunar illumination, and basic • planetary theory. • Development of astronomical computation methods	8
3	**Classical Astronomical Texts and Celestial Phenomena** • Brahmasphuṭasiddhānta: planetary motion, eclipse theory, and computational techniques. • Varāhamihira's Pañcasiddhāntikā and related works. • Mahābhāskarīya, Laghubhāskarīya, and Āryabhaṭīya Bhāṣya. • Planetary longitudes, heliacal rising and setting, conjunctions, solar and lunar eclipses, and phases of the Moon	8
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the Vedic origins, major scholars, historical development, and numeral systems of ancient Indian astronomy.
2	Explain the foundations of ancient Indian astronomy, including calendrical systems and early astronomical models.
3	Interpret classical siddhāntic texts to understand planetary motion, eclipses, and other celestial phenomena.

Learning Resources:	
1	"Bhartiya Knowledge Systems" by M. C. Bora, Khanna Publishing House, 2024.
2	"Indian Mathematics and Astronomy: Some Landmarks (Revised Third Edition)" by S B Rao, Bhartiya Vidhya Bhavan, 2012.
3	"Studies in Indian Mathematics and Astronomy" by A Kolachana, Hindustan Book agency.
4	"Textbook on IKS" by Prof. B Mahadevan, IIM Bengaluru.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Astronomy in Ancient, Medieval and Early Telescopic Era of India	Prof. Amitabha Ghosh	IIT Kanpur

	Course Link: https://nptel.ac.in/courses/121104006		
2	Indian Knowledge System (IKS): Concepts and Applications in Science	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	IIMB
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb23_mg54		

Course Name:	**Signals and Systems**		
Course Code:	ES-EC401	**Category:**	Engineering Science
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Engineering Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop a clear understanding of mathematical representation and classification of continuous-time and discrete-time signals and systems.
2	To apply transform techniques such as Fourier, Laplace, and Z-transforms for analysis of signals relevant to computing and data processing applications.
3	To analyze system behavior in time and frequency domains with respect to stability, causality, and system response.
4	To use computational tools and programming environments for simulation, visualization, and interpretation of signals and systems.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to signal:** Standard Continuous Time Signals, Classification of Continuous Time Signals (Periodic and Nonperiodic Signals, Symmetric and Antisymmetric Signals, Energy and Power Signals, Causal, Noncausal and Anti-causal Signals), Mathematical Operations on Continuous Time Signals (Scaling, Folding, Time Shifting, Addition, Multiplication, Differentiation and Integration).	**6**
2	**Introduction to System and LTI Modelling:** Overview of System, Classification of Continuous Time Systems (Static and Dynamic, Time Invariant and Time Variant, Linear and Non-linear, Causal and Noncausal, Stable and Unstable), LTI System, Linear and Circular Convolution, Properties of Convolution.	**6**
3	**Laplace Transform and System Analysis:** Introduction to Laplace Transform, Region of Convergence (ROC), Properties of Laplace Transform, Initial and Final value Theorem, Convolution Theorem using Laplace Transform, Representation of Poles and Zeros in 'S' Plane, Inverse Laplace Transform by Partial Fraction Expansion Method.	**6**
4	**Fourier Series and Frequency Representation:** Introduction to Fourier Series, Conditions for Existence of Fourier Series, Properties of Fourier Series, Gibbs Phenomenon, Trigonometric Form of Fourier Series, Exponential Form of Fourier Series.	**4**
5	**Fourier Transform and Discrete Frequency Analysis:** Introduction to Fourier Transform, Properties of Fourier Transform, Relation Between Fourier and Laplace Transform, Discrete time Fourier Transform (DTFT), Discrete Fourier Transform (DFT), Overview of FFT algorithm, Parseval's Theorem.	**6**
6	**Sampling and Signal Reconstruction:** Representation of Continuous Time Signals by its Samples, Sampling theorem (Nyquist Sampling Criterion), Concept of Sampling in Time Domain, Aliasing Effect.	**6**
7	**Z-Transform and Discrete System Analysis**: Introduction to Z-Transformation, Properties of Z-transform, Relationship between Z-transform and Fourier Transform, Region of Convergence (ROC), Representation of Poles and Zeros in z-plane, Inverse Z-Transform,	**6**

	Analysis of LTI Discrete Time System Using Z-Transform.	
Total		**40**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Model and classify continuous-time and discrete-time signals and systems using mathematical representations.
2	Apply transform techniques (Fourier, Laplace, and Z-transforms) to analyze signals and system behavior in time and frequency domains.
3	Evaluate stability, causality, and system responses of LTI systems using analytical and computational methods.
4	Implement signal processing operations and system analysis using computational tools such as MATLAB or Python for simulation and visualization.

Learning Resources:	
1	A.Nagoor Kani- Signals and Systems- McGraw Hill
2	P.Ramesh Babu & R.Anandanatarajan- Signals and Systems 4/e- Scitech
3	A.V.Oppenheim, A.S.Willsky and S.H.Nawab -Signals & Systems, Pearson
4	S.Haykin & B.V.Veen, Signals and Systems- John Wiley

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Principles of Signals and Systems	Prof. Aditya K. Jagannatham	IIT Kanpur
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee37/preview		
2	Signals and Systems	Prof. Hitesh Shrimali, Prof. Kushal K. Shah	IIT Mandi, IISER Bhopal
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee79/preview		

Course Name:	**Discrete Mathematics**		
Course Code:	PC-CS401	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know about Set-Relation-Function and Number theory.
2	To learn counting techniques and apply the concept of generating function in solving recurrence relations.
3	To learn about different algebraic structures.
4	To use the concept of graph theory in engineering problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Sets-Relation-Function** • Introduction to Set theory, Partial Order Relation, Lattice **Number Theory** • Introduction to Number theory, Division Algorithm, Prime Numbers, Fundamental Theorem of Arithmetic, Greatest Common Divisor, Least Common Multiple, Euclidean Algorithm, Diophantine Equation, Congruence and Residue Classes of Integer Modulo *n.*	10
2	**Combinatorics** • Basic Counting Techniques, Inclusion and Exclusion Theorem • Permutation and Combination • Pigeon-Hole Principle • Recurrence Relation, Generating Functions	6
3	**Abstract Algebra** • Group, Subgroup, Cyclic group, Permutation group, Symmetric group. • Coset, Lagrange's Theorem, Normal Subgroup, Quotient group • Homomorphism and Isomorphism of groups • Rings, Integral Domain and Fields	12

4	**Advanced Graph Theory** • Planar and Dual graph: Kuratowski's graphs, Euler's formulae for connected and disconnected planar graphs, Detection of planarity • Graph Coloring: Vertex coloring, Chromatic number of complete graphs, circuit and bipartite graph, Chromatic polynomial • Connectivity and matching	8
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply set theory and number theory concepts to the field of computer science and engineering
2	Apply combinatorial techniques to solve counting problems and solve recurrence relations using generating functions.
3	Classify algebraic structure for a given mathematical problem.
4	Utilize techniques of graph theory to model and solve engineering problems.

Learning Resources:	
1	"Discrete Mathematics" by N. Chandrasekaran and M. Umaparvathi, PHI
2	"Discrete Mathematics" by J.K. Sharma, Macmillan Publication
3	"Discrete Mathematics" by S. K. Chakraborty and B. K. Sarkar, OXFORD University Press.
4	"Graph Theory" by N. Deo, Prentice Hall of India.
5	"Discrete Structures" by S.B. Singh, Khanna Publishing House (AICTE Recommended Textbook – 2018)
6	"Higher Algebra: Classical" by S.K. Mapa, Levant Publishers
7	"Higher Algebra: Abstract and Linear" by S.K. Mapa, Levant Publishers.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Discrete Mathematics	Prof. Sudarshan Iyengar	IIT Ropar
	Course Link: https://nptel.ac.in/courses/106106183		
2	Discrete Mathematics for CS	Prof. Nitin Saxena	IIT Kanpur
	Course Link: https://onlinecourses.nptel.ac.in/noc25_cs27/preview		

Course Name:	**Computer Organization and Architecture**		
Course Code:	PC-CS402	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	ES-CS301
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the fundamentals of computer organization
2	To analyze processor design concepts
3	To study control unit design and memory subsystem
4	To understand I/O organization, peripheral interfacing, and performance enhancement techniques

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** History of computing, von Neumann machine, Instruction and data, fixed- point and floating-point numbers, errors, IEEE standards.	3
2	**Processor design:** Instruction Set Architecture - Instruction format, opcode optimization; operand addressing; Instruction implementation-data transfer, branch control, logical, shift, Input/output instruction; arithmetic instruction implementation – addition and subtraction, 2's complement multiplication using Booth's algorithm – theory and examples; Restoring and non-restoring division algorithms.	8
3	**Control unit design:** Hardwired control, micro-programmed control design – micro-instruction formats, control optimization.	5

4	**Memory subsystem:** Memory technology, memory interfacing, Memory hierarchy – introduction to virtual memory system; cache memory – performance, address mapping, content addressable memory (CAM)	6
5	**Peripherals:** Basic properties, bus architectures, interfacing of I/O devices, data transfer schemes – programmed I/O, DMA, mass storage, RAID	6
6	**Pipelining:** Pipelining data path and instructions, speed up, CPI, latency; linear/non-linear pipeline – reservation table, MAL; super-pipelined and super- scalar processors,	6
7	**GPU and Advanced Architecture:** Difference between GPU and CPU architecture, Concept of cores, Threads, Effects of Cores on Program Execution	2
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic computer architecture, data representation, and IEEE standards.
2	Analyze instruction set architecture and instruction execution mechanisms.
3	Apply arithmetic algorithms for multiplication and division.
4	Design and compare hardwired and microprogrammed control units.
5	Analyze memory hierarchy, cache organization, and virtual memory.
6	Analyze I/O organization and pipelining techniques to assess system performance and processor efficiency.
7	Explain the effect of cores, threads, GPU architecture on Program execution complexity.

Learning Resources:	
1	Mano, M.M., "Computer System Architecture", PHI.
2	Hayes J. P., "Computer Architecture & Organisation", McGraw Hill
3	Hamacher, "Computer Organisation", McGraw Hill,
4	Hwang & Briggs—Computer Architecture & Parallel Processing, TMH
5	Hwang, K. "Advanced Computer architecture with parallel programming", McGraw Hill, 1993

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Computer Architecture and Organization	Prof. Indranil Sengupta, Prof. Kamalika Datta	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/106105163		
2	Advanced Computer Architecture	Prof. Smruti R. Sarangi	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102229		

Course Name:	**Design and Analysis of Algorithms**		
Course Code:	PC-CS403	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	PC-CS301
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The aim of this course is to develop the ability to design efficient algorithms for computational problems and to reason formally about their correctness.
2	Through the study of asymptotic complexity measures, students will understand the best, average, and worst-case behavior of algorithms and analyze their time–space trade-offs.
3	The course enables learners to apply fundamental algorithmic strategies such as Divide and Conquer, Greedy Method, Dynamic Programming, Backtracking, and Branch and Bound to solve classical optimization and decision problems.

4	Students will gain an understanding of graph algorithms, network flow techniques, and computational complexity theory, including the distinction between tractable and intractable problems, and classes P, NP, NP-complete, and NP-hard.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Characteristics of algorithms. **Analysis of algorithm:** Asymptotic analysis of complexity bounds – best, average and worst- case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Method of Iteration, Recursion Tree method and Masters' theorem (Examples: Analysis of Binary Search, Merge Sort and Quick Sort using Recurrence)	6
2	**Fundamental Algorithmic Strategies:** Divide and Conquer Method: Basic method, use, example – Max-Min Problems and its complexity analysis. **Greedy Method:** Basic method, use, examples – Fractional Knapsack Problem, Job sequencing with deadlines, Activity Scheduling Problem, Travelling Salesperson Problem and their complexity analysis **Dynamic Programming:** Basic method, use, examples – Matrix Chain Manipulation, 0/1 Knapsack Problem and their complexity analysis Branch and Bound and Backtracking: Basic method, use, examples – 15 Puzzles Problem, N queens' problem, Graph Coloring problem	12
3	**Graph and Tree Algorithms:** Traversal algorithms: Recapitulation of Depth First Search (DFS) and Breadth First Search (BFS) Shortest path Algorithms (Single Source and All Pairs with their Complexity Analysis), Minimum Spanning Tree (Prim's and Kruskal's Algorithms with their Complexity Analysis), Ford Fulkerson algorithm, Max-Flow Min Cut theorem (Statement and Illustration).	10
4	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP- complete and NP-hard. Satisfiability Problem, Cook's theorem, Clique decision problem	6

5	**Advanced Topic:** Randomized Quick Sort Algorithms: Introduction and Analysis	2
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the fundamental concepts of Asymptotic Notations and their mathematical significance.
2	Explain and implement different algorithm design techniques like D&C, Greedy Method, DP, Backtracking, Branch and Bound, Graph Algorithms, NP-class problems.
3	Apply appropriate algorithms and required Data Structure to construct the solution of a given problem.
4	Analyze Randomized algorithm with expected running time and probability of error.
5	Analyze algorithms and determine the correctness.

Learning Resources:	
1	Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2	Fundamentals of Algorithms – E. Horowitz et al.
3	Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4	Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5	Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6	Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
7	Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Design and analysis of algorithms	Prof. Madhavan Mukund	Chennai Mathematical

			Institute
	Course Link: https://nptel.ac.in/courses/106106131		

Course Name:	**Operating Systems**		
Course Code:	PC-CS404	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of Computers, Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the fundamental concepts, structures, and evolution of modern operating systems.
2	To master the mechanisms of process management, thread synchronization, and deadlock handling.
3	To analyze memory management schemes and file system implementations.
4	To explore advanced storage structures (RAID) and modern virtualization/ containerization technologies essential for cloud environments.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: OS functions, Evolution (Batch, Multiprogramming, Time-sharing), System Calls, Kernel architectures (Monolithic,	3

	Microkernel, Layered)	
2	Process Management: Process states, Process Control Block (PCB), Context switching, Operations on processes, Concept of Inter-process Communication (IPC)	3
3	CPU Scheduling: Scheduling criteria, Algorithms: FCFS, SJF, Priority, Round Robin, Multi-level Queue, Multi-processor scheduling.	6
4	Process Synchronization: Critical Section problem, Peterson's solution, Hardware synchronization, Semaphores, Monitors, Classical problems (Dining Philosophers, Producer-Consumer).	6
5	Deadlocks: System model, Deadlock characterization, Prevention, Avoidance (Banker's Algorithm), Detection and Recovery.	6
6	Memory Management: Logical vs. Physical address space, Swapping, Contiguous allocation, Paging (Structure of page table), Segmentation.	3
7	Storage Management: Disk structure, Disk scheduling (FCFS, SSTF, SCAN, C-SCAN), Disk management and Formatting.	3
8	RAID Structures: RAID Levels (0, 1, 5, 6, 10), Error detection and correction, RAID impact on performance and reliability in servers.	1
9	File Systems: File concept, Access methods, Directory structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management.	2
10	History and Benefits, Type-1 and Type-2 Hypervisors, Hardware-assisted virtualization, Containerization, Virtualization in Cloud Infrastructure	2
11	Security: OS security, malware, concept of virus, trojan horse, warm	1
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the application and core elements of Operating System.
2	Analyze various CPU scheduling algorithms, memory management techniques including virtual memory and paging and their efficiency in different environments.
3	Implement deadlock handling mechanism, synchronization primitives to solve concurrency problems.
4	Compare different file systems, and different RAID levels and storage management

	strategies for data reliability.
5	Distinguish between Type-1/Type-2 hypervisors and understand the role of containers (like Docker) in cloud computing.
6	Compare OS security principles to protect system resources.

Learning Resources:	
1	Operating System Concepts, Silberschatz, Galvin, and Gagne (Indian Edition), Wiley India.
2	Operating Systems, Sukomal Pal, Khanna Publishing House.
3	Operating Systems: A Concept-based Approach, Dhananjay M. Dhamdhere, Tata McGraw-Hill.
4	Operating Systems, Sibsankar Haldar and Alex A. Aravind, Pearson Education India.
5	Operating System, P. Balakrishna Prasad, Scitech Publications.
6	Operating Systems: Internals and Design Principles, William Stallings (Indian Edition), Pearson India.
7	Modern Operating Systems, Andrew S. Tanenbaum (Indian Edition), PHI Learning/Pearson.
8	Learning Web Design by Jennifer Niederst Robbins

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Introduction to Operating Systems	Prof. Chester Rebeiro	IIT Madras
	Course Link: https://nptel.ac.in/courses/106106144		

Course Name:	**Computer Organization and Architecture Laboratory**		
Course Code:	PC-CS492	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	
Full Marks:	100		

Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To familiarize students with the operation and verification of basic digital IC chips using data books.
2	To develop skills in designing arithmetic and logic circuits including adders, ALU, and multibit operations.
3	To provide practical understanding of memory design, RAM operations, and memory expansion techniques.
4	To introduce HDL-based design and simulation of registers, ALU, CPU, and CPU–memory interfacing.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Familiarity with IC-chips: a) Multiplexer, b) Decoder, c) Encoder d) Comparator Truth Table verification and clarification from Data-book.	6
2	Design an Adder/Subtractor composite unit.	3
3	Use a multiplexer unit to design a composite ALU	3
4	Use ALU chip for multibit arithmetic operation	3
5	Implement read-write operation using RAM IC	3
6	Cascade two RAM ICs for vertical and horizontal expansion.	3
7	HDL introduction. Basic digital logic base programming with HDL	3
8	8-bit Addition, Multiplication, Division	3
9	8-bit Register design, Memory unit design and perform memory operations.	3
10	8-bit simple ALU design, 8-bit simple CPU design	3

11	Interfacing of CPU and Memory- Simulation only	3
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Experiment with different ICs and gain knowledge about their application.
2	Construct different combinational circuits and use RAM ICs to perform read-write operation
3	Construct various combinational circuits with HDL Programming noting the difference between hardware design and software simulation.
4	Experiment with interfacing between memory and CPU in simulation mode.

Learning Resources:	
1	Circuit Design with VHDL- Volnei A. Pedroni 3rd Edition MIT Press
2	Effective Coding with VHDL: -Ricardo Jasinski MIT Press
3	Hayes J. P., "Computer Architecture & Organisation", McGraw Hill

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Algorithms Laboratory**		
Course Code:	PC-CS493	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	ES-CS191, PC-CS391

Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The aim of this course is to study various design paradigms of algorithms for solving real world problems.
2	Through this course one can apply appropriate algorithms and methods of analysis.
3	To pick an appropriate data structure for a design situation is also under consideration.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**UNIT - I** Divide and Conquer, Greedy Method, Dynamic Programming Implement Binary Search, Merge Sort, Implement Quick Sort, Find Maximum and Minimum Element from an Array of Elements, Implement Knapsack Problem, Job sequencing with deadlines, Find the minimum number of scalar multiplications needed for Chain of Matrix	20
2	**UNIT - II** Graph Traversal Algorithm, Minimum Cost Spanning Tree Generation Algorithms, Shortest Path Algorithms Implement Breadth First Search (BFS), Depth First Search (DFS) Implement Minimum Cost Spanning Tree by Prim's and Kruskal's Algorithm Implement Single Source shortest Path for a graph (Dijkstra, Bellman Ford Algorithm) and All pair of Shortest path for a graph (Floyd- Warshall Algorithm)	16
3	**UNIT - III** Backtracking and Branch and Bound Implement N Queen problem Implement Graph Coloring Problem Implement 15-Puzzle Problem	8
Total		**44**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement Binary Search, Merge Sort, Quick Sort, and Max-Min Problem using D&C Algorithm Design Techniques.
2	Implement Fractional Knapsack, Job Sequencing with Deadline, Matrix Chain, Graph Traversals, MST problems, Shortest Path, N- Queens, Graph Coloring, and 15 Puzzles using proper Algorithm Design Techniques.
3	Apply suitable algorithm for solving a particular problem.
4	Analyze the complexities and memory usages of different algorithms.

Learning Resources:	
1	Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2	Fundamentals of Algorithms – E. Horowitz et al.
3	Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai
4	Design and Analysis of Algorithm, Biswas and Dey, JBBL

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Operating Systems Laboratory**		
Course Code:	PC-CS494	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic Knowledge of Computers

Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the application of UNIX commands
2	To program using Shell script
3	To implement different types of process and operating system features
4	To understand concepts of virtual machines and containerization.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	UNIX Commands and Permissions	3
2	Creating a shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, CLA, String)	6
3	C programs for parent process, child process, orphan process, sleeping process, running process, zombie process	6
4	Multithreaded C program using PThread API	3
5	C programs for signal handling, sending signals and signal interface.	6
6	Inter-process communication through shared memory segment, message queues, pipes and named pipes	6
7	Implement Virtual Machine and Container for micro-services using Docker and Docker-Compose	6
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	List UNIX commands and their applications
2	Implement simple structured and procedural code using Shell script
3	Implement parent, child, sleeping, running, zombie, orphan processes
4	Implement multi-threaded programs and Signals
5	Implement Inter-process communication using Pipes
6	Configure virtual machines, containers, and images.

Learning Resources:	
1	UNIX Concepts and Applications, Sumitabha Das, McGrawhill
2	Vijay Mukhi's The C Odyssey UNIX – The Open Boundless C, BPB Publications
3	Learning Web Design by Jennifer Niederst Robbins

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Mini Project**		
Course Code:	PW-CS481	**Category:**	Project
Semester:	4th	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Basic programming knowledge, and H/W components
Full Marks:	100		
Examination Scheme:	Semester Examination: 100		

Course Objectives:	
1	To practically implement basic solutions to computer science–related problems.
2	To enhance hands on experience leading to critical thinking

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Guidelines**: **Team Formation**: Students will work in teams of 6-8 members. **Project Scope**: The mini project should focus on implementing a small application that strengthens understanding of computer science-related problems and/or addresses a real-life need. **Acceptable Project Types (Not limited to)**: • Implementation of a concept (other than regular lab work) taught in the courses • Application development • Hardware development **Selection Process**: Based on the need analysis, the micro-project title and objectives will be finalized.	48

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify and define a problem statement from the requirements raised from literature survey /need analysis
2	Implement solutions based on the survey /need analysis
3	Examine the impact of the solution.

Learning Resources:	
1	Lab manual
2	Resources provided by Project mentors

Corresponding NPTEL/SWAYAM Courses:			
Sl.	**Course Name**	**Instructor Name**	**Host**

No.			Institute
1			
	Course Link:		

Detailed Curriculum for Undergraduate Degree
B.Tech in Computer Science and Engineering (Data Science)
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Discrete Mathematics**		
Course Code:	PC-CS401	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To know about Set-Relation-Function and Number theory.
2	To learn counting techniques and apply the concept of generating function in solving recurrence relations.
3	To learn about different algebraic structures.
4	To use the concept of graph theory in engineering problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Sets-Relation-Function** • Introduction to Set theory, Partial Order Relation, Lattice **Number Theory** • Introduction to Number theory, Division Algorithm, Prime Numbers, Fundamental Theorem of Arithmetic, Greatest Common Divisor, Least Common Multiple, Euclidean Algorithm, Diophantine Equation, Congruence and Residue Classes of Integer Modulo *n.*	10
2	**Combinatorics** • Basic Counting Techniques, Inclusion and Exclusion Theorem • Permutation and Combination • Pigeon-Hole Principle • Recurrence Relation, Generating Functions	6

3	**Abstract Algebra** • Group, Subgroup, Cyclic group, Permutation group, Symmetric group. • Coset, Lagrange's Theorem, Normal Subgroup, Quotient group • Homomorphism and Isomorphism of groups • Rings, Integral Domain and Fields	12
4	**Advanced Graph Theory** • Planar and Dual graph: Kuratowski's graphs, Euler's formulae for connected and disconnected planar graphs, Detection of planarity • Graph Coloring: Vertex coloring, Chromatic number of complete graphs, circuit and bipartite graph, Chromatic polynomial • Connectivity and matching	8
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply set theory and number theory concepts to the field of computer science and engineering
2	Apply combinatorial techniques to solve counting problems and solve recurrence relations using generating functions.
3	Classify algebraic structure for a given mathematical problem.
4	Utilize techniques of graph theory to model and solve engineering problems.

Learning Resources:	
1	"Discrete Mathematics" by N. Chandrasekaran and M. Umaparvathi, PHI
2	"Discrete Mathematics" by J.K. Sharma, Macmillan Publication
3	"Discrete Mathematics" by S. K. Chakraborty and B. K. Sarkar, OXFORD University Press.
4	"Graph Theory" by N. Deo, Prentice Hall of India.
5	"Discrete Structures" by S.B. Singh, Khanna Publishing House (AICTE Recommended Textbook – 2018)
6	"Higher Algebra: Classical" by S.K. Mapa, Levant Publishers
7	"Higher Algebra: Abstract and Linear" by S.K. Mapa, Levant Publishers.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Discrete Mathematics	Prof. Sudarshan Iyengar	IIT Ropar

	Course Link: https://nptel.ac.in/courses/106106183		
2	Discrete Mathematics for CS	Prof. Nitin Saxena	IIT Kanpur
	Course Link: https://onlinecourses.nptel.ac.in/noc25_cs27/preview		

Course Name:	**Computer Organization and Architecture**		
Course Code:	PC-CS402	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	ES-CS301
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the fundamentals of computer organization
2	To analyze processor design concepts
3	To study control unit design and memory subsystem
4	To understand I/O organization, peripheral interfacing, and performance enhancement techniques

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** History of computing, von Neumann machine, Instruction and data, fixed- point and floating-point numbers, errors, IEEE standards.	3
2	**Processor design:** Instruction Set Architecture - Instruction format, opcode optimization; operand addressing; Instruction implementation-data transfer, branch control, logical, shift, Input/output instruction; arithmetic instruction implementation –	8

	addition and subtraction, 2's complement multiplication using Booth's algorithm – theory and examples; Restoring and non-restoring division algorithms.	
3	**Control unit design:** Hardwired control, micro-programmed control design – micro-instruction formats, control optimization.	5
4	**Memory subsystem:** Memory technology, memory interfacing, Memory hierarchy – introduction to virtual memory system; cache memory – performance, address mapping, content addressable memory (CAM)	6
5	**Peripherals:** Basic properties, bus architectures, interfacing of I/O devices, data transfer schemes – programmed I/O, DMA, mass storage, RAID	6
6	**Pipelining:** Pipelining data path and instructions, speed up, CPI, latency; linear/non-linear pipeline – reservation table, MAL; super-pipelined and super- scalar processors.	6
7	**GPU and Advanced Architecture:** Difference between GPU and CPU architecture, Concept of cores, Threads, Effects of Cores on Program Execution.	2
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic computer architecture, data representation, and IEEE standards.
2	Analyze instruction set architecture and instruction execution mechanisms.
3	Apply arithmetic algorithms for multiplication and division.
4	Design and compare hardwired and microprogrammed control units.
5	Analyze memory hierarchy, cache organization, and virtual memory.
6	Analyze I/O organization and pipelining techniques to assess system performance and processor efficiency.
7	Explain the effect of cores, threads, GPU architecture on Program execution complexity.

Learning Resources:	
1	Mano, M.M., "Computer System Architecture", PHI.

2	Hayes J. P., "Computer Architecture & Organisation", McGraw Hill
3	Hamacher, "Computer Organisation", McGraw Hill,
4	Hwang & Briggs—Computer Architecture & Parallel Processing, TMH
5	Hwang, K. "Advanced Computer architecture with parallel programming", McGraw Hill, 1993

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Computer Architecture and Organization	Prof. Indranil Sengupta, Prof. Kamalika Datta	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/106105163		
2	Advanced Computer Architecture	Prof. Smruti R. Sarangi	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102229		

Course Name:	**Design and Analysis of Algorithms**		
Course Code:	PC-CS403	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	PC-CS301
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The aim of this course is to develop the ability to design efficient algorithms for computational problems and to reason formally about their correctness.
2	Through the study of asymptotic complexity measures, students will understand the best, average, and worst-case behavior of algorithms and analyze their time–space

	trade-offs.
3	The course enables learners to apply fundamental algorithmic strategies such as Divide and Conquer, Greedy Method, Dynamic Programming, Backtracking, and Branch and Bound to solve classical optimization and decision problems.
4	Students will gain an understanding of graph algorithms, network flow techniques, and computational complexity theory, including the distinction between tractable and intractable problems, and classes P, NP, NP-complete, and NP-hard.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Characteristics of algorithms. **Analysis of algorithm:** Asymptotic analysis of complexity bounds – best, average and worst- case behavior; Performance measurements of Algorithm, Time and space trade-offs, Analysis of recursive algorithms through recurrence relations: Substitution method, Method of Iteration, Recursion Tree method and Masters' theorem (Examples: Analysis of Binary Search, Merge Sort and Quick Sort using Recurrence)	6
2	**Fundamental Algorithmic Strategies:** Divide and Conquer Method: Basic method, use, example – Max-Min Problems and its complexity analysis. **Greedy Method:** Basic method, use, examples – Fractional Knapsack Problem, Job sequencing with deadlines, Activity Scheduling Problem, Travelling Salesperson Problem and their complexity analysis **Dynamic Programming:** Basic method, use, examples – Matrix Chain Manipulation, 0/1 Knapsack Problem and their complexity analysis Branch and Bound and Backtracking: Basic method, use, examples – 15 Puzzles Problem, N queens' problem, Graph Coloring problem	12
3	**Graph and Tree Algorithms:** Traversal algorithms: Recapitulation of Depth First Search (DFS) and Breadth First Search (BFS) Shortest path Algorithms (Single Source and All Pairs with their Complexity Analysis), Minimum Spanning Tree (Prim's and Kruskal's Algorithms with their Complexity Analysis), Ford Fulkerson	10

	algorithm, Max-Flow Min Cut theorem (Statement and Illustration).	
4	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP- complete and NP-hard. Satisfiability Problem, Cook's theorem, Clique decision problem	6
5	**Advanced Topic:** Randomized Quick Sort Algorithms: Introduction and Analysis	2
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the fundamental concepts of Asymptotic Notations and their mathematical significance.
2	Explain and implement different algorithm design techniques like D&C, Greedy Method, DP, Backtracking, Branch and Bound, Graph Algorithms, NP-class problems.
3	Apply appropriate algorithms and required Data Structure to construct the solution of a given problem.
4	Analyze Randomized algorithm with expected running time and probability of error.
5	Analyze algorithms and determine the correctness.

Learning Resources:	
1	Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2	Fundamentals of Algorithms – E. Horowitz et al.
3	Algorithm Design, 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
4	Algorithm Design: Foundations, Analysis, and Internet Examples, Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
5	Algorithms -- A Creative Approach, 3RD Edition, UdiManber, Addison-Wesley, Reading, MA
6	Design & Analysis of Algorithms, Gajendra Sharma, Khanna Publishing House (AICTE Recommended Textbook – 2018)
7	Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Design and analysis of algorithms	Prof. Madhavan Mukund	Chennai Mathematical Institute
	Course Link: https://nptel.ac.in/courses/106106131		

Course Name:	**Operating Systems**		
Course Code:	PC-CS404	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of Computers, Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the fundamental concepts, structures, and evolution of modern operating systems.
2	To master the mechanisms of process management, thread synchronization, and deadlock handling.
3	To analyze memory management schemes and file system implementations.
4	To explore advanced storage structures (RAID) and modern virtualization/ containerization technologies essential for cloud environments.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction: OS functions, Evolution (Batch, Multiprogramming, Time-sharing), System Calls, Kernel architectures (Monolithic, Microkernel, Layered)	3
2	Process Management: Process states, Process Control Block (PCB), Context switching, Operations on processes, Concept of Inter-process Communication (IPC)	3
3	CPU Scheduling: Scheduling criteria, Algorithms: FCFS, SJF, Priority, Round Robin, Multi-level Queue, Multi-processor scheduling.	6
4	Process Synchronization: Critical Section problem, Peterson's solution, Hardware synchronization, Semaphores, Monitors, Classical problems (Dining Philosophers, Producer-Consumer).	6
5	Deadlocks: System model, Deadlock characterization, Prevention, Avoidance (Banker's Algorithm), Detection and Recovery.	6
6	Memory Management: Logical vs. Physical address space, Swapping, Contiguous allocation, Paging (Structure of page table), Segmentation.	3
7	Storage Management: Disk structure, Disk scheduling (FCFS, SSTF, SCAN, C-SCAN), Disk management and Formatting.	3
8	RAID Structures: RAID Levels (0, 1, 5, 6, 10), Error detection and correction, RAID impact on performance and reliability in servers.	1
9	File Systems: File concept, Access methods, Directory structure, Allocation methods (Contiguous, Linked, Indexed), Free-space management.	2
10	History and Benefits, Type-1 and Type-2 Hypervisors, Hardware-assisted virtualization, Containization, Virtualization in Cloud Infrastructure	2
11	Security: OS security, malware, concept of virus, trojen horse, warm	1
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the application and core elements of Operating System.
2	Analyze various CPU scheduling algorithms, memory management techniques including virtual memory and paging and their efficiency in different environments.
3	Implement deadlock handling mechanism, synchronization primitives to solve concurrency problems.
4	Compare different file systems, and different RAID levels and storage management strategies for data reliability.
5	Distinguish between Type-1/Type-2 hypervisors and understand the role of containers (like Docker) in cloud computing.
6	Compare OS security principles to protect system resources.

Learning Resources:	
1	Operating System Concepts, Silberschatz, Galvin, and Gagne (Indian Edition), Wiley India.
2	Operating Systems, Sukomal Pal, Khanna Publishing House.
3	Operating Systems: A Concept-based Approach, Dhananjay M. Dhamdhere, Tata McGraw-Hill.
4	Operating Systems, Sibsankar Haldar and Alex A. Aravind, Pearson Education India.
5	Operating System, P. Balakrishna Prasad, Scitech Publications.
6	Operating Systems: Internals and Design Principles, William Stallings (Indian Edition), Pearson India.
7	Modern Operating Systems, Andrew S. Tanenbaum (Indian Edition), PHI Learning/Pearson.
8	Learning Web Design by Jennifer Niederst Robbins

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Introduction to Operating Systems	Prof. Chester Rebeiro	IIT Madras
	Course Link: https://nptel.ac.in/courses/106106144		

Course Name:	**Introduction to AI**		
Course Code:	PC-CS(D)401	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic computer science concepts and familiarity with statistics and probability
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Become familiar with basic principles of AI toward problem solving, inference, perception, knowledge representation, and learning.
2	Investigate applications of AI techniques in intelligent agents, expert systems, artificial neural networks and other machine learning models.
3	Experiment with a machine learning model for simulation and analysis.
4	Explore the current scope, potential, limitations, and implications of intelligent systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to AI and Decision Making:** Fundamentals of AI: Definitions, history, key concepts. Decision-making frameworks: Rationality, bounded rationality, intuition. The role of AI in decision making: Opportunities and challenges, Types of Artificial Intelligence, Weak AI, Strong AI, Data-Driven AI, Agent and Environment, Human-AI Collaboration.	2
2	**Representing and Reasoning with Uncertain Knowledge:** Probability reasoning, connection to logic, independence, Bayes rule,	5

	Semantics of Bayesian networks, probabilistic inference, Knowledge representation in an uncertain domain, Dempster-Shafer theory, Fuzzy sets & fuzzy logics, confidence estimation, explainable AI.	
3	**Problem solving by Searching:** State space search, Depth first search, Breadth-first search. Heuristic Based Search: Heuristic search, Best-first search, A*Algorithm and AO* algorithm, Min-max algorithms, game playing – Alpha beta pruning branch and bound.	7
4	**Basics of Learning:** Foundation of Machine Learning, Types of Machine Learning – Supervised Learning v/s Unsupervised Learning, k-NN and Linear Regression Algorithm (basic idea), Reinforcement learning overview, Q-learning for learning action policies, Neural Network Basics.	4
5	**Industrial Applications of AI:** • Natural Language Processing (basics) • Computer Vision (introductory concepts) • Robotics (basic architecture) • Expert systems – Healthcare, Finance, Transportation, Customer Service & Chatbots, Education, Agriculture, E-Commerce and Social Media.	2
6	**Introduction to Prompt Engineering:** Introduction of LLMs and Prompting, Examples of good vs bad Prompts, Prompt Engineering Techniques, Prompts for Effective Writing: Introduction, Igniting the Writing Process with Prompts.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate fundamental understanding of artificial intelligence (AI), including problem-solving approaches, decision-making, scope, and limitations.
2	Apply basic principles of AI in solutions that require problem solving, knowledge representation, and learning.
3	Demonstrate understanding of AI techniques including intelligent agents, expert systems, and basic machine learning concepts.

4	Demonstrate understanding of AI applications across various domains and their practical implications.
5	Demonstrate fundamental understanding of prompt engineering techniques and their use with large language models.

Learning Resources:	
1	Peter Norvig and Stuart J. Russell, Artificial Intelligence: A Modern Approach, Prentice Hall, 3rd Edition.
2	Kevin Knight, Elaine Rich, B. Nair, Artificial Intelligence, The McGraw-Hill, 3rd Edition.
3	M.C. Trivedi, A classical approach to Artificial Intelligence, Khanna Book Publishing Company Private Limited.
4	Introduction to Artificial Intelligence & Expert Systems, Dan W. Patterson, Pearson (2015) 1st ed.
5	Poole, Computational Intelligence, OUP.
6	Expert Systems, Giarranto, VIKAS.
7	Tom Taulli, Prompt Engineering for Generative AI: ChatGPT, LLMs, and Beyond, Apress, Springer Nature.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Artificial Intelligence: Knowledge Representation and Reasoning	Prof. Deepak Khemani	IIT Madras
	Course Link: https://nptel.ac.in/courses/106106140		
2	An Introduction to Artificial Intelligence	Prof. Mausam	IIT Delhi
	Course Link: https://nptel.ac.in/courses/106102220		

Course Name:	**Basics of Indian Astronomy (Indian Knowledge System-III)**		
Course Code:	BS-M403	**Category**	Basic Science Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	HM-HU202, BS-M303
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To introduce the Vedic origins, historical development, and numeral systems of ancient Indian astronomy.
2	To describe foundational astronomical concepts, calendrical systems, and early models of celestial motion.
3	To analyze classical Siddhāntic texts to understand planetary motion, eclipses, and celestial phenomena.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Basic Astronomy** • Astronomy in the Vedic period: origins, concepts, and observational traditions. • Mathematical and astronomical sūtras of Āryabhaṭa, Bhāskara, Brahmagupta, Pāṇini, Bharata Muni, and other scholars. • Period-wise survey of astronomical achievements in ancient India. • Mathematical methods and measurement systems used in ritual and astronomy.	8
2	**Foundations of Ancient Indian Astronomy** • Introduction to ancient Indian astronomical traditions and siddhāntic systems. • Vedāṅga Jyotiṣa: calendrical systems, nakṣatras, time-reckoning, and empirical observations. • Āryabhaṭīya: Earth's rotation, lunar illumination, and basic planetary theory. • Development of astronomical computation methods	8
3	**Classical Astronomical Texts and Celestial Phenomena** • Brahmasphuṭasiddhānta: planetary motion, eclipse theory, and computational techniques. • Varāhamihira's Pañcasiddhāntikā and related works.	8

	• Mahābhāskarīya, Laghubhāskarīya, and Āryabhaṭīya Bhāṣya. • Planetary longitudes, heliacal rising and setting, conjunctions, solar and lunar eclipses, and phases of the Moon	
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the Vedic origins, major scholars, historical development, and numeral systems of ancient Indian astronomy.
2	Explain the foundations of ancient Indian astronomy, including calendrical systems and early astronomical models.
3	Interpret classical siddhāntic texts to understand planetary motion, eclipses, and other celestial phenomena.

Learning Resources:	
1	"Bhartiya Knowledge Systems" by M. C. Bora, Khanna Publishing House, 2024.
2	"Indian Mathematics and Astronomy: Some Landmarks (Revised Third Edition)" by S B Rao, Bhartiya Vidhya Bhavan, 2012.
3	"Studies in Indian Mathematics and Astronomy" by A Kolachana, Hindustan Book agency.
4	"Textbook on IKS" by Prof. B Mahadevan, IIM Bengaluru.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Astronomy in Ancient, Medieval and Early Telescopic Era of India	Prof. Amitabha Ghosh	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/121104006		
2	Indian Knowledge System (IKS): Concepts and Applications in Science	Prof. B. Mahadevan, Dr. Vinayak Rajat Bhat, Dr. R Venkata Raghavan	IIMB
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb23_mg54		

Course Name:	**Algorithms Laboratory**		
Course Code:	PC-CS493	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	ES-CS191, PC-CS391
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	The aim of this course is to study various design paradigms of algorithms for solving real world problems.
2	Through this course one can apply appropriate algorithms and methods of analysis.
3	To pick an appropriate data structure for a design situation is also under consideration.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	UNIT - I Divide and Conquer, Greedy Method, Dynamic Programming Implement Binary Search, Merge Sort, Implement Quick Sort, Find Maximum and Minimum Element from an Array of Elements, Implement Knapsack Problem, Job sequencing with deadlines, Find the minimum number of scalar multiplications needed for Chain of Matrix	20
2	UNIT - II Graph Traversal Algorithm, Minimum Cost Spanning Tree Generation Algorithms, Shortest Path Algorithms Implement Breadth First Search (BFS), Depth First Search (DFS) Implement Minimum Cost Spanning Tree by Prim's and Kruskal's Algorithm	16

	Implement Single Source shortest Path for a graph (Dijkstra, Bellman Ford Algorithm) and All pair of Shortest path for a graph (Floyd- Warshall Algorithm)	
3	UNIT - III Backtracking and Branch and Bound Implement N Queen problem Implement Graph Coloring Problem Implement 15-Puzzle Problem	8
Total		**44**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement Binary Search, Merge Sort, Quick Sort, and Max-Min Problem using D&C Algorithm Design Techniques.
2	Implement Fractional Knapsack, Job Sequencing with Deadline, Matrix Chain, Graph Traversals, MST problems, Shortest Path, N- Queens, Graph Coloring, and 15 Puzzles using proper Algorithm Design Techniques.
3	Apply suitable algorithm for solving a particular problem.
4	Analyze the complexities and memory usages of different algorithms.

Learning Resources:	
1	Introduction to Algorithms, 4TH Edition, Thomas H Cormen, Charles E Lieserson, Ronald L Rivest and Clifford Stein, MIT Press/McGraw-Hill.
2	Fundamentals of Algorithms – E. Horowitz et al.
3	Algorithms Design and Analysis, Udit Agarwal, Dhanpat Rai
4	Design and Analysis of Algorithm, Biswas and Dey, JBBL

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Operating Systems Laboratory**		
Course Code:	PC-CS494	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic Knowledge of Computers
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the application of UNIX commands
2	To program using Shell script
3	To implement different types of process and operating system features
4	To understand concepts of virtual machines and containerization.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	UNIX Commands and Permissions	3
2	Creating a shell script, making a script executable, shell syntax (variables, conditions, control structures, functions, CLA, String)	6
3	C programs for parent process, child process, orphan process, sleeping process, running process, zombie process	6
4	Multithreaded C program using PThread API	3
5	C programs for signal handling, sending signals and signal interface.	6
6	Inter-process communication through shared memory segment,	6

	message queues, pipes and named pipes	
7	Implement Virtual Machine and Container for micro-services using Docker and Docker-Compose	6
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	List UNIX commands and their applications
2	Implement simple structured and procedural code using Shell script
3	Implement parent, child, sleeping, running, zombie, orphan processes
4	Implement multi-threaded programs and Signals
5	Implement Inter-process communication using Pipes
6	Configure virtual machines, containers, and images.

Learning Resources:	
1	UNIX Concepts and Applications, Sumitabha Das, McGrawhill
2	Vijay Mukhi's The C Odyssey UNIX – The Open Boundless C, BPB Publications
3	Learning Web Design by Jennifer Niederst Robbins

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Data Visualization Laboratory**		
Course Code:	PC-CS(D)492	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Understand the Importance of data Visualization for business intelligence and decision making.
2	Learn different approaches to understand the importance of visual perception.
3	Learn different data visualization techniques and tools.
4	Gain knowledge of effective data visuals to solve workplace problems.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction to Tableau- Tableau Workspace, Tableau terminologies, basic functionalities.	3
2	Connecting to Data Source – Connecting to Database, Different types of Tableau Joins.	3
3	Creating a View - formatting charts, adding filters, creating calculated fields and defining parameters.	3
4	Dashboard Design and Storytelling – Components of Dashboard, Understanding how to place worksheets in Containers, Action filters and its types.	6

5	Introducing Power BI –Components and the flow of work. Power BI Desktop Interface- The Report has five main areas.	3
6	Querying Data from CSV - Query Editor, Connecting the data from the Excel Source, Clean, Transform the data.	3
7	Creating Reports & Visualizations - Different types of charts, Formatting charts with Title, Colors.	3
8	Dashboards - Filters in Power BI, Formatting dashboards.	6
9	Analysis of Real World dataset, such as: Revenue in sales dataset, GDP dataset, HR Dataset, Amazon Prime Dataset etc.	6
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design the experiment to create basic charts and graphs using Tableau and Power BI.
2	Develop the solution for the given real-world problem.
3	Analyse the results and produce substantial written documentation.

Learning Resources:	
1	Matthew O. Ward, Georges Grinstein, Daniel Keim, "Interactive Data Visualization: Foundations, Techniques, and Applications", 2nd Edition, CRC press, 2015.
2	Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master, Ryan Sleeper, Oreilly Publications, 2018.
3	Molly Monsey, Paul Sochan "Tableau For Dummies", ISBN: 9789390466078
4	Jack A. Hyman "Microsoft Power BI For Dummies", ISBN: 9789354645778
5	Chandraish Sinha "Mastering Power BI", Publisher: BPB Publications
6	Greg Deckler (Author), Brett Powell (Author) "Mastering Microsoft Power BI: Expert techniques to create interactive insights for effective data analytics and business intelligence" Publisher: Packt Publishing Limited, Edition: 2nd Revised Edition.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Analytics and Visualization with MS Power BI	Dr. Anand A. Kopare	Atlas SkillTech University, Mumbai
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg218		
2	Data to Dashboard: Mastering Visual Storytelling with Tableau	Dr. Arjun V. Singar aka Pundit Singri	Indian Institute of Science (IISc)
	Course Link: https://elearn.nptel.ac.in/shop/completed-courses/short-term-programs-completed/data-to-dashboard-mastering-visual-storytelling-with-tableau-batch-3/?v=13b5bfe96f3e		

Course Name:	**Mini Project**		
Course Code:	PW-CS481	**Category:**	Project
Semester:	4th	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Basic programming knowledge, and H/W components
Full Marks:	100		
Examination Scheme:	Semester Examination: 100		

Course Objectives:	
1	To practically implement basic solutions to computer science–related problems.
2	To enhance hands on experience leading to critical thinking

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Guidelines**: **Team Formation**: Students will work in teams of 6-8 members. **Project Scope**: The mini project should focus on implementing a small application that strengthens understanding of computer science-related problems and/or addresses a real-life need. **Acceptable Project Types (Not limited to)**: • Implementation of a concept (other than regular lab work) taught in the courses • Application development • Hardware development **Selection Process**: Based on the need analysis, the micro-project title and objectives will be finalized.	48

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify and define a problem statement from the requirements raised from literature survey /need analysis
2	Implement solutions based on the survey /need analysis
3	Examine the impact of the solution.

Learning Resources:	
1	Lab manual
2	Resources provided by Project mentors

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Detailed Curriculum for Undergraduate Degree
B.Tech in Electrical Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Leadership and Management Skills (Jeevan Kaushal-III)**		
Course Code:	HM-HU401	**Category:**	Humanities and Social Sciences including Management Courses
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concept of Management
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop effective leadership skills such as communication, motivation, decision-making, and emotional intelligence for managing individuals and teams.
2	To understand leadership theories and managerial practices and apply them to real-world organizational situations.
3	To enhance team management and conflict resolution abilities, enabling leaders to build high-performing and cohesive teams.
4	To foster ethical, strategic, and adaptable leadership, preparing learners to lead organizations responsibly in a dynamic and competitive environment.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Leadership & Management:** Meaning, nature, and levels of leadership; Leadership vs Management; Importance of leadership in professional and personal contexts; Leadership traits, roles, and responsibilities; Leadership and Life Skills synergy	**4L**
2	**Leadership Theories and Styles:** Great Man Theory; Trait Theory; Behavioral Theories (Ohio State, Michigan); Contingency Theories (Fiedler, Path-Goal); Leadership styles: Transformational, Transactional, Servant, Situational.	**4L**
3	**Core Leadership Skills Development:** Effective Communication; Active Listening; Emotional Intelligence & Self-awareness; Decision-making and Problem-solving; Time Management and Priority Setting; Creativity and Critical Thinking.	**6L**
4	**Team Leadership & People Management:** Team building fundamentals; Motivation: Theories and workplace application; Conflict resolution & negotiation skills; Coaching & mentoring approaches; Cultural sensitivity and diversity in teams.	**4L**
5	**Ethical Leadership & Social Responsibility:** Ethical decision-making; Corporate Social Responsibility & sustainability in leadership; Personal values and ethical dilemmas; Building trust and accountability.	**3L**
6	**Practical Leadership Application & Case Studies:** Case studies of successful leaders; Leadership challenges in startups and corporate environments; Group activities: role-plays, simulations, reflection logs; Personal leadership action plan.	**3L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	To develop leadership and teamwork skills required for managing technical teams, projects, and multidisciplinary work environments.
2	To enhance communication, decision-making, and problem-solving abilities, enabling students to lead technical tasks and projects effectively.
3	To build ethical, professional, and responsible leadership qualities, essential for engineers in organizational and societal contexts.
4	To prepare students for managerial and leadership roles in the engineering profession, fostering adaptability, innovation, and lifelong learning in a rapidly changing technological landscape

Learning Resources:	
1	Hughes, Ginnett & Curphy; Leadership; 9th Indian Edition; Mc Graw Hill
2	Gary Yukl: Leadership in organisations, Pearson Education, New Delhi.
3	L M Prasad: Organisational Behaviour, Sultan Chand & Sons, New Delhi.
4	P. Guggenheimer & M. Diana Szulc: Understanding Leadership Competencies, Viva, books, New Delhi

Course Name:	**Biology for Engineers**		
Course Code:	BS-BIO401	**Category:**	Basic Science Courses
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Physics (BS-PH201), Chemistry (BS-CH101) and Mathematics (BS-M101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop an understanding of biological systems from an engineering perspective, including fundamental concepts of cell structure and function.
2	To explain the physiological principles of neuron function and human organ systems relevant to bioengineering applications.
3	To introduce bio-design principles for analyzing and modeling biological systems using engineering approaches.
4	To equip students with the knowledge and skills necessary for bioengineering applications, enabling the development of advanced technological solutions for societal improvement.
5	To promote interdisciplinary research aptitude by integrating concepts from biology and engineering for innovative problem solving.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to bio engineering and cell structure:** Need to study Biology: – Life Science Studies Significance – Bio	**5L**

	Inspired Inventions – Role of Biology in Next Generation Technology Development – Cell Structure – Cell Potential – Action Potential – introduction to Bio signals– Sodium Potassium channels– Neuron function	
2	**Human Organ Systems and Bio Design-I:** Brain as a CPU system- Structure, CNS and Peripheral Nervous System, Signal transmission, EEG-application for prosthetic control and neurological disease diagnosis and prognosis. Eye as a Camera system- Structure of rod and cone cells, optical corrections, cataract, lens materials, bionic eye. Heart as a pump system- Structure, Electrical signaling – ECG monitoring and heart related issues, reasons for blockages of blood vessels, Principles of pacemakers and defibrillators.	**6L**
3	**Human Organ Systems and Bio Design-II:** Lungs as purification system- Structure, gas exchange mechanisms, Spirometry, Abnormal lung physiology- Chronic Obstructive Pulmonary Disease (COPD), Principles of Ventilators and Heart-lung machine. Kidney as a filtration system- Structure, mechanism of filtration, Chronic Kidney Disease (CKD), Principle of Dialysis systems. Musculoskeletal System- Structure, mechanisms, EMG, Engineering solutions to musculoskeletal disorders- assistive devices, exoskeletons.	**5L**
4	**Nature- Bioinspired Materials and Mechanisms:** Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces). Genetics: Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes.	**4L**
5	**Trends in Bioengineering:** Bioprinting techniques and materials, 3D printing of ear, bone and skin. Electronic tongue and electronic nose in food science, Principles of	**4L**

	Bio-imaging for disease diagnosis.	
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify the origin of bio signals and their relevance in biological systems.
2	Compare Brain as a CPU System, Eye as a Camera system, Heart as a pump system, Lungs as purification system, Kidney as a filtration system, and Musculoskeletal System as support system.
3	Describe various diagnostic tools and techniques related to Human Organ Systems and Bio Design.
4	Demonstrate the mechanism of Nature-Bioinspired Materials.
5	Explain Bio-printing, 3D Printing, and Bioengineering (Understand level)

Learning Resources:	
Recommended Text Books:	
1	Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022.
2	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
Reference Books:	
3	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011.
4	Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5	Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6	Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Fabrication Techniques for MEMs-based Sensors: Clinical Perspective	Prof. Hardik Jeetendra Pandya	IISc Bangalore
	Course Link: https://onlinecourses.nptel.ac.in/noc25_ee144/preview		
2	Basics of Biology	Prof. Vishal Trivedi	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc26_bt16/preview		

Course Name:	**Vedic Mathematics (Indian Knowledge System II)**		
Course Code:	BS-M401	**Category:**	Basic Science Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on Śulba Sūtra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata, Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	**3L**
2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and sub-sutras, Vedic sutras for addition- Purna puranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	**3L**
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva–Tiryag bhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method, Vilokanam), and cubes (Yāvadunam).	**5L**
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya Samuccaya Gunita, Solution of quadratic equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat,	**5L**
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4×4 using Urdhva Tiryag Sutra, Inverse of matrices using Vedic approaches.	**3L**
6	**Vedic Geometry and Śulba Sūtra Concepts:** Geometrical ideas from Śulba Sūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	**5L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and Śulba Sūtra texts.

Learning Resources:	
1	"Vedic Mathematics" by Bharati Krishna Tirthaji, Motilal Banarsidass Publishing.
2	"Essentials of Vedic Mathematics" by Rajesh Kumar Thakur, Rupa Publications.
3	"Vedic Mathematics for All Ages" by Vandana Singhal, Motilal Banarsidass Publishing.
4	"Elements of Vedic Mathematics" by Udayan S. Patankar & Sunil M. Patankar, TTU Press.
5	"Vedic Mathematics Made Easy" by Dahaval Bathia, Jaico Publishing House.
6	"Vedic Mathematics: The Problem Solver" by Ronak Bajaj, Black Rose Publications.
7	"Vedic Geometry Course" by S. K. Kapoor, Lotus Press.
8	"The Śulba Sūtras" by S. N. Sen & A. K. Bag (Eds.), Indian National Science Academy.
9	"Geometry in Ancient and Medieval India" by T. A. Sarasvati Amma, Motilal Banarsidass Publishing

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Mathematics in India – From Vedic Period to Modern Times	Prof. K. Ramasubramanian, Prof. M. D. Srinivas, Prof. M. S. Sriram	IIT Bombay
	Course Link: https://nptel.ac.in/courses/111101080		

Course Name:	**Electric Machine-I**

Course Code:	PC-EE401	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	4
L-T-P:	3-1-0	**Pre-Requisites:**	Basic Electrical & Electronics Engineering (ES-EE 201), Physics (BS-PH201)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To review the concept of magnetic fields and magnetic circuits
2	To learn the principle of production of electromagnetic force and torque.
3	To learn the basic principle of operation of DC machine
4	To learn the principle of operation and characteristics of DC motor and generator
5	To learn the principle of operation, connections and different tests on Transformers
6	To acquire problem solving skills to solve problems of DC machines and Transformers

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Electromechanical Energy Conversion Principle:** Singly Excited Magnetic System and Doubly Excited Magnetic system. Physical concept of torque production; Electromagnetic torque and Reluctance torque. **Concept of General terms pertaining to Rotating Machines:** Review of magnetic circuits - MMF, flux, reluctance, inductance; Visualization of magnetic fields produced by a bar magnet and a current carrying coil - through air and through a combination of iron and air, MMF produced by Distributed Windings, Electrical & Mechanical degree.	**8L**
2	**DC Machines:** Basic construction of a DC machine: Field and armature, Types of armature winding: lap and wave windings, EMF generated in the armature, Derivation of EMF equation, Methods of Excitation, Armature reaction & its effect in the performance,	**14L**

	Methods of decreasing the effects of Armature reaction, Effect of Brush shift. Compensating winding, Commutation process, Construction of commutator, Resistance commutation, Delayed commutation, Voltage commutation, Improvement of Commutation, Brush shift and interpoles. **Operating Characteristics of DC Generators:** Separately Excited generators, Shunt Generators, Series Generators and Compound Generators. **Direct Current motors:** Review of types of DC motors, Torque equation, Derivation of back EMF equation. **Speed torque characteristics:** shunt, series and compound motors. **Starting of DC motors:** 3-point starter & its step calculation, 4-point starter, Speed control by controlling armature resistance, field excitation and armature voltage. Ward- Leonard method of speed control. Losses & efficiency of DC machines, Hopkinson's & Swinburne's test. **D.C Machine application:** Generator application, Motor application	
3	**1-phase Transformers:** Construction and operation of single-phase transformers, Equivalent circuit, Phasor diagram, Voltage regulation, Losses and efficiency Testing - open circuit and short circuit tests, Polarity test, Back-to-back test, Parallel operation of single-phase transformers, Separation of hysteresis and eddy current losses, Autotransformers - construction, principle, applications and comparison with two winding transformer.	**6L**
4	**3-phase Transformers:** Three-phase transformer - construction, Determination of polarity and connections (star/star, star/delta, delta/star, star/zigzag, delta/zigzag, open delta), Phasor groups and their comparative features. Magnetizing current, Effect of unbalanced loading, Production of Harmonics in Transformer and its suppression, Phase conversion - 3 phase to 2 phase transformation, Scott connection, three phase to six-phase conversion, Double star and Double delta, 3 winding transformer: Parameter estimation, application, Parallel operation of three-phase transformers, Tap-changing transformers - No-load and onload tap-changing of transformers, Cooling of transformers.	**12L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Discuss general concept pertaining rotating machines and magnetic fields, EMFs and torque production
2	Explain the construction, operation, different types of DC machine and analysis of characteristics curve.
3	Describe construction, operation of single phase transformer.
4	Describe construction, operation of three phase transformer and different types of three phase transformer with their operation.
5	Apply the concept of different electrical circuits using DC machine, single and three phase Transformer for solution depending on the desired output.

Learning Resources:	
Recommended Text Books:	
1	Electrical Machinery, P.S. Bhimra, 6th Edition, Khanna Publishers.
2	Theory and Performance of Electric Machines, J. B. Gupta, Katson Books.
3	Electric Machines: Theory, Operating Applications, and Controls, Charles I. Hubert, 2/e, Pearson Education.
Alternative Text Books:	
4	The performance and Design of Alternating Current Machines, M.G.Say, CBS Publishers & Distributors.
5	Electric Machinery & transformer, Irving L Koskow, 2nd Edition, Prentice Hall India
6	Electric machines, D.P. Kothari & I.J Nagrath, 3rd Edition, Tata Mc Graw-Hill Publishing Company Limited
Reference Books:	
7	Electrical Machines, P.K. Mukherjee & S. Chakrabarty, 2nd edition, Dhanpat Rai Publication.
8	Electric Machinery & Transformers, Bhag S. Guru and H.R. Hiziroglu, 3rd Edition, Oxford University press.
9	Electrical Machines, R.K. Srivastava, Cengage Learning
10	Theory of Alternating Current Machinery, Alexander S Langsdorf, Tata Mc Graw Hill Edition

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Electrical Machines	Prof. G. Bhuvaneshwari	IIT Delhi
	Course Link: https://nptel.ac.in/courses/108102146		
2	Electrical Machines - I	Prof. Tapas Kumar Bhattacharya	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105155		

Course Name:	**Analog and Digital Communication**		
Course Code:	PC-EE402	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concept of signal analysis
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the need for modulation in communication applications
2	To analyze various analog modulation schemes
3	To analyze various digital modulation techniques
4	To identify the utilities of various line coding techniques
5	To apply the knowledge of digital carrier modulation techniques for choosing application specific modulation schemes

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Communication** Introduction to Communication, Elements of communication system i.e Transmitters, Transmission channels & receivers, Concept of Baseband signal, Concept of modulation, it's need. A review of Fourier Series and Fourier transform.	**3L**
2	**Continuous Wave Modulation** • Basic principle of Amplitude Modulation (AM), Time and frequency domain representation of AM signal, Calculation of Modulation Index. Multi tone modulation. Generation of AM waves, Demodulation of AM wave. Bandwidth and Transmission power of AM. Double side band suppressed carrier (DSB-SC) modulation: time and frequency domain expressions, Bandwidth and Transmission power for DSB. Demodulation of DSB-SC modulation. Single side band modulation (SSB). Basic concept of Vestigial sideband transmission(VSB), Spectra and band-width. • Basic concept of Frequency and Phase Modulation, Time and Frequency domain representations, Generation of FM waves, Demodulation of FM waves, Calculation of modulation index, power and bandwidth.	**10L**
3	**Source Encoding** • Introduction to Digital Communication, Concept of sampling, Pulse Amplitude Modulation (PAM), Pulse Code Modulation (PCM), uniform and non-uniform quantization, quantization noise, binary encoding, A-Law and μ -law companding, Probability of error, Differential PCM(DPCM), Delta modulation(DM) and Adaptive delta modulation(ADM). Relative merits and demerits. Different line coding schemes i.e RZ, NRZ, Manchester coding . Properties of efficient line codes.	**10L**
4	**Base band pulse transmission** Nyquist criteria, ISI, Eye pattern, Matched Filter.	**4L**
5	**Digital carrier modulation and demodulation techniques** Different digital modulation techniques i.e ASK, BPSK, BFSK, QPSK- Basic theory, Transmitter and Receiver, Bit error rate, Bandwidth requirement and Bandwidth Efficiency. Introduction to QAM and Minimum Shift Keying. Comparison between various digital modulation schemes.	**9L**
6	Basic concept of VHF, UHF communication, Global navigation satellite systems (GNSS).	**4L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the need for modulation, representation of the modulated carrier wave in both analog and digital communication.
2	Describe the different types of analog modulation techniques.
3	Understand the basic concept of analog to digital signal conversion techniques, concept of line coding and apply the knowledge to solve engineering problems.
4	Analyze different digital career modulation techniques.

Learning Resources:	
1	Principles of Communication Systems , H. Taub and D. L. Schilling, Goutam Saha, TMH Publishing Co., 4th edition, 2017.
2	Communication Systems , Simon Haykin, Wiley, 4th edition, 2006.
3	Modern Digital and Analog Communication Systems, B. P Lathi. Oxford University Press, 4th edition, 2011.
4	Analog and Digital Communications, Sanjay Sharma, Kataria Publishers, 7th edition, 2017.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Analog and Digital Communication: Modulation	Dr. Ribhu Chopra	IIT Guwahati
	Course Link: https://share.google/JNZV8yFz9z8oA4vh5		
2	Quantization, PCM and Delta Modulation	Prof. Bikash Kumar Dey	IIT, Bombay
	Course Link: https://share.google/UtjNmZyJkUBuicH78		

Course Name:	**Measurements and Instrumentation**		
Course Code:	PC-EE403	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical and Electronics Engineering (ES-EE-201), Electric Circuit Theory (PC-EE-301)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn methods of measurement, errors in measurement and its classification.
2	To learn the basic principle of operation of instrument transformers. Also, to learn the principle of measurement of high voltage, power, energy and different electrical parameters.
3	To learn the fundamental principles of various types of Measuring systems i.e. Mechanical, Electromechanical, Resistive, Inductive, Capacitive, Piezoelectric, Thermal, Magnetic etc.
4	To learn working principles of electronic measuring systems and the principle of operation of cathode ray oscilloscope (CRO) and Digital Storage oscilloscope (DSO).
5	To learn about advanced measuring techniques- PLC, I/O modules of PLC, Programming languages and instructions of PLC, Evolution and architecture of DCS, SCADA architecture, communication in SCADA

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Measurements:** • Classification of Measuring instruments with working principle. Characterization parameters for measuring systems-Accuracy, Precision, Resolution, Drift, Repeatability, Reliability, Speed of response, Hysteresis, Linearity, Error in measurement, Classification of errors, loading effect due to shunt and series connected instruments, Impedance Matching. **Analog meters:** • General features, Construction, Principle of operation and torque equation of Moving coil, Moving iron, Electrodynamometer, Induction instruments, Principle of operation of the Electrostatic, Thermoelectric, Rectifier type instruments, Extension of instrument ranges- shunt and multipliers.	**6L**
2	**Instrument transformer:** Disadvantage of shunt and multipliers for AC Measurement, Advantage of Instrument transformers, Principle of operation of current & potential transformer, errors. **Measurement of Power:** • Principle of operation of Electrodynamic & Induction type wattmeter, Wattmeter errors. **Measurement of Energy:** • Construction, theory and application of AC energy meter, testing of energy meters.	**6L**
3	**High Voltage Measurement and Testing:** High voltage transformer, measurement of peak value and voltages, low frequency H.V test, High voltage DC testing, Cockcroft Walton circuit, High voltage DC testing of cables, Localization of faults in high voltage cables, Surge (Impulse) testing, Testing of insulating materials, High voltage testing of cables, High voltage test on Porcelain insulators, Testing of electric strength of insulating oils,	**8L**
4	**Measurement of Resistance and Impedances:** • Measurement of medium, low and high resistances, Megger **AC Bridges:** • Measurement of Inductance, Capacitance and frequency by AC bridges, Universal impedance bridge, sources of errors in bridge circuits, **Measurement of Process variables:** • Introduction to sensors & Transducers, Primary sensing elements, Electrical Transducers, Selection of Transducers, Final Control element. • **Flow Measurement:** Fluid properties, turbulent & laminar flow, Reynolds number, velocity profile. Different types of variable head type flow meters: Orifice plate, Venturi tube, Flow nozzle, Variable	**13L**

	area type flow meters, electromagnetic flow meter, Ultrasonic flow meters, Mass Flowmeter. • **Level Measurement:** float and displacer gauges, electrical types of level gauges using resistance, capacitance. • Measurement of Humidity and Moisture Content, Measurement of Displacement, Force, Torque, speed, LVDT, RVDT, Strain gauge, Piezoelectric materials. • Measurement of pH, Measurement of Pressure. •**Measurement of Temperature:** Thermocouple, Thermopile, Thermowell, RTD, Thermistors, Filled system Thermometer, Pyrometers, Semiconductor based temperature measurement system.	
5	**Electronic Measurements:** • Advantages of digital meter over analog meters, Digital voltmeter, Resolution and sensitivity of digital meters, Digital multimeter, Digital frequency meter, Signal generator. **Cathode ray oscilloscope (CRO) and Digital Storage oscilloscope (DSO):** • Principle of oscilloscope, Measurement of voltage, current, frequency & phase by oscilloscope. Frequency limitation of CRO. Sampling and storage oscilloscope, Double beam CRO, Digital Storage oscilloscope (DSO).	**7L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain basic measurement systems, analog meters, instrument transformers, energy meters, bridge, potentiometers, CROs, DSOs, sensors and transducers.
2	Apply the concept of measurement system for concluding about the pros and cons of the system.
3	Evaluate the parameters associated with the instruments.
4	Use the measurement system for recording and controlling system variables.
5	Use the measurement system for data manipulation and analysis.

Learning Resources:	
Recommended Text Books	
1	A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.

2	A Course in Electronics and Electrical Measurements and Instrumentation, J.B. Gupta, S K Kataria and Sons Publisher.
Alternative Text Books	
3	Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
4	Industrial Instrumentation and control, S K Singh, Tata McGraw-Hill.
Reference Books	
5	Measurement Systems: Application and Design, 4th edition, E.O. Doebelin, Mc Graw-Hill Publishing Co., New York.
6	Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.
7	Modern Electronic instrumentation & Measuring instruments, A.D. Helfrick & W.C. Copper, Wheeler Publication.
8	Sensors & Transducers, D. Patranabis, PHI, 2nd edition.
9	Instrument transducers, H.K.P. Neubert, Oxford University press.
10	Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw Hill.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Measurement and Instrumentation	Prof. Ravindra Kumar Jha	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee01/preview		
2	Mechanical Measurement Systems	Prof. Ravi Kumar	IIT Roorkee
	Course Link: https://onlinecourses.nptel.ac.in/noc26_me80/preview		
3	Sensors and Actuators	Prof. Hardik Jeetendra Pandya	IISc Bangalore
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee13/preview		
4	Transducers for Instrumentation	Prof. Ankur Gupta	IIT Delhi
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee29/preview		

Course Name:	**Electric Machine-I Laboratory**		
Course Code:	PC-EE491	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To learn operating principle and characteristics of DC motor and generator
2	To learn the operating principle and characteristics of single and thee phase transformer
3	To calculate parameters and study different connections of three phase transformer
4	To understand performance of the transformer using different operations.

Course Contents: (Choose 8 experiments from the following)

Module No.	**Description of Topic**	**Contact Hrs.**
1	Determination of the characteristics of a separately excited DC generator.	3P
2	Determination of the characteristics of a DC motor	3P
3	Study of methods of speed control of DC motor	3P
4	Determination of the characteristics of a compound DC generator (short shunt)	3P
5	Determination of speed of DC series motor as a function of load torque.	3P
6	Polarity test on a single phase transformer	3P

7	Determination of equivalent circuit of a single phase transformer and efficiency.	3P
8	Study of different connections of three phase transformer.	3P
9	Study of Parallel operation of a single phase transformers.	3P
10	Determination of temperature rise and efficiency of the transformer (Back to back test).	3P
Total		**24P**

Course Name:	**Measurements and Instrumentation Laboratory**		
Course Code:	PC-EE493	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Knowledge of Basic Electrical Engineering and Electric Circuit Theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Understand the construction and working principles of analog and digital measuring instruments including PMMC, MI, Electrodynamic, Thermoelectric, Rectifier type instruments and Digital Multimeter.
2	Develop practical skills in measuring electrical parameters such as power, resistance, frequency, and capacitance using standard bridges and instrument transformers.
3	Perform calibration of measuring instruments such as AC energy meter and load cell and evaluate their performance characteristics.
4	Apply transducer-based measurement techniques for determining non-electrical parameters such as temperature, pressure, displacement, and load.

Course Contents: (Choose 8 experiments from the following)		
Module No.	**Description of Topic**	**Contact Hrs.**
1	a) Instrument workshop- Observe the construction of PMMC, MI, Electrodynamic, Thermoelectric and Rectifier type of instruments. b) Study of the working principle of Digital Multi-meter.	3P
2	Study of Static Characteristics (Accuracy, Precision, Repeatability and Linearity) of measuring instruments.	3P
3	Calibrate AC energy meter.	3P
4	Measurement of power using Instrument transformer.	3P
5	Measurement of power in Polyphase circuits (Delta connected Load).	3P
6	Measurement of Temperature by Thermocouple and Thermistor.	3P
7	Measurement of Pressure by semiconductor Strain gauge.	3P
8	Measurement of Displacement by LVDT.	3P
9	Calibration of Load Cell and Measurement of Unknown Load.	3P
10	Measurement of resistance using Kelvin double bridge.	3P
11	Measurement of unknown frequency by Wien Bridge.	3P
12	Measurement of capacitance by Schering Bridge.	3P
Total		**24P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the construction and operating principles of various analog and digital measuring instruments.
2	Analyze static characteristics (accuracy, precision, repeatability, linearity) of measuring instruments through experimental observations.
3	Calibrate electrical measuring instruments such as AC energy meter and load cell and interpret calibration curves.
4	Measure electrical quantities including power (single and Polyphase), resistance

	(Kelvin double bridge), frequency (Wien bridge), and capacitance (Schering bridge) using appropriate experimental setups.
5	Understand the performance of transducers such as thermocouple, thermistor, semiconductor strain gauge, and LVDT for measurement of temperature, pressure, displacement, and load.

Learning Resources:	
Recommended Text Books:	
1	A course in Electrical & Electronic Measurements & Instrumentation, A.K. Sawhney, Dhanpat Rai & sons.
2	A Course in Electronics and Electrical Measurements and Instrumentation, J.B. Gupta, S K Kataria and Sons Publisher.
Alternative Text Books:	
3	Electrical Measurement & Measuring Instruments, E.W. Golding & F.C. Wides, Wheeler Publishing.
4	Industrial Instrumentation and control, S K Singh, Tata McGraw-Hill.
Reference Books:	
5	Measurement Systems: Application and Design, 4th edition, E.O. Doebelin, Mc Graw-Hill Publishing Co., New York.
6	Electronic Instruments, H.S. Kalsi, Tata Mc-Graw hill, 2nd Edition.
7	Modern Electronic instrumentation & Measuring instruments, A.D. Helfrick & W.C. Copper, Wheeler Publication.
8	Sensors & Transducers, D. Patranabis, PHI, 2nd edition.
9	Instrument transducers, H.K.P. Neubert, Oxford University press.
10	Digital Instrumentation, A.J. Bouwens, Tata Mc-Graw Hill.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Measurement and Instrumentation	Prof. Ravindra Kumar Jha	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ee01/preview		
2	Mechanical Measurement Systems	Prof. Ravi Kumar	IIT Roorkee
	Course Link: https://onlinecourses.nptel.ac.in/noc26_me80/preview		

Course Name:	**Python Programming**

Course Code:	ES-CS491	**Category:**	Engineering Science Courses
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Computing Circuit Theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To understand the fundamentals of writing Python scripts.
2	To learn core Python scripting elements such as variables and flow control structures.
3	To use python for reading and writing files.
4	To understand the object oriented concept of Python.
5	To design electrical circuits using python.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Introduction of Python environment, use of GitHub, coding structure. Programming on uses of variables, Data Types, Operators.	3P
2	**Conditional Statements:** Programming on If , If- else, Nested if-else, Looping, For, While, Nested loops	3P
3	**Control Statements and string manipulation:** Using Break, Continue, Pass statement in Python programming Programming on various operations of String	3P
4	**Lists/Tuple/Dictionaries:** Accessing values in Sequence, Working with sequences, Programming on various properties of sequences	3P

5	**Functions/Modules:** Programming on user defined functions and module, Importing module, Math module, Implementation of Array using numpy module,	3P
6	**Exception Handling:** Exception, Exception Handling, Except clause, Try- finally clause, User Defined Exceptions	3P
7	**The Object-Oriented Approach:** Classes, Methods, Objects Basic concepts of object programming, Implementation of Properties of Object-oriented Programming, Inheritance.	3P
8	**File Handling:** Implementation of various File Operations in programming.	3P
9	**Data Visualization using Python:** Concept of Data Visualization, Using Pyplot of Matplotlib library, Creating Line chart, Bar chart and Pie chart using pyplot interface, Customizing the Plot.	3P
10	**Application in Electrical Engineering problems:** Generation of different electrical signals, Transient response of RL, RC and RLC circuit, Design a DC motor and related problems	9P
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Write basic Python programs using appropriate syntax and logic.
2	Use Python control structures and functions to solve engineering problems.
3	Apply Python programming for simple electrical engineering computations and data analysis.

Learning Resources:	
Recommended Text Books	
1	E. Balagurusamy, *Programming with Python*, McGraw Hill Education.
2	Wesley J. Chun, *Core Python Programming*, Pearson Education.
3	Reema Thareja, *Python Programming using Problem Solving Approach*, Oxford University Press.
Alternative Text Books	
4	John Zelle, *Python Programming: An Introduction to Computer Science*, Franklin, Beedle & Associates.
5	Mark Lutz, *Learning Python*, O'Reilly Media.
Reference Books	
6	Allen B. Downey, *Think Python*, O'Reilly Media.

7	David Beazley, *Python Essential Reference*, Addison-Wesley.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Programming, Data Structures and Algorithms using Python	Prof. Madhavan Mukund	Chennai Mathematical Institute
	Course Link: https://nptel.ac.in/courses/106106145		

Course Name:	**Micro Project**		
Course Code:	PW-EE481	**Category:**	Project/ Internships/ Sessional
Semester:	Fourth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Knowledge on domain of project work and associated tools.
Full Marks:	100		
Examination Scheme:	Semester Examination: 100	Continuous Assessment: 0	Attendance: 0

Course Objectives:	
1	To study the content and techniques of the literature for project problem formulation
2	To inculcate skills for team work, independent study, analysis and modeling based on literature survey.
3	Planning, Preliminary Modeling, Simulation and Experiment Design (or building a prototype model) related to the topic.
4	Developing skills for writing a micro project report, preparing presentation on the topic and demonstrating a prototype if applicable.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Guide Line:** **1.** This particular course would be organized as a guided assignment, which should normally include literature survey on the assigned topic. The assignment could be allocated to small group of students. **2.** The team would work out a preliminary approach to the Problem relating to the assigned topic. **3.** The team would conduct modeling, simulation, experiment preparation of bill of materials, project planning and design as applicable. **4.** The team would prepare a written report and presentation materials (including prototype if any) on the study conducted for presentation to the department. **5.** Individual members of the team would make oral presentation before a departmental committee as final seminar	**12P**
Total		**12P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the content and techniques of the literature for project problem formulation.
2	Analyze the model based on literature survey and plan for innovative thinking to inculcate skills for team work
3	Plan, design of preliminary model by simulation or experiment for building a prototype related to the topic.
4	Represent project report and prepare presentation on the topic to demonstrate a prototype.

Course Name:	**Environmental Science**		
Course Code:	AU-BS471	**Category:**	Audit Courses
Semester:	Fourth	**Credit:**	0

L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Physics (BS-PH201), Chemistry (BS-CH101) and Mathematics (BS-M101)
Full Marks:	100		
Examination Scheme:	Teacher Assessment: 70 (30 + 40)	Participation in Events: 15	Attendance: 15

Course Objectives:	
1	To solve various engineering problems applying ecosystem to produce eco-friendly products.
2	To use relevant air, noise, water and soil control method to solve domestic and industrial problems.
3	To recognize relevant energy sources required for domestic and industrial applications.
4	To solve local solid and e-waste problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Ecosystem:** Structure of ecosystem, Food chain and food web, Aquatic and terrestrial ecosystem, Carbon, Nitrogen, Sulphur and Phosphorous cycle, Depletion of ozone.	**2L**
2	**Environmental Degradation:** Air Pollution: Natural and manmade sources of air pollution, Effects and control (Bag filter, Cyclone separator, Electrostatic Precipitator) Noise Pollution: Sources and effects of pollution, measurement of pollution level, Noise pollution Rules-2000 Water Pollution: Types of water pollutants, BOD and COD, Waste	**7L**

	Water Treatment (Primary, Secondary and Tertiary methods). Soil Pollution: Causes, Effects and Preventive measures of soil pollution, E- waste, Plastic waste	
3	**Renewable sources of Energy:** Solar Energy: Basics of Solar energy, Solar Pond, Solar water heater, solar dryer, Solar stills. Biomass: Biogas production mechanism, Utilization and storage of biogas. Wind Energy: Current status and future prospects of wind energy. New Energy sources: Hydrogen energy, Ocean energy resources, Tidal energy conversion.	**7L**
4	**Solid Waste Management, ISO 14000 & Environmental Management:** Solid waste: Municipal solid waste, Biomedical waste, Metallic and Non-metallic wastes, Hazardous waste, Collection and disposal of municipal solid waste, Waste to wealth Concept of carbon footprint Environmental management in fabrication industry ISO14000: Implementation in industries, Benefits.	**8L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the ecosystem and terminology and solve various engineering problems applying ecosystem knowledge to produce eco-friendly products.
2	Analyse the air, water, soil and noise pollution, and control measures and acts.
3	Understand different renewable energy resources and efficient process of harvesting.
4	Understand solid waste management, ISO 14000 & Environmental Management.

Learning Resources:	
1	"Fundamentals of Environment and Ecology" by D. De & D. De, S Chand Publication
2	"Text Book of Environmental Studies" by E. Bharucha, Byju's

3	"Environmental Studies" by S. C. Sharma and M. P. Poonia, Khanna Book Publishing
4	"Environmental Studies" by M. Basu, Cambridge University Press
5	"Fundamentals of renewable energy processes" by A. Vieira & D. Rosa, Academic Press Inc
6	"Principles Solar Engineering" by F. Kreith and J. F. Kreider, CRC Press.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Environmental Science	Prof. Shamik Chowdhury, Prof. Sudha Goel	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/109105203		
2	Introduction to Environmental Engineering and Science - Fundamental and Sustainability Concepts	Prof. Brajesh K Dubey	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/127105018		

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243 G.T. Road (N), Liluah, Howrah- 711204, West Bengal, India
Ph: +91 33 26549315/17 Fax: +91 33 26549318 Web: www.mckvie.edu.in/

Detailed Curriculum for Undergraduate Degree
B. Tech in Electronics and Communications Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Digital Electronic Circuits**		
Course Code:	PC-EC401	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Electrical & Electronics Engineering ES-EE101
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Introduction to basic concept of different number system and their conversions.
2	Developing the concept of Venn diagram, Logic gates, SOP, POS and K-Map for logic simplification.
3	Developing the knowledge of different combination and sequential circuits and their design.
4	Developing the conception of different converter circuit and logic families.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	a) Data and number systems: Binary, Octal and Hexadecimal representation and their conversions ; BCD,ASCII, EBCDIC, Gray codes and their conversions; Signed binary number representation with r‟s and (r-1)‟s complement methods. b) Venn diagram,	4L
2	Boolean algebra; Various Logic gates- their truth tables and circuits; minterms and maxterms, Representation in SOP and POS forms; algebraic manipulation Minimization of logic expressions by algebraic method, K-map method, Quine- McCluskey method.	8L
3	a) Combinational circuits- Adder and Subtractor circuits; Applications and circuits of Encoder, Decoder, Comparator, Multiplexer, De-Multiplexer and Parity Generator, Design of Combinational circuits using MUX b) Memory Systems: RAM, ROM, EPROM, E^2PROM c) Design of combinational circuits-using ROM, Programming logic	9L

	devices and gate arrays. (PLAs and PLDs)	
4	Sequential Circuits- Basic memory element- Basic Flip-flop & Latch , S-R, J-K, D and T Flip Flops, Race around condition, Master-slave Flip Flops, Registers (SISO, SIPO, PIPO, PISO) Ring counter, Johnson counter, Basic concept of Synchronous and Asynchronous counter, General counter design methodology, Introduction to Finite State Machine (FSM) , Design of Sequence Detector using FSM.	12L
5	a) Different types of A/D and D/A conversion techniques. b) Logic families- TTL, ECL, Tri-State Logic, MOS and CMOS, their operation and specifications.	7L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understanding the different number system and their conversions.
2	Understanding the Venn diagram, logic gates, SOP, POS and K-Map for logic simplification.
3	Design and Analyze the modular combinational circuits
4	Design and Analyze sequential logic circuits.
5	Apply the combinational and sequential circuit understanding for the analyze of converter circuit and logic families.

Learning Resources:	
1	Digital Logic and Computer Design, Morries Mano, 2016, Pearson India
2	Modern Digital Electronics, R.P.Jain, 4th ,2010, Mc Graw Hill
3	Digital Electronics: Principles, Devices and Applications, A.K.Maini,2007, Wiley India
4	Fundamentals of Digital Circuits, A.Anand Kumar , 3rd, PHI
5	Digital Systems Principles and Applications, Ronald J. Tocci , Neal S.Widmer & Gregory L.Moss, 10th, 2007,Pearson
6	Digital Electronics Principles and Applications, S.K.Mandal, 2010, Mc Graw Hill.
7	Digital Principles and Application, Leach, Malvino & Saha ,8th, Mc Graw Hill
8	Digital Fundamentals, Floyed & Jain ,8th,2005,Pearson

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Digital System Design	Prof. Neeraj Goel	IIT Ropar
	Course Link: https://nptel.ac.in/courses/108106177		
2	**Digital Electronic Circuits**	Prof. Goutam Saha	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105132		
3	Digital System Design with PLDs and FPGAs	Prof. Kuruvilla Varghese	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/117108040		
4	**Digital Circuits**	Prof. Santanu Chattopadhyay	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105113		

Course Name:	**Microprocessors & Microcontrollers**		
Course Code:	PC-EC402	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concept of Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce architecture and operation of microprocessor and microcontroller
2	To learn assembly language programming for microprocessor and microcontroller
3	To understand and design microprocessor and microcontroller based real world applications.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Introduction to embedded systems, evolution of microprocessors and microcontrollers, difference between microprocessor and microcontroller, block diagram of a microprocessor-based system, applications of embedded systems in consumer, industrial, and automotive domains. Number systems, data representation, and Instruction execution cycle.	4L
2	Architecture of 8085 microprocessor, register organization, pin configuration and signal description, addressing modes, instruction set and classification, flag register. Assembly language programming: data transfer, arithmetic and logical operations, looping and branching, delay routines. Stack, subroutines, and interrupts.	10L
3	Memory interfacing techniques, address decoding, interfacing of RAM and ROM. I/O interfacing concepts, memory-mapped and I/O- mapped I/O. Programmable Peripheral Interface (8255) architecture and modes of operation. Interfacing of simple input/output devices such as LEDs, switches, and stepper motors. Application examples of 8085-based systems. Concept of Direct Memory Access (DMA).	4L
4	Need for 16-bit microprocessors and evolution from 8085 to 8086. Architecture of 8086 including BIU and EU. Register organization and memory segmentation with practical address computation. Addressing modes and instruction set overview. Assembly programming for data handling and string operations. Interrupts and basic system design concepts. Minimum and maximum mode operation. Concept of Pipelining operation.	8L
5	Architecture and features of the 8051 microcontroller, memory organization, register banks, special function registers, I/O ports, timers and counters, interrupt structure, and serial communication. Assembly language programming and interfacing of basic input/output devices. Introduction to sensor and actuator interfacing and simple embedded system applications.	10L
6	Introduction to low-power microcontrollers (MSP430): Salient features and architecture of low-power microcontrollers, low-power operating modes, and basic application examples.	4L
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the architecture, operation, and programming model of 8-bit and 16-bit microprocessors and microcontrollers.
2	Develop and analyze assembly language programs for data processing, control, and simple real-time applications.
3	Interface memory, I/O devices, sensors, and actuators with microprocessors and microcontrollers for practical applications.
4	Compare legacy microprocessors and modern low-power microcontrollers and apply appropriate devices for basic embedded system applications.

Learning Resources:	
1	Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 2018, Penram International Publishing. .
2	Fundamentals of Microprocessor and Microcomputer, B Ram, 2025, Dhanpat Rai Publications.
3	Advanced Microprocessor and Peripherals, K M Bhurchandi, A K Ray, 2017, McGraw Hill Education.
4	The 8051 Microcontroller, Kenneth J. Ayala, 2007, PenramInternational Publishing
5	The 8051 Microcontroller and Embedded Systems: Using Assembly and C, M. A. Mazidi, J. G. Mazidi and R D McKinlay, 2007, Pearson.
6	Microprocessors & Interfacing, Douglas V. Hall and SSSP Rao, 2017, McGraw Hill Education.
7	Computer Organization and Design: The Hardware/Software Interface, David A. Patterson, John L. Hennessy, 2016, Morgan Kaufmann Publishing.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	NPTEL course: Microprocessors And Microcontrollers	Prof. Santanu Chattopadhyay	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105102		
2	NPTEL course: Microprocessors And Microcontrollers	Prof. Krishna Kumar	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/106108100		

Course Name:	**Control System**		
Course Code:	PC-EC403	**Category:**	Professional Core
Semester:	Sixth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic knowledge of mathematics: Laplace Transform, Matrix, Circuit Theory
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To make the students knowledgeable with control system and make them able to illustrate the mathematical representation of the real SISO & MIMO systems.
2	To make the students able to determine the system response to analyze the transient & steady state performance of different systems.
3	To make the students efficient to analyze the stability of the systems using different techniques and be able to design some classical control system.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Concepts of Control Systems, Classification of control systems, Open Loop and closed loop control systems and their differences, Feed-Back Characteristics, Effects of feedback. Different examples of control systems.	5L
2	**Mathematical Modelling and Transfer Function of Physical Systems:** Mathematical modeling of electrical and mechanical systems, transfer function of DC servo motor, Mechanical and electrical analogous systems, block diagram representation of systems considering electrical systems as examples, block diagram reduction technique and signal flow graph, mason's gain formula.	5L
3	**Time Response Analysis:** Standard test signals, time response of first order systems, characteristic equation of feedback control systems, transient response of second order systems, time domain specifications, steady state response, steady state errors and error constants, effects of proportional derivative, proportional integral systems.	5L

4	**Stability Analysis in S-Domain:** The concept of stability- Routh's stability criterion, absolute, relative, conditional and bounded input, bounded output stability, limitations of Routh's stability. The root locus concept, construction of root loci, effects of adding poles and zeros to G(s)H(s) on the root loci.	5L
5	**Frequency Response Analysis:** Introduction, frequency domain specifications, bode diagrams-determination of frequency domain specifications and transfer function from the bode diagram, phase margin and gain margin, stability analysis from bode plots, polar plot, Nyquist plots, stability analysis.	6L
6	**Classical Control Design Techniques:** Improvement of system performance through compensation. Lead, Lag and Lead- lag compensation, and P, PI, PD and PID control.	4L
7	**State variable Analysis:** Concepts of state variables. State space model formation of physical system. Solution of state equations, Eigen values, State transition matrix and its properties. Concept of controllability and observability.	5L
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand basic knowledge of control system and illustrate mathematical representation of the real SISO & MIMO systems.
2	Determine the system response to analyze the transient & steady state performance of the systems.
3	Analyze the stability of system using different techniques.
4	Design some classical control system and perform stability analysis.

Learning Resources:	
Recommended Text Books	
1	Control Systems Engineering– by I. J. Nagrath and M. Gopal, New Age International
2	Control System Engineering– by P. Ramesh Babu, SCITECH
3	Automatic Control Systems 8th edition– by B. C. Kuo 2003– John Wiley and son's
Alternative Text Books	
4	Modern Control Engineering– by Katsuhiko Ogata– Prentice Hall of India Pvt. Ltd.,
5	Linear Control Systems– by B. S. Manke – Khanna Publishers
Reference Books	
6	Automatic control systems – S. Hasan Saeed, S.K. Kataria & Sons
7	Control System , Madan Gopal, MH

NPTEL Link

8	https://www.youtube.com/watch?v=ZVLbrBO4mlo http://www.digimat.in/nptel/courses/video/107106081/L34.html https://nptel.ac.in/courses/107106081 https://nptel.ac.in/courses/115108104

Course Name:	**Design Thinking**		
Course Code:	ES-EC401	**Category:**	Engineering Science
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	-
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To impart basic understanding of the fundamentals of design thinking
2	To impart knowledge about the usage of basic tools, techniques & approaches of design thinking
3	To impart an insight to learning
4	To introduce concept of prototyping and testing
5	To Use Design Thinking to Enhance Customer Experience,

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**An Insight to Learning -** Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting. Remembering Memory - Understanding the Memory process, Problems in retention, Memory enhancement techniques, Emotions: - Experience & Expression, Understanding Emotions- Experience & Expression, Assessing Empathy, Application with Peers.	5L
2	**Basics of Design Thinking** - Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) – Empathize, Define, Ideate, Prototype, Test Being Ingenious & Fixing Problem - Understanding Creative thinking process, Understanding Problem Solving, Testing Creative, Problem Solving, Process of Product Design - Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Engineering Product Design.	9L

3	**Prototyping & Testing** - What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample, Example, Test Group Marketing, Celebrating the Difference - Understanding Individual differences & Uniqueness, Group Discussion and Activities to encourage Understanding, acceptance and appreciation of Individual differences.	6L
4	**Design Thinking, Customer Centricity and Originality assurance -** Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design, Feedback, Re-Design & Re-Create Feedback loop, Focus on User Experience, Address "ergonomic challenges, User focused design, rapid prototyping & testing, originality check, final product, "Solving Practical Engineering Problem through Innovative Product Design & Creative Solution".	6L
Total		**26L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Compare and classify the various learning styles and memory techniques and apply them in their engineering education.
2	Analyze emotional experience and inspect emotional expressions to better understand users while designing innovative products
3	Develop new ways of creative thinking and learn the innovation cycle of design thinking process for developing innovative products
4	Propose real-time innovative engineering product designs and choose appropriate frameworks, strategies, techniques during prototype development
5	Relate individual differences and its impact on everyday decisions and further create a better customer experience
6	Apply design thinking approach while developing practical solutions for real world problems.

Learning Resources:	
1	E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company
2	Yousef Haik, Sangarappillai Sivaloganathan, Tamer M. Shahin, Engineering Design Process, Cengage Learning 2003, Third Edition, ISBN-10: 781305253285,
3	Voland, G., Engineering by Design, Pearson India 2014, Second Edition, ISBN
4	Philip Kosky, Robert Balmer, William Keat, George Wise, Exploring Engineering, Fourth Edition: An Introduction to Engineering and Design, Academic Press 2015, 4th Edition,ISBN: 9780128012420
5	Clive L. Dym, Engineering Design: A Project-Based Introduction, John Wiley & Sons, New York 2009, Fourth Edition, ISBN: 978-1-118-32458-5
6	Pahl, G., Beitz, W., Feldhusen, J., Grote, K.-H., Engineering Design: A Systematic Approach, Springer 2007, Third Edition, ISBN 978-1-84628-319-2
7	Nigel Cross, Design Thinking: Understanding How Designers Think and Work, Berg Publishers 2011, First Edition, ISBN: 978-1847886361.

Course Name:	**Vedic Mathematics (Indian Knowledge System-II)**		
Course Code:	BS-M401	**Category**	Basic Science Course
Semester:	4th	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on Śulba Sutra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:		
Module No.	**Description of Topic**	**Conduct Hrs.**
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata, Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	3L
2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and sub- sutras, Vedic sutras for addition- Purna puranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	3L
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva– Tiryag bhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method, Vilokanam), and cubes (Yāvadunam).	5L
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya Samuccaya Gunita, Solution of quadratic equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat,	5L
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4×4 using Urdhva Tiryag Sutra, Inverse of matrices using Vedic approaches.	3L
6	Vedic Geometry and Śulba Sūtra Concepts: Geometrical ideas from Śulba Sūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	5L
Total		**24 L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and Sulba Sūtra texts.

Learning Resources:	
1	"Vedic Mathematics" by Bharati Krishna Tirthaji, Motilal Banarsidass Publishing.
2	"Essentials of Vedic Mathematics" by Rajesh Kumar Thakur, Rupa Publications.
3	"Vedic Mathematics for All Ages" by Vandana Singhal, Motilal Banarsidass Publishing.
4	"Elements of Vedic Mathematics" by Udayan S. Patankar & Sunil M. Patankar, TTU Press.
5	"Vedic Mathematics Made Easy" by Dahaval Bathia, Jaico Publishing House.
6	"Vedic Mathematics: The Problem Solver" by Ronak Bajaj, Black Rose Publications.
7	"Vedic Geometry Course" by S. K. Kapoor, Lotus Press.
8	"The Śulba Sūtras" by S. N. Sen & A. K. Bag (Eds.), Indian National Science Academy.
9	"Geometry in Ancient and Medieval India" by T. A. Sarasvati Amma, Motilal Banarsidass Publishing

Course Name:	**Biology for Engineers**		
Course Code:	BS-BIO401	**Category:**	Basic Science Courses
Semester:	4th	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Physics (BS-PH201), Chemistry (BS-CH101) and Mathematics (BS-M101)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To develop an understanding of biological systems from an engineering perspective, including fundamental concepts of cell structure and function.
2	To explain the physiological principles of neuron function and human organ systems relevant to bioengineering applications.
3	To introduce bio-design principles for analyzing and modeling biological systems using engineering approaches.
4	To equip students with the knowledge and skills necessary for bioengineering applications, enabling the development of advanced technological solutions for societal improvement.
5	To promote interdisciplinary research aptitude by integrating concepts from biology and engineering for innovative problem solving.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to bio engineering and cell structure:** Need to study Biology: – Life Science Studies Significance – Bio Inspired Inventions – Role of Biology in Next Generation Technology Development – Cell Structure – Cell Potential – Action Potential – introduction to Bio signals– Sodium Potassium channels– Neuron function	5L
2	**Human Organ Systems and Bio Design-I:** Brain as a CPU system- Structure, CNS and Peripheral Nervous System, Signal transmission, EEG-application for prosthetic control and neurological disease diagnosis and prognosis. Eye as a Camera system- Structure of rod and cone cells, optical corrections, cataract, lens materials, bionic eye. Heart as a pump system- Structure, Electrical signaling – ECG monitoring and heart related issues, reasons for blockages of blood vessels, Principles of pacemakers and defibrillators.	6L
3	**Human Organ Systems and Bio Design-II:** Lungs as purification system- Structure, gas exchange mechanisms, Spirometry, Abnormal lung physiology- Chronic Obstructive Pulmonary Disease (COPD), Principles of Ventilators and Heart-lung machine. Kidney as a filtration system- Structure, mechanism of filtration, Chronic Kidney Disease (CKD), Principle of Dialysis systems. Musculoskeletal System- Structure, mechanisms, EMG, Engineering solutions to musculoskeletal disorders- assistive devices, exoskeletons.	5L
4	**Nature- Bioinspired Materials and Mechanisms:** Echolocation (ultrasonography, sonars), Photosynthesis (photovoltaic cells, bionic leaf). Bird flying (GPS and aircrafts), Lotus leaf effect (Super hydrophobic and self-cleaning surfaces). Genetics: Concepts of recessiveness and dominance. Concept of mapping of phenotype to genes.	4L
5	**Trends in Bioengineering:** Bioprinting techniques and materials, 3D printing of ear, bone and skin. Electronic tongue and electronic nose in food science, Principles of Bio-imaging for disease diagnosis.	4L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify the origin of bio signals and their relevance in biological systems.

2	Compare Brain as a CPU System, Eye as a Camera system, Heart as a pump system, Lungs as purification system, Kidney as a filtration system, and Musculoskeletal System as support system.
3	Describe various diagnostic tools and techniques related to Human Organ Systems and Bio Design.
4	Demonstrate the mechanism of Nature-Bioinspired Materials.
5	Explain Bio-printing, 3D Printing, and Bioengineering (Understand level)

Learning Resources:	
Recommended Text Books:	
1	Human Physiology, Stuart Fox, Krista Rompolski, McGraw-Hill eBook. 16th Edition, 2022.
2	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., Tata McGraw-Hill, New Delhi, 2012.
Reference Books:	
3	Biology for Engineers, Arthur T. Johnson, CRC Press, Taylor and Francis, 2011.
4	Biomedical Instrumentation, Leslie Cromwell, Prentice Hall 2011.
5	Biology for Engineers, Sohini Singh and Tanu Allen, Vayu Education of India, New Delhi, 2014.
6	Biomimetics: Nature-Based Innovation, Yoseph Bar-Cohen, 1st edition, 2012, CRC Press.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Fabrication Techniques for MEMs- based Sensors: Clinical Perspective	Prof. Hardik Jeetendra Pandya	IISc Bangalore
	Course Link: https://onlinecourses.nptel.ac.in/noc25_ee144/preview		
2	Basics of Biology	Prof. Vishal Trivedi	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc26_bt16/preview		

Course Name:	**Leadership Skill and Management (Jeevan Kaushal- III)**		
Course Code:	HM-HU 401	**Category:**	Management Science
Semester:	4th	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concept of Management
Full Marks:	100		
Examination Scheme:	Semester Examination:70	Semester Examination:70	Semester Examination:70

Course Objectives:	
1	To develop effective leadership skills such as communication, motivation, decision- making, and emotional intelligence for managing individuals and teams.
2	To understand leadership theories and managerial practices and apply them to real- world organizational situations.
3	To enhance team management and conflict resolution abilities, enabling leaders to build high-performing and cohesive teams.
4	To foster ethical, strategic, and adaptable leadership, preparing learners to lead organizations responsibly in a dynamic and competitive environment.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Introduction to Leadership & Management:** Meaning, nature, and levels of leadership; Leadership vs Management; Importance of leadership in professional and personal contexts; Leadership traits, roles, and responsibilities; Leadership and Life Skills synergy (NEP 2020)	4L
2	**Leadership Theories and Styles:** Great Man Theory; Trait Theory; Behavioral Theories (Ohio State, Michigan); Contingency Theories (Fiedler, Path-Goal); Leadership styles: Transformational, Transactional, Servant, Situational	4L
3	**Core Leadership Skills Development:** Effective Communication; Active Listening; Emotional Intelligence & Self-awareness; Decision-making and Problem-solving; Time Management and Priority Setting; Creativity and Critical Thinking	6L

4	**Team Leadership & People Management:** Team building fundamentals; Motivation: Theories and workplace application; Conflict resolution & negotiation skills; Coaching & mentoring approaches; Cultural sensitivity and diversity in teams	4L
5	**Ethical Leadership & Social Responsibility:** Ethical decision-making; Corporate Social Responsibility & sustainability in leadership; Personal values and ethical dilemmas; Building trust and accountability	3L
6	**Practical Leadership Application & Case Studies:** Case studies of successful leaders; Leadership challenges in startups and corporate environments; Group activities: role-plays, simulations, reflection logs; Personal leadership action plan	3L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	To develop leadership and teamwork skills required for managing technical teams, projects, and multidisciplinary work environments.
2	To enhance communication, decision-making, and problem-solving abilities, enabling students to lead technical tasks and projects effectively.
3	To build ethical, professional, and responsible leadership qualities, essential for engineers in organizational and societal contexts.
4	To prepare students for managerial and leadership roles in the engineering profession, fostering adaptability, innovation, and lifelong learning in a rapidly changing technological landscape

Learning Resources:	
1	Hughes, Ginnett & Curphy; Leadership; 9th Indian Edition; Mc Graw Hill
2	Gary Yukl: Leadership in organisations, Pearson Education, New Delhi.
3	L M Prasad: Organisational Behaviour, Sultan Chand & Sons, New Delhi.
4	P. Guggenheimer & M. Diana Szulc: Understanding Leadership Competencies, Viva, books, New Delhi

Course Name:	**Digital Electronic Circuits Laboratory**		
Course Code:	PC-EC491	**Category:**	PC [Professional Core]
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Electrical & Electronics Laboratory ES-EE191
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Introduction to digital lab related all required circuit components.
2	Developing concept of different combinational circuit making and verifying its operations.
3	Developing concept of different sequential circuit making and verifying its operations.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Realization of basic gates using Universal logic gates.	2
2	Implementation of the Given Boolean Function using Logic Gates in Both SOP and POS Forms.	2
3	Realization of suitable code conversion circuits and vice-versa.	2
4	Realization of parity generator and comparator circuits.	2
5	Construction of simple Encoder and Multiplexer circuits using logic gates.	2
6	Construction of simple Decoder and De-Multiplexer circuits using logic gates.	2
7	Construction of simple arithmetic circuits-Adder, Substractor.	2
8	Realization of RS, JK, T and D flip-flops using suitable logic gates.	2
9	Realization of Asynchronous Up/Down counters.	2

10	Realization of Synchronous Up/Down counters.	2
11	Design of Sequential Counter with irregular sequences.	2
12	Realization of Ring counter and Johnson‟s counter.	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify the various digital ICs and understand their operation
2	Develop the concept of Boolean laws and digital systems.
3	Apply Boolean laws for the different combinational logic circuit design.
4	Design the different sequential logic circuits.

Learning Resources:	
1	Digital Logic and Computer Design, Morries Mano, 2016, Pearson India
2	Modern Digital Electronics, R.P.Jain, 4th ,2010, Mc Graw Hill
3	Digital Electronics: Principles, Devices and Applications, A.K.Maini,2007, Wiley India
4	Fundamentals of Digital Circuits, A.Anand Kumar , 3rd, PHI
5	Digital Systems Principles and Applications, Ronald J. Tocci , Neal S.Widmer & Gregory L. Moss, 10th, 2007,Pearson
6	Digital Electronics Principles and Applications, S.K.Mandal, 2010, Mc Graw Hill.
7	Digital Principles and Application, Leach, Malvino & Saha ,8th, Mc Graw Hill
8	Digital Fundamentals, Floyed & Jain ,8th,2005,Pearson.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	**Digital System Design**	Prof. Neeraj Goel	IIT Ropar
	Course Link: https://nptel.ac.in/courses/108106177		

2	**Digital Electronic Circuits**	Prof. Goutam Saha	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105132		
3	Digital System Design with PLDs and FPGAs	Prof. Kuruvilla Varghese	IISc Bangalore
	Course Link: https://nptel.ac.in/courses/117108040		
4	**Digital Circuits**	Prof. Santanu Chattopadhyay	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/108105113		

Course Name:	**Microprocessors and Microcontrollers Lab**		
Course Code:	PC-EC492	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To write and execute assembly language program using a trainer kit and simulator.
2	To understand interfacing.
3	To design and implement microprocessor and microcontroller based applications.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Familiarization with 8085 simulator/development kit. Assembly language programs using 8085 for data transfer, arithmetic, and logical operations.	2
2	8085 Programs using looping, branching, and delay routines. Application-based tasks such as LED blinking and software-based counters.	2

3	Interfacing LEDs, switches, or seven-segment displays using 8255 Programmable Peripheral Interface. Control word programming.	2
4	Implementation of a simple application such as digital clock / stepper motor control / sensor-based alarm system using 8085.	2
5	Basic assembly language programs for 8086 covering data transfer, arithmetic operations, using trainer kit / simulator.	2
6	Familiarization with 8051 simulator/development kit. Assembly language programming of 8051 for data transfer, arithmetic, and logical operations.	2
7	8051 I/O port operation. Interfacing LEDs and switches.	2
8	Serial communication using UART or interfacing a basic sensor (temperature/light) with data display or indication.	2
9	Basic programming of MSP430 microcontroller.	2
10	Implementation of a small embedded application integrating concepts learned (any microprocessor / microcontroller platform). Examples: automatic streetlight controller, digital counter, or sensor- based alert system etc.	4
Total		**32**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Write and execute assembly language programs for microprocessors and microcontrollers to perform basic data processing and control tasks.
2	Interface and test basic input/output operations using on-board resources and development tools.
3	Implement and verify simple application-oriented experiments using microprocessors and microcontrollers.

Learning Resources:	
1	Microprocessor Architecture, Programming and Applications with the 8085, Ramesh Gaonkar, 2018, Penram International Publishing. .
2	Fundamentals of Microprocessor and Microcomputer, B Ram, 2025, Dhanpat Rai Publications.
3	Advanced Microprocessor and Peripherals, K M Bhurchandi, A K Ray, 2017, McGraw Hill Education.
4	The 8051 Microcontroller, Kenneth J. Ayala, 2007, Penram International Publishing
5	The 8051 Microcontroller and Embedded Systems: Using Assembly and C, M. A. Mazidi, J. G. Mazidi and R D McKinlay, 2007, Pearson.
6	Microprocessors & Interfacing, Douglas V. Hall and SSSP Rao, 2017, McGraw Hill Education.
7	Computer Organization and Design: The Hardware/Software Interface, David A. Patterson, John L. Hennessy, 2016, Morgan Kaufmann Publishing.

Course Name:	**Control System Lab**		
Course Code:	PC-EC493	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Knowledge of required simulation software
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of importance of simulation software.
2	Apply the concepts of simulation software to determine the step, impulse response for 1st and 2nd order system with increased system Type.
3	Determination of time and frequency domain analysis for different Type and order of System using simulation software toolbox
4	Study of Compensator and Controller using simulation software

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Familiarization with simulation software Control System tool Box.	2
2	Introduction to simulation software and determination of transient response for1st order & 2nd order system.	2
3	Determination of step response for 1st order & 2nd order system with Unity feedback and calculation of control system specifications for variations of system design.	4
4	Simulation of step response & impulse response for Type- I & Type- II system with unity feedback using simulation software.	2
5	Determination of root locus using simulation software control system toolbox for a given 2nd order transfer function & determination of different control system specifications	2
6	Determination of Bode-plot, Nyquist Plot, using simulation software control system toolbox for a given 2nd order transfer function & determination of different control system specifications	4
7	Evaluation of steady-state error, setting time, percentage peak overshoots, gain margin, phase margin with addition of lead compensator in forward path transfer functions using simulation software.	2
8	Determination of PI, PD, and PID controller action on1st order simulated process using simulation software.	4
9	Determination of approximate transfer function experimentally using Bode Plot.	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use different simulation software Control System tool Box.
2	Use the concepts of simulation software to determine the step, impulse response for 1st and 2nd order system with increased system Type.
3	Determine the time and frequency domain analysis with Root Locus, Bode Plot, and Nyquist plot for different Type and order of system using simulation software toolbox.
4	Determine the compensator and controller actions using simulation software.

Learning Resources:	
1	Laboratory Manual

Course Name:	**Micro Project**		
Course Code:	PW-EC481	**Category:**	Sessional
Semester:	4th	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Analog Electronics, Digital Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 30 (Viva)	Continuous Assessment:60	Attendance: 10

Course Objectives:	
1	To impart the essential knowledge of electronic circuit design through real-life applications.
2	To enhance hands on experience by hardware and /or simulation and encourage innovativeness.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Guidelines**: The micro-project is a team activity having 3-4 students in a team. Micro Project should cater to a small electronic system required in laboratory or real-life application The micro project may be a complete hardware or hardware with small programming aspect. It should encompass electronics components, devices, analog or digital ICs, micro controller etc. Based on need analysis the title and objectives of Micro-project will be decided. **Each group should perform any five of the following:**	5
2	Design of an automatic street light controller circuit based on ambient light.	5
3	Design of a wave shaping circuit.	5

4	Design of a pocket piano: A simple musical instrument.	5
5	Design a system that simplifies logic expressions to generate 4-bit data, stores it at a predefined RAM location, retrieves it, and verifies the result.	5
6	Design of a fastest finger fast circuit for quizzers.	5
7	Design of a 4-bit parallel multiplier Circuit.	5
8	Design of a 4-bit serial adder/Substractor composite unit.	5
9	Noise reduction from ECG signal using MATLAB.	5
10	Design and implement a non-inverting adder circuit.	5
11	Design of a power efficient mini-inverter.	5
12	Design and Implementation of a Digital Stopwatch	5
13	Design of a Solar Battery Charging Controller Circuit	5
14	Design of a Smart Door Security System	5
15	Design of a Mosquito Repelling Circuit.	5
16	Design of Person counter in a room.	5

Learning Resources:	
Recommended Text Books	
1	Data Sheets of Electronics Components, ICs, Sensors and Microcontrollers.
2	Lab Manual.
3	Electronics For You Magazine.

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify and define a problem statement from the requirements raised from literature survey /need analysis

2	Build and test electronic circuits/prototype for developing laboratory requirement/ real life small electronic applications.
3	Work in teams, write comprehensive report of the project work

Course Name:	**Idea Laboratory**		
Course Code:	AU-EC492	**Category:**	Audit Course
Semester:	Fourth	**Credit:**	0
L-T-P:	2-0-4	**Pre-Requisites:**	Basic Electronics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 40	Attendance: 00

Course Objectives:	
1	To impart familiarization with electronic components and devices.
2	To impart knowledge about usage of CAD tools.
3	To impart hands on training of electronic circuit soldering.
4	To impart knowledge about schematic design of electronic circuits and their PCB layout.
5	To impart familiarization with Arduino and Raspberry pi boards and their applications.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Familiarization of Electronic components and devices- CRO, Function Generator, DSO.	4
2	Study of DMM and LCR Bridge.	4
3	Basic 2D designing using CAD tools.	4
4	Basic 3D designing using CAD tools.	4
5	Electronic Circuit soldering using soldering iron.	2
6	Schematic design of electronic circuit and its single layer single sided PCB layout	4

7	Schematic design of electronic circuit and its single layer double sided PCB layout	4
8	Familiarization of Arduino board and Raspberry pi board to study analog and digital circuits.	4
9	Ideation to prototype design of electronic circuits	8
Total		**38**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify and explain usage of electronic components and devices.
2	Design using CAD tools.
3	Use soldering iron to solder electronic circuits.
4	Design electronic circuits and their PCB layout.
5	Explain operations of Arduino and Raspberry pi boards and use them for applications.

Learning Resources:	
1	Neamen- Semiconductor Physics and Devices TMH
2	Streetman Banerjee-Solid State Devices-PHI
3	Boylestad & Nashelsky- Electronics Devices and Circuit Theory- Pearson
4	Milman & Halkias - Electronics Devices and Circuits- TMH
5	Bhattacharya & Sharma- Solid State Electronic Devices- Oxford

Detailed Curriculum for Undergraduate Degree
B. Tech in Information Technology
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Discrete Mathematics**		
Course Code:	ES-IT401	**Category:**	Engineering Science
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	BS-M101, BS-M201
Full Marks:	100		
Examination Scheme:	Semester Examination:70	Continuous Assessment:25	Attendance:05

Course Objectives:	
1	To know about Set-Relation-Function and Number theory.
2	To learn counting techniques and apply the concept of generating function in solving recurrence relations.
3	To learn about different algebraic structures.
4	To use the concept of graph theory in engineering problems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Sets-Relation-Function** • Introduction to Set theory, Partial Order Relation, Lattice **Number Theory**	10L

	• Introduction to Number theory, Division Algorithm, Prime Numbers, Fundamental Theorem of Arithmetic, Greatest Common Divisor, Least Common Multiple, Euclidean Algorithm, Diophantine Equation, Congruence and Residue Classes of Integer Modulo *n.*	
2	**Combinatorics** • Basic Counting Techniques, Inclusion and Exclusion Theorem • Permutation and Combination • Pigeon-Hole Principle • Recurrence Relation, Generating Functions	6L
3	**Abstract Algebra** • Group, Subgroup, Cyclic group, Permutation group, Symmetric group. • Coset, Lagrange's Theorem, Normal Subgroup, Quotient group • Homomorphism and Isomorphism of groups • Rings, Integral Domain and Fields	12L
4	**Advanced Graph Theory** • Planar and Dual graph: Kuratowski's graphs, Euler's formulae for connected and disconnected planar graphs, Detection of planarity • Graph Coloring: Vertex coloring, Chromatic number of complete graphs, circuit and bipartite graph, Chromatic polynomial • Connectivity and matching	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply set theory and number theory concepts to the field of computer science and engineering
2	Apply combinatorial techniques to solve counting problems and solve recurrence relations using generating functions.
3	Classify algebraic structure for a given mathematical problem.
4	Utilize techniques of graph theory to model and solve engineering problems.

Learning Resources:	
1	"Discrete Mathematics" by N. Chandrasekaran and M. Umaparvathi, PHI
2	"Discrete Mathematics" by J.K. Sharma, Macmillan Publication
3	"Discrete Mathematics" by S. K. Chakraborty and B. K. Sarkar, OXFORD University Press.
4	"Graph Theory" by N. Deo, Prentice Hall of India.
5	"Discrete Structures" by S.B. Singh, Khanna Publishing House (AICTE Recommended Textbook – 2018)
6	"Higher Algebra: Classical" by S.K. Mapa, Levant Publishers
7	"Higher Algebra: Abstract and Linear" by S.K. Mapa, Levant Publishers.

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Discrete Mathematics	Prof. Sudarshan Iyengar	IIT Ropar
2	Discrete Mathematics for CS	Prof. Nitin Saxena	IIT Kanpur

Course Name:	**Database Management System**		
Course Code:	PC-IT401	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of Data Structure & Algorithms and Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the fundamental concepts and applications of database systems, including data models, database languages, and diagrammatic approaches for database design.

2	To understand and explain the logical and mathematical foundations of database systems, and to apply these concepts in learning database implementation languages.
3	To understand and develop relational database design principles for efficient data organization.
4	To understand and explain the internal operations of database systems, including transaction management and data storage architecture.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Database Models, Schema, and System Architecture: Overview of databases and DBMS; advantages of the DBMS approach; database users and roles; responsibilities of the Database Administrator (DBA); data models and their categories; database schema and instances; database languages; three-schema architecture of DBMS; data independence. Entity–Relationship (ER) Model: Basic concepts of the ER model; design issues; cardinality constraints; entity types and entity sets; attributes and keys; Entity–Relationship diagrams; weak entity sets; extended ER modeling concepts including generalization, specialization, and aggregation.	9L
2	Relational Model and Query Processing: Relational model concepts including domains, attributes, tuples, and relations. Relational algebra operators such as select, project, rename, Cartesian product, various types of joins, division, intersection, union, and set difference (minus). Tuple relational calculus and domain relational calculus. Extended relational algebra operations. Query Processing and Database Programming: Concepts of database languages including DDL, DML, and DCL. Domain constraints and referential integrity constraints. Query structure and nested subqueries. Views, stored procedures, and triggers. Overview of query processing and query optimization techniques.	10L
3	Relational Database Design and Normalization: Basic concepts of functional dependencies; axioms; closure and attribute closure; equivalence of sets of functional dependencies; canonical cover. Normalization concepts including super keys, candidate keys, and primary keys; determination of candidate keys using functional dependencies; anomalies in database design; normal forms such as First Normal Form (1NF), Second Normal Form (2NF), Third Normal Form (3NF), Boyce–Codd Normal Form (BCNF), and Fourth Normal Form (4NF); multivalued dependencies. Lossy and lossless decomposition; denormalization in databases.	9L
4	Transaction Processing, Recovery Management, and Storage Structures: Basic concepts of transactions, schedules, and ACID properties. Concurrency control mechanisms including conflict and view serializability. Recovery management concepts including transaction models and properties, transaction states, serializability, lock-based protocols, and two-phase locking (2PL).	8L

	File and record organization concepts including placement of file records on disk; fixed-length and variable-length records. Indexing techniques including single-level indexes (primary, secondary, and clustering), multilevel indexing, and dynamic multilevel indexing using B-tree and B+ tree structures.	
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Gain a clear understanding of database systems and database design principles.
2	Learn database design concepts using logical and mathematical foundations such as relational algebra and relational calculus, which will further extend to the study of SQL.
3	Develop an understanding of relational database design through the principles of normalization.
4	Understand the internal workings of a DBMS, including transaction management and the data storage architecture of a database system.

Learning Resources:	
1	Henry F. Korth and Silberschatz Abraham, "Database System Concepts", Mc.Graw Hill.
2	Elmasri Ramez and Navathe Shamkant, "Fundamentals of Database Systems", Benjamin Cummings Publishing Company.
3	Ramakrishnan: Database Management System, McGraw-Hill.
4	Gray Jim and Reuter Address, "Transaction Processing: Concepts and Techniques", Moragan Kauffman. Publishers.
5	James Martin, "Principles of Database Management Systems", 1985, Prentice Hall of India, New Delhi.
6	"Fundamentals of Database Systems", Ramez Elmasri, Shamkant B. Navathe, Addison Wesley Publishing Edition
7	"Database Management Systems", Arun K. Majumdar, Pritimay Bhattacharya, Tata McGraw Hill.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Database Management System	Prof. Partha Pratim Das Prof. Samiran Chattopadhyay	IIT Kharagpur,
	Course Link: https://nptel.ac.in/courses/106105175		

Course Name:	**Design and Analysis of Algorithms**		
Course Code:	PC-IT402	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	PC-IT301(Data Structure and Algorithms)
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To analyse the asymptotic performance of algorithms.
2	To be familiar with major algorithms and data structures.
3	To apply important algorithmic design paradigms and methods of analysis.
4	To Synthesize efficient algorithms in common engineering design situations.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Characteristics of algorithm; Analysis of algorithm: Asymptotic analysis of complexity bounds – best, average and worst-case behaviour; Performance measurements of Algorithm, Time and space trade-offs; Analysis of recursive algorithms through recurrence relations: Iterative method, Substitution method, Recursion tree method and Masters' theorem.	6L
2	**Fundamental Algorithmic Strategies:** Study of fundamental algorithm design paradigms- Divide and Conquer, Greedy Method, Dynamic Programming, Branch and Bound, and Backtracking, along with applications.	12L
3	**Graph and Tree Algorithms:** Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS); Shortest path algorithms, Transitive closure, Minimum Spanning Tree, Topological sorting, Network Flow Algorithm.	8L
4	**Tractable and Intractable Problems:** Computability of Algorithms, Computability classes – P, NP, NP-complete and NP-hard. Cook's theorem, Standard NP-complete problems and Reduction techniques.	6L
5	**Advanced Topics:** Approximation algorithms, Randomized algorithms, Class of problems beyond NP – P SPACE	4L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand basic algorithm concepts, characteristics, and complexity analysis.
2	Apply major algorithm design techniques Divide and Conquer, Greedy, Dynamic Programming, Branch and Bound and Backtracking to solve problems.
3	Analyze graph and tree algorithms for performance and correctness.
4	Evaluate problems using complexity classes and reduction methods.
5	Design solutions using approximation, randomized, and advanced algorithms.

Learning Resources:	
1	"Fundamentals Of Computer Algorithms" by Horowitz, Sahani, Universities Press
2	"Algorithm Design", 1ST Edition, Jon Kleinberg and Éva Tardos, Pearson.
3	"Algorithm Design: Foundations, Analysis, and Internet Examples", Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
4	"Algorithms - A Creative Approach", 3RD Edition, Udi Manber, Addison-Wesley, Reading, MA

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Design and Analysis of Algorithms	Prof. Abhiram G Ranade, Prof. Ajit A Diwan, Prof. Sundar Viswanathan	IIT Bombay
	Course Link: https://nptel.ac.in/courses/106101060		

Course Name:	**Object Oriented Programming**		
Course Code:	PC-IT403	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic Knowledge of

			Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand object-oriented design principles and programming concepts using the characteristics of the Java programming language.
2	To apply the principles of inheritance, packages, and interfaces in object-oriented program design.
3	To demonstrate the use of exception handling and Java collection classes.
4	To develop synchronized applications using Java threads and to implement generic classes.
5	To design graphical user interfaces using AWT and Swing.
6	To handle networking and database-related problems using Java networking APIs and JDBC tools.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Object Oriented Design:** Concepts of object oriented programming language, Major and minor elements, Object, Class, relationships among objects, aggregation, links, relationships among classes-association, aggregation, using, instantiation, meta-class, grouping constructs, State Modeling	5L
2	**Features of object-oriented programming:** Objects and Classes, Abstraction, Encapsulation, Inheritance, Polymorphism, Modularity	4L
3	**Basic concepts of Object Oriented Programming using Java:** **Class & Object properties:** Basic concepts of java programming – advantages of java, byte-code & JVM, data types, access specifiers, operators, control statements & loops, array, creation of class, object, constructor, finalize and garbage collection, use of method overloading, this keyword, use of objects as parameter & methods returning objects, call by value & call by reference, static variables & methods, garbage collection, nested & inner classes, basic string handling concepts, command line arguments, basics of I/O operations – keyboard input using Buffered Reader & Scanner classes, I/O operation	6L
4	**Reusability properties**:	4L

	Super class & subclasses including multilevel hierarchy, process of constructor calling in inheritance, use of super and final keywords with super() method, dynamic method dispatch, use of abstract classes & methods, interfaces. Creation of packages, importing packages, member access for packages	
5	**Exception Handling and Multithreading :** Exception handling basics, different types of exception classes, use of try & catch with throw, throws & finally, creation of user defined exception classes. Basics of multithreading, main thread, thread life cycle, creation of multiple threads, thread priorities, thread synchronization, inter-thread communication, deadlocks for threads, suspending & resuming threads	4L
6	**Java Collections Framework:** Need for collections, Overview of Java Collections Framework, Collection hierarchy, **List interface**: Array List, Linked List, **Set interface**: Hash Set, Linked Hash Set, Tree Set, **Map interface**: HashMap, Linked Hash Map, Tree Map, Iterator and List Iterator, Comparable and Comparator interfaces, Generics (introduction), Use of collections in real-world applications	5L
7	**Graphical programming with AWT and Swing:** Frame, Components, working with 2D shapes, Using color, fonts, and images, Basics of event handling, event handlers, adapter classes, actions, mouse events, AWT event hierarchy. Introduction to Swing, layout management, Swing Components, Text Fields , Text Areas , Button-Check Boxes-Radio Buttons, Lists, choices, Scrollbars, Windows –Menus – Dialog Boxes	4L
8	***Database Connectivity using JDBC and Java Networking concepts***	4L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Recognize the features of object-oriented design such as encapsulation, polymorphism, inheritance, and composition of systems based on object identity
2	Express basic programming techniques using loops, methods, and arrays within the object-oriented programming paradigm
3	Apply the concepts of encapsulation, inheritance, and polymorphism in the development of object-oriented software solutions
4	Apply Java Collections Framework to store, retrieve, and manipulate data efficiently in object-oriented applications
5	Design applications with event-driven graphical user interfaces and integrate database connectivity with network concepts.
6	Practice effective mapping of real-world interdisciplinary problems into object-oriented programming methodologies.

Learning Resources:	
1	Rambaugh, James Michael, Blaha – "Object Oriented Modelling and Design" – Prentice

	Hall, India
2	Ali Bahrami – "Object Oriented System Development" – McGraw Hill
3	Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
4	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
5	Ivor Horton's Beginning Java 2 SDK – Wrox

Alternative NPTEL/SWAYAM Courses:			
Sl. No.	**NPTEL Course Name**	**Instructor**	**Host Institute**
1	Programming In Java	Prof. Debasis Samanta	IIT Kharagpur

Course Name:	**Vedic Mathematics (Indian Knowledge System-II)**		
Course Code:	BS-M401	**Category**	Basic Science Course
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment:25	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on ŚulbaSūtra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:		
Module No.	**Description of Topic**	**Conduct Hrs.**
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata, Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	3L

2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and sub-sutras, Vedic sutras for addition- Purnapuranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	3L
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva–Tiryagbhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method, Vilokanam), and cubes (Yāvadunam).	5L
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya Samuccaya Gunita, Solution of quadratic equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat,	5L
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4×4 using Urdhva Tiryag Sutra, Inverse of matrices using Vedic approaches.	3L
6	**Vedic Geometry and Śulba Sūtra Concepts:** Geometrical ideas from ŚulbaSūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	5L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and ŚulbaSūtra texts.

Learning Resources:	
1	"Vedic Mathematics" by Bharati Krishna Tirthaji, Motilal Banarsidass Publishing.
2	"Essentials of Vedic Mathematics" by Rajesh Kumar Thakur, Rupa Publications.
3	"Vedic Mathematics for All Ages" by VandanaSinghal, MotilalBanarsidass Publishing.
4	"Elements of Vedic Mathematics" by Udayan S. Patankar& Sunil M. Patankar, TTU Press.
5	"Vedic Mathematics Made Easy" by Dahaval Bathia, Jaico Publishing House.
6	"Vedic Mathematics: The Problem Solver" by Ronak Bajaj, Black Rose Publications.
7	"Vedic Geometry Course" by S. K. Kapoor, Lotus Press.
8	"The ŚulbaSūtras" by S. N. Sen& A. K. Bag (Eds.), Indian National Science Academy.
9	"Geometry in Ancient and Medieval India" by T. A. Sarasvati Amma, Motilal Banarsidass Publishing

Course Name:	**Leadership Skill and Management (JeevanKaushal-III)**		
Course Code:	HM-HU401	**Category:**	Management Science
Semester:	Fourth	**Credit:**	2
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concept of Management
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1.	**To develop effective leadership skills** such as communication, motivation, decision-making, and emotional intelligence for managing individuals and teams.
2.	To understand leadership theories and managerial practices and apply them to real-world organizational situations.
3.	To enhance team management and conflict resolution abilities, enabling leaders to build high-performing and cohesive teams.
4.	To foster ethical, strategic, and adaptable leadership, preparing learners to lead organizations responsibly in a dynamic and competitive environment.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Leadership & Management:** Meaning, nature, and levels of leadership; Leadership vs Management; Importance of leadership in professional and personal contexts; Leadership traits, roles, and responsibilities; Leadership and Life Skills synergy (NEP 2020)	4L
2	**Leadership Theories and Styles:** Great Man Theory; Trait Theory; Behavioral Theories (Ohio State, Michigan); Contingency Theories (Fiedler, Path-Goal); Leadership styles: Transformational, Transactional, Servant, Situational	4L
3	**Core Leadership Skills Development:** Effective Communication; Active Listening; Emotional Intelligence & Self-awareness; Decision-making and Problem-solving; Time Management and Priority Setting; Creativity and Critical Thinking	6L
4	**Team Leadership & People Management:** Team building fundamentals; Motivation: Theories and workplace application; Conflict resolution & negotiation skills; Coaching & mentoring approaches; Cultural sensitivity and diversity in teams	4L
5	**Ethical Leadership & Social Responsibility:** Ethical decision-making; Corporate Social Responsibility & sustainability in leadership; Personal values and ethical dilemmas; Building trust and accountability	3L

6	**Practical Leadership Application & Case Studies:** Case studies of successful leaders; Leadership challenges in startups and corporate environments; Group activities: role-plays, simulations, reflection logs; Personal leadership action plan	3L
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	To develop leadership and teamwork skills required for managing technical teams, projects, and multidisciplinary work environments.
2.	To enhance communication, decision-making, and problem-solving abilities, enabling students to lead technical tasks and projects effectively.
3.	To build ethical, professional, and responsible leadership qualities, essential for engineers in organizational and societal contexts.
4.	To prepare students for managerial and leadership roles in the engineering profession, fostering adaptability, innovation, and lifelong learning in a rapidly changing technological landscape

Learning Resources:	
1.	Hughes, Ginnett & Curphy; Leadership; 9th Indian Edition; McGraw Hill
2.	Gary Yukl: Leadership in organisations, Pearson Education, New Delhi.
3.	L M Prasad: Organisational Behaviour, Sultan Chand & Sons, New Delhi.
4.	P. Guggenheimer& M. Diana Szulc: Understanding Leadership Competencies, Viva, books, New Delhi

Course Name:	**Database Management System Laboratory**		
Course Code:	PC-IT491	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic concepts of Data Structure & Algorithms and Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To enable students to create and modify database objects using SQL by applying appropriate data types and integrity constraints.

2	To develop skills in handling tables and records using data manipulation commands for inserting, updating, deleting, and retrieving data.
3	To provide hands-on experience in writing complex SQL queries involving joins, subqueries, aggregate functions, and views for effective data retrieval and management.
4	To provide hands-on experience in writing complex SQL queries involving joins, subqueries, aggregate functions, and views for effective data retrieval and management.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Creating database objects: creation of tables; specification of relational data types and constraints; use of DROP and ALTER statements; creating database object structures from existing structures. Table and record handling: INSERT, DELETE, UPDATE, and TRUNCATE statements; populating data from other tables using INSERT with SELECT.	12P
2	Retrieving data from a database: SELECT statement; WHERE clause; logical operators; use of IN, BETWEEN, LIKE; ORDER BY, GROUP BY, and HAVING clauses; aggregate functions; joining tables using JOINs; subqueries.	9P
3	Database management: creating views; creating column aliases; creating database users; usage of GRANT and REVOKE commands	6P
4	Oracle PL/SQL stored procedures: conditional and iterative statements; introduction to functions and stored procedures; exception handling. Cursors in Oracle PL/SQL: cursors and their applications; triggers.	9P
Total		**36P**

Course Outcomes:

After completion of the course, students will be able to:

1	Create, alter, and manage database objects using SQL with appropriate data types and constraints.
2	Perform table and record operations and retrieve data using SQL queries involving conditions, joins, subqueries, and aggregate functions.
3	Implement database management features such as views, user creation, and access control using GRANT and REVOKE commands.
4	Develop PL/SQL programs using procedures, functions, cursors, triggers, and exception handling to solve database-oriented problems.

Learning Resources:	
1	SQL,PL/SQL the Programming Language of Oracle by Ivan Bayross.
2	SQLin10Minutes, Sams Teach Yourself (4thEdition)
3	SQL The Complete Reference by Groff James.
4	SQL:QuickStartGuide–TheSimplifiedBeginner'sGuideToSQLbyClydebankTechnology
5	Oracle PL/SQL Programming by Feuerstein, Steven.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Database Management System	Prof. Partha Pratim Das Prof. Samiran Chattopadhyay	IIT Kharagpur,
	Course Link: https://nptel.ac.in/courses/106105175		

Course Name:	**Design and Analysis of Algorithms Laboratory**		
Course Code:	PC-IT492	**Category:**	Professional Core Courses
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	PC-IT391(Data Structure and Algorithms Laboratory)
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To develop skills to design and analyse fundamental algorithms
2	To strengthen the ability to identify and apply the suitable algorithm for the given real world problem
3	To gain knowledge in practical applications and role of computational complexity to determine the efficiency of an algorithm

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Divide and Conquer Methodology:** a. Binary Search algorithm with theoretical performance analysis b. Merge Sort algorithm with theoretical performance analysis. c. Quick Sort algorithm with theoretical performance analysis.	4P
2	**Greedy Methods:** a. Knapsack Optimization problem. b. Job Sequencing with Deadlines.	4P
3	**Dynamic Programming Technique :** a. Chain Matrix Multiplication b. Traveling Salesman problem	8P
4	**Graph Algorithm :** a. Breadth First Search (BFS) algorithm & Depth First Search (DFS) algorithm. b.Prim's algorithm & Kruskal's algorithm. c. Dijkstra Algorithm &Bellman-Ford. d. Floyed & Warshall.	12P
5	**Branch and Bound Technique :** 15-Puzzle problem.	4P
6	**Backtracking :** a. 8 Queens problem b. Graph Coloring problem	8P
Total		**40P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Implement recursive divide-and-conquer algorithms such as Binary Search, Merge Sort, and Quick Sort.
2	Use greedy methods to obtain optimal solutions for Knapsack and Job Sequencing problems.
3	Apply dynamic programming techniques to solve Matrix Chain Multiplication and Traveling Salesman problems.
4	Implement graph traversal, shortest path, and minimum spanning tree algorithms.
5	Apply branch and bound technique to solve combinatorial problems like the 15-Puzzle.
6	Design backtracking solutions for N-Queens, graph coloring.

Learning Resources:	
1	"Algorithm Design", 1ST Edition, Jon Kleinberg and ÉvaTardos, Pearson.
2	"Algorithm Design: Foundations, Analysis, and Internet Examples", Second Edition, Michael T Goodrich and Roberto Tamassia, Wiley.
3	"Algorithms -- A Creative Approach", 3RD Edition, Udi Manber, Addison-Wesley, Reading, MA
4	"Fundamentals Of Computer Algorithms", by Horowitz, Sahani, Universities Press

Course Name:	**Object Oriented Programming Laboratory**		
Course Code:	PC-IT493	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Basic Knowledge of Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To enable students to learn an object-oriented approach to problem solving
2	To develop the ability to analyze problems and design solutions using Java as a programming language

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Assignments on class, constructor, overloading, inheritance, overriding	6P
2	Assignments on wrapper class, arrays, vectors	3P
3	Assignments on interfaces for multiple inheritance and collection classes such as List, Set, Map	6P
4	Assignments on creating and accessing packages	3P
5	Assignments on multithreaded programming	3P
6	Assignments on Java GUI Application Development using AWT and Swing programming	9P
7	Assignments on Database Connectivity through JDBC	3P

8	Assignments on Implementation of Networking concept	3P
Note: Use Java language for programming		
Total:		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Use standard input/output (I/O) operations to interact with the user, populate variables, and control program flow
2	Develop Java programs to solve problems using core object-oriented programming features such as classes, objects, inheritance, polymorphism, and encapsulation
3	Apply Java Collection classes to store, retrieve, and manipulate data efficiently in object-oriented applications
4	Develop event-driven GUI applications using AWT/Swing and integrate database connectivity and basic networking concepts
5	Practice effective mapping of real-world interdisciplinary problems into object-oriented programming methodologies for solution development

Learning Resources:	
1	Patrick Naughton, Herbert Schildt – "The complete reference-Java2" – TMH
2	Deitel and Deitel – "Java How to Program" – 6th Ed. – Pearson
3	Ivor Horton's Beginning Java 2 SDK – Wrox
4	E. Balagurusamy – " Programming With Java: A Primer" – 3rd Ed. – TMH

Course Name:	**Micro Project**		
Course Code:	PW-IT481	**Category:**	PW
Semester:	Fourth	**Credit:**	2
L-T-P:	0-0-4	**Pre-Requisites:**	Basic Knowledge of engineering, science subjects
Full Marks:	100		
Examination Scheme:	Semester Assessment: 100		

Course Objectives:	
1	In depth knowledge gain in the domain of the assigned topic.
2	To be able to finalize the approach to the problem of the assigned topic.
3	To be able to prepare an Action Plan for conducting the investigation, including team work.

4	To be able to do Detailed Analysis/Modelling/Simulation/Problem solving/Experiment as needed.
5	To perform Development of product/process, testing, results, conclusions and future scope analysis.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	**Guidelines:** Team Formation: Students are required to work in teams consisting of 4–6 members. **Project Scope:** The micro project should involve the development of a small-scale application aimed at enhancing the understanding of computing concepts and/or addressing practical real-world problems. **Types of Projects (including but not limited to):** • Implementation of concepts beyond regular laboratory assignments covered in the curriculum • Application development/Product development • Hardware-based development **Selection Process:** The project title and objectives will be finalized based on the identified needs and problem analysis.	4P /Week
Total		**48P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Evaluate the problem statement based on factors like industry/Research trends, Challenges and potential.
2	Understand uniqueness and creativity of the approach.
3	Implement the idea effectively by considering factors like user interface, technology platform, data sources.
4	Create clear, concise, and well-structured reports that effectively communicate information and adhere to professional standards.
5	Develop the ability to work efficiently, punctually as a team member or leader to achieve common goals.

Learning Resources:	
1	Text Book of Project Management: Gopal krishnan, P. and Ramamoorthy, V.E., McMillan
2	Project Management for Engineering, Business and Technology: Nicholas, J.M., and Steyn, H.,PHI
3	Project Management: The Managerial Process: Gray, C.F., Larson, E.W. and Desai, G.V., MGH

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Project Management	Prof. Raghu Nandan Sengupta	IIT Kanpur
	Course Link: https://elearn.nptel.ac.in/shop/nptel/project-management/?v=13b5bfe96f3e		
2	Introduction to Project Management Principles and Practices	Dr. Nimisha Singh	Quality Council of India
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/imb25_mg80		

Detailed Curriculum for Undergraduate Degree
B.Tech in Mechanical Engineering
(w.e.f. AY: 2025-26)

Part VI: Detailed Curriculum

Course Name:	**Heat Transfer**		
Course Code:	PC-ME401	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Knowledge of Engineering Thermodynamics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	The aim of the course is to build a solid foundation in heat transfer exposing students to the three basic modes namely conduction, convection and radiation.
2	Rigorous treatment of governing equations and solution procedures for the three modes will be provided, along with solution of practical problems using empirical correlations.
3	The course will also briefly cover boiling and condensation heat transfer, and the analysis and design of heat exchangers and mass transfer in introductory level.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1	Conductive heat transfer: Introduction to three modes of heat transfer, derivation of heat	**14L**

	balance equation, Steady one dimensional solution for conduction heat transfer in Cartesian, cylindrical and spherical geometry, concept of conduction and film resistances, critical insulation thickness, lumped system approximation and Biot number, heat transfer through pin fins- Two dimensional conduction solutions for both steady and unsteady heat transfer, approximate solution to unsteady conduction heat transfer by the use of Heissler charts.	
2	Convective heat transfer: Heat convection, basic equations, boundary layers, forced convection, external and internal flows, natural convective heat transfer, Dimensionless parameters for forced and free convection, heat transfer correlations for forced and free convection, approximate solutions to laminar boundary layer equations (momentum and energy) for both internal and external flow, estimating heat transfer rates in laminar and turbulent flow situations using appropriate correlations for free and forced convection.	**10L**
3	Radiative heat transfer: Interaction of radiation with materials, definitions of radioactive properties, Stefan Boltzmann's law, black and gray body radiation, Calculation of radiation heat transfer between surfaces using radiative properties, view factors and the radiosity method.	**9L**
4	Types of heat exchangers, Analysis and design of heat exchangers using both LMTD and ε - NTU methods.	**7L**
5	Boiling and Condensation heat transfer, Pool boiling curve.	**4L**
6	Introduction to mass transfer, Similarity between heat and mass transfer.	**4L**
Total		**48L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Formulate and analyze a heat transfer problem involving any of the three modes of heat transfer
2	Obtain exact solutions for the temperature variation using analytical methods where possible or employ approximate methods or empirical correlations to evaluate the rate of heat transfer
3	Design devices such as heat exchangers and also estimate the insulation needed to reduce heat losses where necessary.

Learning Resources:	
1	A. Bejan, Heat Transfer, John Wiley, 1993.
2	J.P. Holman, Heat Transfer, Eighth Edition, McGraw Hill, 1997.
3	F.P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6 th Edition, John Wiley, 2007.
4	M. Kaviany, Principles of Heat Transfer, John Wiley, 2002
5	Y.A. Cengel, Heat Transfer: A Practical Approach, McGraw Hill, 2002

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Mechanical- Heat and Mass Transfer	Prof. S. P. Sukhatme and Prof. U. N. Gaitonde	IIT Mumbai
	https://www.youtube.com/watch?v=qa-PQOjS3zA&list=PL5F4F46C1983C6785		
2	Conduction and Convection Heat Transfer	Prof. Suman Chakraborty and Prof. S. K. Som	IIT KGP
	https://www.youtube.com/watch?v=4bh4efqyzpo&list=PL3zvA_WajfGCwYlesmh4UAl8KtsxXVQYn		

Course Name:	**Fluid Mechanics and Hydraulic Machines**		
Course Code:	PC-ME402	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Engineering Mathematics and Engineering Mechanics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To learn about the application of mass and momentum conservation laws for fluid flows
2	To understand the importance of dimensional analysis
3	To obtain the velocity and pressure variations in various types of simple flows
4	To analyze the flow in water pumps and turbines

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Fluid Properties:** Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility, surface tension, and capillary effect.	**5L**
2	**Fluid Statics:** Variation of Static Pressure, Absolute and Gauge Pressures, Pressure Measurement by Manometers – Simple, Differential Micromanometer, and Inclined Manometers; Forces on Plane and Curved Surfaces; Stability of Submerged and Floating Bodies – Metacentre and Metacentric Height, Evaluation of Metacentric height; Fluid Rotation about a Vertical Axis.	**7L**
3	**Fluid Kinematics:** Methods of Describing Fluid Motion – Lagrangian and Eulerian Descriptions – Acceleration Field and Material Derivative, Classification of Flow, Flow Patterns – Streamlines, Streamtubes, Pathlines, and Streaklines; Continuity Equation; Velocity Potential, Stream Function, Relation between them; Circulation and Vorticity; Vortex Flow.	**7L**
4	**Fluid Dynamics:** Euler's Equation of Motion, Bernoulli's equation and its applications. Navier-Stokes Equation, Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli - concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram; open channel flow.	**8L**
5	**Dimensional Analysis and Modeling:** Need for dimensional analysis – methods of dimension analysis, Buckingham PI Theorem – Similitude – types of similitude Dimensionless parameters – application of	**4L**

	dimensionless parameters – Model analysis.	
6	**Hydraulic machines:** Euler's equation of Turbomachinery, various efficiencies, velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle. Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.	**9L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the importance of different fluid properties.
2	Determine static pressure and forces on a flat and curved-shaped bodies.
3	Describe flow field and analyze mathematically simple flow situations.
4	Analyze different physical flow phenomenon non-dimensionally and perform the model similitude.
5	Evaluate the performance of pumps and turbines.

Learning Resources:	
1	Fluid Mechanics and Machinery, R. K. Bansal, Laxmi Publication.
2	Introduction to Fluid Mechanics & Fluid Machines, Som and Biswas, TMH.
3	A Textbook on Fluid Mechanics and Machines, S. Pati, McGraw-Hill.
4	Fluid Mechanics and Machinery, C. S. P. Ojha, R. Berndtsson and P. N. Chadramouli, Oxford University Press, 2010.
5	Hydraulics and Fluid Mechanics, P M Modi and S M Seth, Standard Book House.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Basic Concepts of Fluid	Prof. Subashisa Dutta	IIT Guwahati

	Course Link: https://youtu.be/AdhWBb7j55c?si=kkXWWm8mrvs7VJpG		
2	Measurement of Pressure and Hydrostatic Forces	Prof. Subashisa Dutta	IIT Guwahati
	Course Link: https://youtu.be/pdNr-hXxmQc?si=l9sg5U1wfa3jG_ko		
3	Bernoulli's Equation	Prof. Subashisa Dutta	IIT Guwahati
	Course Link: https://youtu.be/qie6UCJqM_Q?si=u3QQZnp78iLU6mN9		
4	Applications of Bernoulli's Equation	Prof. Subashisa Dutta	IIT Guwahati
	Course Link: https://youtu.be/dlsMHsM2V88?si=9ErOltvkUw7Xi_fw		
5	Dimensional Analysis and Similarity	Prof. Subashisa Dutta	IIT Guwahati
	Course Link: https://youtu.be/JB-4aqn70OQ?si=o0PFVoojxjK0kXhs		
6	Navier-Stokes Equation	Prof. Subashisa Dutta	IIT Guwahati
	Course Link: https://youtu.be/8vJJ-v0eCr4?si=UVViras3-c1AIm5F		
7	Open Channel Flow	Prof. Subashisa Dutta	IIT Guwahati
	Course Link: https://youtu.be/VCz8a-2jmug?si=FcH9ZZ1H6EtuxyE-		
9	Impulse and Reaction Machines: Introductory Concepts	S. K. Som	IIT Kgp
	Course Link: https://youtu.be/RcdA2tGts_E?si=aq1Ra4PFdSuagT9X		
10	Axial Flow Turbine	S. K. Som	IIT Kgp
	Course Link: https://youtu.be/TyygDiQPzaA?si=p59xR3lSUDu9ajEC		

Course Name:	**Strength of Materials**		
Course Code:	PC-ME403	**Category:**	Professional Core
Semester:	Fourth	**Credit:**	4.0
L-T-P:	3-1-0	**Pre-Requisites:**	Engineering Mechanics

Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the nature of stresses developed in simple geometries such as bars, cantilevers, beams, shafts, cylinders and spheres for various types of simple loads.
2	To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Deformation in solids-Hooke's law, stress, strain, elongation. Tensile, compressive and shear stresses in 2D solids. Elastic constants and their relations. Volumetric, linear and shear strains. Principal stresses and strains. Principal planes and Mohr's circle.	**8L**
2	Torsion, stresses and deformation in circular type: solid and hollow shafts, stepped shafts, deflection of shafts fixed at both ends. Stresses and deflection of helical springs.	**8L**
3	Beams and types, transverse loading on beams, point and distributed loads. Shear force and bending moment diagrams. Types of beam supports, simply supported, over-hanging beams, cantilevers, fixed and guided beams. Static determinacy and indeterminacy. Theory of bending of beams, pure bending stress distribution and neutral plane, shear stress distribution.	**8L**
4	Moment of inertia about an axis and polar moment of inertia. Deflection of a beam using double integration method (Macaulay's method), computation of slopes and deflection in beams, Maxwell's reciprocal theorems. Castigliano's first and second theorems.	**8L**
5	Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure. Columns and struts.	**8L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Solve problems related to the concepts of stress and strain, strength and stiffness, deformations and displacements, strain energy, torsion and springs.
2	Analyze Mohr's circle for an arbitrary two dimensional stress/strain state for combined loading conditions and stresses in thin walled pressure vessels.
3	Identify and formulate structural problem and solve using a range of analytical methods and determination of internal actions in statically determinate structures and draw internal action diagrams like Shear Force (SFD) and Bending Moment Diagrams (BMD) for these structures.
4	Solve deflection of statically determinate and indeterminate beams due to bending moment by different methods.
5	Predict behaviour of the solid bodies subjected to certain types of loading and theories related to columns and struts.

Learning Resources:	
1	S. S. Rattan (2017), Strength of Materials, McGraw Hill Education.
2	Ferdinand P. Beer, Russel Johnson Jr and John J. Dewole (2005), Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi.
3	R. Subramanian (2007), Strength of Materials, Oxford University Press.

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1	Strength of Materials	Prof. Sriman Kumar Bhattacharya	IIT Kharagpur
	Course Link: https://nptel.ac.in/courses/105105108		
2	Strength of Materials	Prof. K. Ramesh, Prof. Hariprasad	IIT Madras
	Course Link: https://nptel.ac.in/courses/112106319		

Course Name:	**Metrology and Instrumentation**		
Course Code:	PC-ME404	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	4.0
L-T-P:	4-0-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the working of linear and angular measuring instruments.
2	To familiarize with the working of optical measuring instruments and fundamentals of limits and limit gauges.
3	To give basic idea about various methods for measurement of screw thread and surface finish parameters.
4	To give an exposure to advanced measuring devices and machine tool metrology.
5	To provide students an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
6	To provide basic idea about working principle and applications of devices for measurement of force and torque; strain and stress and temperature.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	Concept of measurement: Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement; Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length. Linear Measurement – slip gauges, wringing, grades; surface plate, dial indicators, height gauges and vernier calliper, screw gauge. Angular Measurement – bevel protractor; sine bar, , sine centre, angle gauges, sprit level.	**8L**

2	Limits and Limit gauges – Systems of limits and fits; types of fits; hole basis system and shaft basis system. Tolerance, allowance and deviation (as per BIS). Limit Gauges- GO and NO GO gauges; types of limit gauges. Gauge design - Taylor's principle of gauging. Optical Measuring Instruments: - Benefits of light waves as standards; principle of interference. Interference band, optical flat etc.	**8L**
3	Screw thread measurement: Screw thread terminology; Measurement of major diameter; root diameter; pitch; effective diameter with two wire method and three wire method. Measurement of surface texture – roughness and waviness; analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and Ra value, Rt, Rz etc.	**8L**
4	Introduction to Digital Measurement – significance of digital measurement, methods, classification. Stages in generalized measuring system; Active and Passive transducers. Transducers – Working, Classification of transducers. Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations.	**8L**
5	Strain and Stress Measurement - Electrical resistance strain gauge. Measurement of Force and Torque – Strain gauge load cells, hydraulic and pneumatic load cells. Torque Measurement – Dynamometers – Mechanical, Hydraulic and Electrical. Temperature Measurement -Liquid-in-glass thermometers, pressure thermometers. Thermocouples – Resistance Temperature Detectors (RTD); Thermistors; Pyrometers.	**8L**
Total		**40L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand the working of linear and angular measuring instruments.
2	Know the fundamentals of limits and limit gauges, various methods for measurement of screw thread and surface roughness parameters and the working of optical measuring instruments.
3	Acquire an overview of mechanical measurement systems and principle of instruments for motion and dimension measurement.
4	Get basic idea about working principle and applications of devices regarding measurement of force and torque; strain and stress and temperature.

Learning Resources:	
1	Anand K Bewoor, Vinay A Kulkarni, Metrology & Measurement, McGraw-Hill, 2009
2	Ernest O. Doebelin, Dhanesh N. Manik, Measurement Systems Application and Design, McGraw-Hill, 2004
3	Galyer J.F.W., Schotbolt C.R., Metrology for Engineers, ELBS,1990
4	Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E, Pearson Prentice Hall, 2007
5	R.K. Rajput, Mechanical Measurements & Instrumentation, S.K.Kataria & Sons.
6	R. K. Jain, Engineering Metrology, Khanna Publishers.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Engineering Metrology	Prof. J. Ramkumar and Prof. Amandeep Singh	IIT Kanpur
	Course Link: https://nptel.ac.in/courses/112104250		

Course Name:	**Leadership Skill and Management (Jeevan Kaushal-III)**		
Course Code:	HM-HU401	**Category:**	Management Science
Semester:	Fourth	**Credit:**	2.0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic concept of Management
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 15

Course Objectives:	
1	To develop effective leadership skills such as communication, motivation, decision-making, and emotional intelligence for managing individuals and teams.
2	To understand leadership theories and managerial practices and apply them to real-

	world organizational situations.
3	To enhance team management and conflict resolution abilities, enabling leaders to build high-performing and cohesive teams.
4	To foster ethical, strategic, and adaptable leadership, preparing learners to lead organizations responsibly in a dynamic and competitive environment.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Leadership & Management:** Meaning, nature, and levels of leadership; Leadership vs Management; Importance of leadership in professional and personal contexts; Leadership traits, roles, and responsibilities; Leadership and Life Skills synergy (NEP 2020).	**4L**
2	**Leadership Theories and Styles:** Great Man Theory; Trait Theory; Behavioral Theories (Ohio State, Michigan); Contingency Theories (Fiedler, Path-Goal); Leadership styles: Transformational, Transactional, Servant, Situational.	**4L**
3	**Core Leadership Skills Development:** Effective Communication; Active Listening; Emotional Intelligence & Self-awareness; Decision-making and Problem-solving; Time Management and Priority Setting; Creativity and Critical Thinking.	**6L**
4	**Team Leadership & People Management:** Team building fundamentals; Motivation: Theories and workplace application; Conflict resolution & negotiation skills; Coaching & mentoring approaches; Cultural sensitivity and diversity in teams.	**4L**
5	**Ethical Leadership & Social Responsibility:** Ethical decision-making; Corporate Social Responsibility & sustainability in leadership; Personal values and ethical dilemmas; Building trust and accountability.	**3L**

6	**Practical Leadership Application & Case Studies:** Case studies of successful leaders; Leadership challenges in startups and corporate environments; Group activities: role-plays, simulations, reflection logs; Personal leadership action plan.	**3L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1.	To develop leadership and teamwork skills required for managing technical teams, projects, and multidisciplinary work environments.
2	To enhance communication, decision-making, and problem-solving abilities, enabling students to lead technical tasks and projects effectively.
3	To build ethical, professional, and responsible leadership qualities, essential for engineers in organizational and societal contexts.
4	To prepare students for managerial and leadership roles in the engineering profession, fostering adaptability, innovation, and lifelong learning in a rapidly changing technological landscape.

Learning Resources:	
1	Hughes, Ginnett & Curphy; Leadership; 9th Indian Edition; Mc Graw Hill
2	Gary Yukl: Leadership in organisations, Pearson Education, New Delhi.
3	L M Prasad: Organisational Behaviour, Sultan Chand & Sons, New Delhi.
4	P. Guggenheimer & M. Diana Szulc: Understanding Leadership Competencies, Viva, books, New Delhi

Course Name:	**Biology for Engineers**		
Course Code:	BS-BIO401	**Category:**	Basic Science Course
Semester:	Fourth	**Credit:**	2.0
L-T-P:	2-0-0	**Pre-Requisites:**	Basic knowledge of Biology, Mechanics, Thermodynamics

			and Heat Transfer
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To understand the specific engineering application in biological domain.
2	Evaluate the human physiological system from the perspective of mechanical engineering.
3	To analyze biological system from the engineering perspectives for a specific solution.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Biology:** Biology as an important scientific discipline, Role of Biology in Next Generation Technology Development, Biomimetic, Nature inspired designs, Photosynthesis: Photovoltaic cells & bionic leaf, Five kingdoms of classification.	**2L**
2	**Cell Biology & Biomolecules:** Cell-Basic unit of life; Gene as code of life (Concept of DNA, RNA and Gene expression), Bio-membrane, Transport across cell membranes; Cell potential, Bio Signals, Signal Transduction Biomolecules, Applications of biomolecules: bio-filters, bioplastics, vaccines, SCP, biodiesel, bio-detergents, biochips.	**5L**
3	**Human Organ Systems and Bio Designs:** Human organ system-basics; Brain as a CPU system, Signal transmission, EEG; Eye as a camera, bionic eye; Heart as a pump system, heart related issues & ECG, stents, pacemakers, defibrillators; Lungs as purification system, Heart-Lung machine, Ventilators:	**6L**

	Kidney as a filtration system, Dialysis systems; Musculoskeletal System, Gait Analysis: Introduction to human movement analysis, gait cycle phases, and gait in health/disease. Kinematics: Linear and angular kinematics of movement (position, velocity, acceleration). Kinetics: Forces, moments, work, energy, and power in joints (Spine, Hip, Knee, Ankle). Bioengineering solution for musculoskeletal disorders, biomechanics in prosthetics and robotics.	
4	**Human body and Thermodynamics:** Human body as thermodynamics system, cellular respiration and metabolic heat production, thermoregulation and thermal comfort.	**5L**
5	**Bio-heat transfer:** Bio-heat models, Pennes Bioheat Equation, and applications.	**3L**
6	**Bio-fluid engineering:** Biological fluids and basic principles, fluid dynamics of blood, joint lubrication and cardiovascular system.	**3L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Elucidate the basic biological concepts via relevant engineering applications and case studies.
2	Evaluate the principles of design and development, for exploring novel bioengineering projects.
3	Corroborate the concepts of biological thermodynamics for specific requirements
4	Think critically towards exploring innovative engineering solutions for biomedical application socially relevant problems.
5	Analyze bio-inspired systems and demonstrate their relevance to mechanical and computational engineering.

Learning Resources:	
1	"Biology for Engineers" by Arthur T. Johnson, CRC Press
2	"Biofluid dynamics- Principles and Selected Applications" by Clement Kleinstreuer,

	CRC Press
3	"Biology and Engineering of Stem Cell Niches" by A. K. Vishwakarma and Jefferey Karp, Academic Press
4	"Environmental Biology for Engineers and Scientists" by David A. Vaccari, P. P. Storm and J. F Alleman, Wiley-Interscience
5	Biology for Engineers, Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi
6	"Biology for Engineers" by G. K. Suraishkumar, Oxford University Press

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Biology for engineers and other non-biologists	Prof. G.K. Suraishkumar & Prof. Madhulika Dixit	IIT Madras
	Course Link: https://onlinecourses.nptel.ac.in/noc19_ge31/		
2	Biological Engineering	Prof. Abhishek Suresh Dhoble	IIT (BHU) Varanasi
	Course Link: https://onlinecourses.nptel.ac.in/noc25_bt85/		

Course Name:	**Vedic Mathematics (Indian Knowledge System-II)**		
Course Code:	BS-M401	**Category:**	Basic Science Course
Semester:	Fourth	**Credit:**	2.0
L-T-P:	2-0-0	**Pre-Requisites:**	School Mathematics
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce students to the legacy of Indian mathematicians and the evolution of mathematical thought in India.
2	To enhance efficiency in arithmetic operations using Vedic techniques.
3	To develop problem-solving abilities in algebra, linear equations, and matrix operations.
4	To build geometric intuition based on Śulba Sūtra traditions.
5	To encourage appreciation of Indian Knowledge Systems and their relevance to modern engineering education.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Indian Mathematical Heritage and IKS Perspective:** Overview of the development of mathematics in India from ancient to medieval periods. Contributions of eminent mathematicians such as Aryabhata, Brahmagupta, Mahaviracharya, Bhaskara, Kuttaka and others. Algorithmic nature of Indian mathematics and its relevance to modern science and engineering.	**3L**
2	**Fundamentals of Vedic Mathematics:** Introduction to sutras and subsutras, Vedic sutras for addition- Purna puranabhyam, Sankalan Vyavkalanabhyam and Ekadhikena Purvena, Vedic sutras for subtraction- Nikhilam Navatascaramam Dastataḥ and Vinculum.	**3L**
3	**Vedic Techniques for Fast Arithmetic Operations:** Vedic sutras of multiplication and division, their meanings and applications, Urdhva–Tiryag bhyam sutra for multiplication and division. Fast computation of squares and square roots (Dwanda-Yoga or Duplex Method, Vilokanam), and cubes (Yāvadunam).	**5L**
4	**Algebraic Techniques and Linear Equations:** Factorization of cubic polynomial using Gunita Samuccaya, Solution of quadratic	**5L**

	equations using Vilokanam, Shunyam Sama Samuchchaye and Anurupye Sunyamanyat.	
5	**Vedic Approaches to Matrix Algebra and Computation:** Historical development of matrices and determinants. Calculation of determinants up to 4 × 4 using Urdhva Tiryag Sutra, Inverse of matrices using Vedic approaches.	**3L**
6	**Vedic Geometry and Śulba Sūtra Concepts:** Geometrical ideas from Śulba Sūtras, Baudhāyana's formulation of the Pythagorean theorem and its applications, Geometric constructions including transformation of rectangles into squares, approximate squaring of the circle, and rational approximation for $\sqrt{2}$.	**5L**
Total		**24L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the contributions of ancient Indian mathematicians to the development of global mathematics.
2	Apply Vedic arithmetic techniques for numerical computation.
3	Solve algebraic expressions and linear equations efficiently.
4	Apply Vedic mathematical techniques to solve problems involving basic matrix and determinant.
5	Interpret fundamental geometrical ideas derived from Vedic and Śulba Sūtra texts.

Learning Resources:	
1	"Vedic Mathematics" by Bharati Krishna Tirthaji, Motilal Banarsidass Publishing.
2	"Essentials of Vedic Mathematics" by Rajesh Kumar Thakur, Rupa Publications.
3	"Vedic Mathematics for All Ages" by Vandana Singhal, Motilal Banarsidass Publishing.
4	"Elements of Vedic Mathematics" by Udayan S. Patankar & Sunil M. Patankar, TTU Press.
5	"Vedic Mathematics Made Easy" by Dahaval Bathia, Jaico Publishing House.

6	‘‘Vedic Mathematics: The Problem Solver” by Ronak Bajaj, Black Rose Publications.
7	‘‘Vedic Geometry Course” by S. K. Kapoor, Lotus Press.
8	‘‘The Śulba Sūtras” by S. N. Sen & A. K. Bag (Eds.), Indian National Science Academy.
9	‘‘Geometry in Ancient and Medieval India” by T. A. Sarasvati Amma, Motilal Banarsidass Publishing.

Course Name:	**Metrology and Instrumentation Laboratory**		
Course Code:	PC-ME491	**Category:**	Professional Core Course
Semester:	Fourth	**Credit:**	1.5
L-T-P:	0-0-3	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To make students aware of measurement techniques in different manufacturing processes.
2	To recognize the procedure of different system measurement techniques.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Measurement of given sample using different Instrument, and Gauges.	**6P**
2	Measurement of angles, thread, internal and external radius, etc. using different instruments.	**3P**
3	Measurement of bore diameter using micrometer and gauge.	**6P**
4	Measurement of angles using bevel vernier protractor.	**3P**
5	Measurement of tapered objects using Sine Bar and using balls and rollers, etc.	**3P**
6	Measurement of effective diameter with the help of screw pitch micrometer.	**3P**

7	Measurement of gears.	**3P**
8	Measurement of surface roughness.	**3P**
9	Measurement of testing sand: Moisture content, permeability, grain fineness number, strength measurement and core hardness testing.	**6P**
Total		**36P**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate the use of instruments for measuring linear (internal and external), angulardimensions.
2	Formulate some unknown quantity or parameter of engineering interest.
3	Evaluate the surface quality of a given specimen which is important in all kind of manufacturing.
4	Measure different variables of a component.

Learning Resources:	
1	Laboratory Manual

Course Name:	**Project-I**		
Course Code:	PW-ME481	**Category:**	Project Work
Semester:	Fourth	**Credit:**	1.0
L-T-P:	0-0-2	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination (Viva-voce): 100	Continuous Assessment: 00	Attendance: 00

Course Objectives:	
1	This course is aimed to provide more weightage for project work. The project work could be done by a minor practical project in the Institute. Participation in any technical event/ competition to fabricate and demonstrate an innovative machine or

	product could be encouraged under this course.

Course Outcomes:
After completion of the course, students will be able to:
Gather some exposure on some projects, may be designing some innovative ideas, fabricating and/or demonstrating an innovative machine or product, etc.

Detailed Curriculum for Minor Degree under Department of Automobile Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

No Minor paper in 4th semesters.

Detailed Curriculum for Minor Degree under Department of Computer Science and Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

A. Minor Degree in Advanced Web Development

Course Name:	**Fundamentals of Front-end Development**		
Course Code:	MN-CS401A	**Category:**	Minor Course
Semester:	Fourth	**Credit:**	4
L-T-P:	4-0-0	**Pre-Requisites:**	Basic knowledge of programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To specific fundamental web design principles and responsive layout techniques: This objective focuses on equipping students with the ability to structure content using semantic HTML5 and design mobile-first, responsive user interfaces using CSS3 (Flexbox, Media Queries) and modern frameworks like Bootstrap and Tailwind.
2	To bridge existing programming logic with client-side web behavior: This objective aims to translate students' prior knowledge (C/Python) into the web environment, teaching them to create interactive experiences through JavaScript ES6+ syntax, control flow, and DOM manipulation.
3	To enable the development of dynamic, data-driven web applications: This objective covers the practical application of asynchronous JavaScript (Promises, async/await) to consume external data from third-party APIs (Fetch API) and manage application state using local storage.
4	To inculcate industry-standard workflows and deployment strategies: This objective

	ensures students master essential developer tools, specifically Git for version control, and learn the end-to-end process of debugging, integrating, and deploying a multi-page project to a live server.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Foundations of the Web & HTML: Introduction to Web Development (Client-Server, HTTP); The role of HTML, CSS, and JavaScript; HTML Basics: Document structure (<!DOCTYPE>, <html>, <head>, <body>); Essential tags (Headings, Paragraphs, Links, Images, Lists); WCAG Guidelines	6
2	Advanced HTML & Forms: HTML5 Semantic Elements: <header>, <footer>, <nav>, <main>, <article>, <section>; HTML Forms: <form>, <label>, <input> (all key types), <textarea>, <select>; Form attributes and client-side validation; Embedding multimedia: <video>, <audio>, <iframe>	6
3	CSS Fundamentals: Three ways to add CSS (inline, internal, external); CSS Selectors: Element, class, ID, attribute, pseudo-classes (:hover); The Box Model: margin, padding, border, content; Common properties: color, background-color, font-family, font-size	4
4	Responsive Layouts with Flexbox: CSS display and position properties; Deep Dive: Flexbox: The parent container (display: flex, flex-direction, justify-content, align-items); Flex items (flex-grow, flex-shrink, flex-basis); Responsive Web Design (RWD): Mobile-first philosophy; Media Queries: Viewport, min-width, max-width.	6
5	CSS Frameworks (Bootstrap & Tailwind): Introduction to CSS framework; Bootstrap (Component-First): The grid system, key components (Navbar, Card, Button, Form), and setup (CDN); Tailwind CSS (Utility-First): The philosophy, core concepts (flex, pt-4, text-lg), and basic setup; Comparing framework	4
6	JavaScript Fundamentals: (Review): Variables (let, const), data types, operators; (New): Type coercion, "truthy" vs. "falsy"; Functions (declarations, expressions, arrow functions); Scope (global, function, block); Intro to the DOM: The Document Object Model.	4
7	DOM Manipulation & Events: Selecting Elements: querySelector, querySelectorAll, getElementById; Manipulating Elements:	4

	textContent, innerHTML, style, setAttribute, classList; Event Handling: addEventListener (e.g., click, submit, input); The event object.	
8	Control Flow & Data Structures: (Review): Conditionals (if/else), Loops (for, while); (New): for...of loops; Arrays: Methods (.map, .filter, .reduce, .forEach); Objects: Literals, properties, this keyword (basic intro)	4
9	Asynchronous JavaScript & APIs: Synchronous vs. asynchronous programming; Promises (.then(), .catch()); async/await syntax; Fetch API: Making GET requests to public APIs; Understanding JSON.	4
10	Local Storage & Form Validation: Web Storage: localStorage vs. sessionStorage; setItem(), getItem(), JSON.stringify(), JSON.parse(); Advanced Form Validation with JavaScript (preventing default submit behavior)	4
11	Version Control & Final Project Kick-off: Industry Tools: Git & GitHub; Use of version control; Core commands: git init, git add, git commit, git push, git pull, git branch; Introduce the final project requirements.	2
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design well-structured, semantic, and accessible web pages using HTML5.
2	Implement responsive, mobile-first layouts using modern CSS3 (Flexbox, Media Queries) and apply CSS frameworks like Bootstrap and Tailwind.
3	Apply core JavaScript concepts and DOM manipulation to create interactive user experiences.
4	Develop dynamic web applications that consume and display data from third-party APIs using asynchronous JavaScript.
5	Utilize essential developer tools, including Git (version control) and browser dev tools, to build and debug applications.

Learning Resources:	
1	HTML and CSS: Design and Build Websites by Jon Duckett
2	Responsive Web Design with HTML5 and CSS3 by Ben Frain

3	Eloquent JavaScript, 3rd Edition by Marijn Haverbeke
4	JavaScript and JQuery: Interactive Front-End Web Development by Jon Duckett
5	Pro Git by Scott Chacon and Ben Straub
6	Learning Web Design by Jennifer Niederst Robbins

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Course Name:	**Fundamentals of Front-end Development Laboratory**		
Course Code:	MN-CS491A	**Category:**	Minor Course
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic knowledge of programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	To specific fundamental web design principles and responsive layout techniques: This objective focuses on equipping students with the ability to structure content using semantic HTML5 and design mobile-first, responsive user interfaces using CSS3 (Flexbox, Media Queries) and modern frameworks like Bootstrap and Tailwind.
2	To bridge existing programming logic with client-side web behavior: This objective aims to translate students' prior knowledge (C/Python) into the web environment, teaching them to create interactive experiences through JavaScript ES6+ syntax, control flow, and DOM manipulation.
3	To enable the development of dynamic, data-driven web applications: This objective

	covers the practical application of asynchronous JavaScript (Promises, async/await) to consume external data from third-party APIs (Fetch API) and manage application state using local storage.
4	To inculcate industry-standard workflows and deployment strategies: This objective ensures students master essential developer tools, specifically Git for version control, and learn the end-to-end process of debugging, integrating, and deploying a multi-page project to a live server.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Foundations of the Web & HTML: Introduction to Web Development (Client-Server, HTTP); The role of HTML, CSS, and JavaScript; HTML Basics: Document structure (<!DOCTYPE>, <html>, <head>, <body>); Essential tags (Headings, Paragraphs, Links, Images, Lists); Introduction to VS Code, extensions (Live Server), and browser dev tools	2
2	WCAG Guidelines implementation, Advanced HTML & Forms: HTML5 Semantic Elements: <header>, <footer>, <nav>, <main>, <article>, <section>; HTML Forms: <form>, <label>, <input> (all key types), <textarea>, <select>; Form attributes and client-side validation; Embedding multimedia: <video>, <audio>, <iframe>	2
3	CSS Fundamentals: Three ways to add CSS (inline, internal, external); CSS Selectors: Element, class, ID, attribute, pseudo-classes (:hover); The Box Model: margin, padding, border, content; Common properties: color, background-color, font-family, font-size	2
4	Responsive Layouts with Flexbox: CSS display and position properties; Deep Dive: Flexbox: The parent container (display: flex, flex-direction, justify-content, align-items); Flex items (flex-grow, flex-shrink, flex-basis); Responsive Web Design (RWD): Mobile-first philosophy; Media Queries: Viewport, min-width, max-width.	2
5	CSS Frameworks (Bootstrap & Tailwind): Introduction to CSS framework; Bootstrap (Component-First): The grid system, key components (Navbar, Card, Button, Form), and setup (CDN); Tailwind CSS (Utility-First): The philosophy, core concepts (flex, pt-	2

	4, text-lg), and basic setup; Comparing framework	
6	JavaScript Fundamentals: (Review): Variables (let, const), data types, operators; (New): Type coercion, "truthy" vs. "falsy"; Functions (declarations, expressions, arrow functions); Scope (global, function, block); Intro to the DOM: The Document Object Model.	2
7	DOM Manipulation & Events: Selecting Elements: querySelector, querySelectorAll, getElementById; Manipulating Elements: textContent, innerHTML, style, setAttribute, classList; Event Handling: addEventListener (e.g., click, submit, input); The event object.	2
8	Control Flow & Data Structures: (Review): Conditionals (if/else), Loops (for, while); (New): for...of loops; Arrays: Methods (.map, .filter, .reduce, .forEach); Objects: Literals, properties, this keyword (basic intro)	2
9	Asynchronous JavaScript & APIs: Synchronous vs. asynchronous programming; Promises (.then(), .catch()); async/await syntax; Fetch API: Making GET requests to public APIs; Understanding JSON.	2
10	Local Storage & Form Validation: Web Storage: localStorage vs. sessionStorage; setItem(), getItem(), JSON.stringify(), JSON.parse(); Advanced Form Validation with JavaScript (preventing default submit behavior)	2
11	Version Control & Final Project Kick-off: Industry Tools: Git & GitHub; Use of version control; Core commands: git init, git add, git commit, git push, git pull, git branch; Introduce the final project requirements; GitHub Desktop	2
12	Deployment & Project Presentations: Deploying a static site	2
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Design well-structured, semantic, and accessible web pages using HTML5.
2	Implement responsive, mobile-first layouts using modern CSS3 (Flexbox, Media Queries) and apply CSS frameworks like Bootstrap and Tailwind.
3	Apply core JavaScript concepts and DOM manipulation to create interactive user

	experiences.
4	Develop dynamic web applications that consume and display data from third-party APIs using asynchronous JavaScript.
5	Utilize essential developer tools, including Git (version control) and browser dev tools, to build and debug applications.
6	Integrate all technologies to build and deploy a complete, multi-page front-end project.

Learning Resources:	
1	HTML and CSS: Design and Build Websites by Jon Duckett
2	Responsive Web Design with HTML5 and CSS3 by Ben Frain
3	Eloquent JavaScript, 3rd Edition by Marijn Haverbeke
4	JavaScript and jQuery: Interactive Front-End Web Development by Jon Duckett
5	Pro Git by Scott Chacon and Ben Straub
6	Learning Web Design by Jennifer Niederst Robbins

Corresponding NPTEL/SWAYAM Courses:

Sl. No.	Course Name	Instructor Name	Host Institute
1			
	Course Link:		

B. Minor Degree in Quantum Technologies

Course Name:	**Foundations of Quantum Computing: Physics, Engineering, and Mathematics Computing**		
Course Code:	MN-CS401B	**Category:**	Minor Course
Semester:	Fourth	**Credit:**	4
L-T-P:	4-0-0	**Pre-Requisites:**	Basics of Physics, Mathematics.
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Provide students with a strong interdisciplinary foundation for quantum computing by integrating essential concepts from linear algebra, probability and statistics, classical and quantum mechanics, electromagnetic theory, computer architecture, and digital logic.
2	Develop the mathematical, physical, and architectural understanding required to analyze, model, and comprehend quantum information processing systems and the classical–quantum interface underlying modern quantum computing platforms.

Course Contents:

Module No.	**Description of Topic**	**Contact Hrs.**
1	**Linear Algebra** Concept of Vector Spaces. Basis & dimensions Linear Combination of Vectors: Vector representation of a quantum state, Uniqueness of a spanning set, Inner Product(its relation to the vector dot product), Orthonormality, Gram-Schmidt orthogonalization, Bra-ket formalism and its usefulness, the	12

	Cauchyschwarz Inequality. Outer Products, The Closure Relation Concept of Operators in Quantum Mechanics and their representation using matrices, Hermitian &Unitary operators Concept of Eigen values & Eigen Vectors and the span of vector space, Spectral Decomposition, Trace of an operator, important properties of Trace.	
2	**Foundations of Probability and Statistics for Quantum Computing** Random variables and probability distributions, Conditional probability & Bayes' theorem, Expectation values and moments, Variance, covariance, and uncertainty relations, Statistical interpretation of the Born rule. Projective measurements vs POVM, Measurement-induced randomness Law of large numbers and the Central Limit Theorem	10
3	**Hamiltonian and Lagrangian Mechanics** Lagrangian formulation of classical system, Hamiltonian mechanics and phase space representation. Canonical transformations, Poisson brackets vs commutators, Canonical quantization, Construction of Hamiltonian for two state systems.	7
4	**Electromagnetic Theory for Quantum Hardware** Maxwell's equations, Boundary conditions and EM fields in confined geometries, Waveguides, transmission lines, and resonators Lumped vs distributed circuit models, Hamiltonian formulation and Quantization of LC circuits, Coplanar waveguide resonators, Power loss mechanisms and quality factor.	7
5	**Computer Architecture Basics and Von Neumann Architecture** Von Neumann architecture: assumptions and limitations for quantum systems, Sequential execution vs quantum parallelism, Classical memory vs quantum memory, No-cloning theorem and its impact on memory design, Von Neumann memory hierarchy vs quantum state storage.	6

6	**Classical Digital Logic vs Quantum Logic** Boolean logic, Reversible logic and its importance for quantum gates, Irreversibility and heat dissipation, Classical logic gates vs quantum gates. Reversible logic Gates (CNOT, Toffoli, Fredkin gates), ancilla bits.	6
Total		**48**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Apply concepts of vector spaces, inner products, operators, and matrix representations to describe and analyze quantum states and observables using linear algebra and bracket formalism.
2	Use probability and statistical principles to interpret quantum measurement outcomes, uncertainty relations, and statistical behavior of quantum systems.
3	Analyze classical systems using Lagrangian and Hamiltonian mechanics and use canonical quantization to switch from Classical to Quantum domain, and construct Hamiltonian for simple quantum systems.
4	Explain the role of electromagnetic theory in quantum hardware, including waveguides, resonators, circuit quantization, and loss mechanisms relevant to qubit implementations.
5	Compare classical computer architecture with quantum computing paradigms, identify the limitations of Von Neumann architecture and the implications of quantum memory and parallelism.
6	Distinguish between classical digital logic and quantum logic and analyze the importance of reversible logic gates and low-energy computation in quantum information processing.

Learning Resources:	
1	Elementary Linear Algebra with Applications, Bernard Kolman, David A Hill, Pearson New International Edition, (2013).
2	Elementary Statistics: Picturing the World, Ron Larson, 8th edition, Pearson (2023)

3	Classical Mechanics" –3rd edition, Herbert Goldstein, Addisen Wesley Publisher
4	Introduction to Electrodynamics, Griffiths D. J., 4th edition, Cambridge University Press (2020)
5	Computer system architecture, M. Morris Mano, (3rd ed.). Prentice Hall, Inc. USA.
6	Digital Fundamentals, 11th Edition, Thomas L. Floyd, Pearson Publication
7	Digital Logic and Computer Design, M. Morris Mano, by Pearson Publication
8	An Introduction to Quantum Computing' by Phillip Kaye, Raymond Laflamme and Michele Mosca. Oxford University Press

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Linear Algebra	Prof. Pranav Haridas	Kerala School of Mathematics
	Course Link: https://onlinecourses.nptel.ac.in/noc26_ma56/preview		

Course Name:	**Computational Skills and Numerical Modelling Laboratory**		
Course Code:	MN-CS491B	**Category:**	Minor Course
Semester:	Fourth	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Basic Engineering Mathematics, Basic Python Programming
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	Develop foundational programming, data structures, and algorithm skills for computational problem-solving.
2	Apply numerical methods to solve ODE's and PDE's and Eigen value problems.
3	Utilize probability and statistics for scientific data analysis and modeling.
4	Implement Python-based computational techniques to model quantum mechanical and electromagnetic systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Basics of programming Data structures, classes, Object-oriented programming Data storage and retrieval, Memory allocation Scientific plotting, documentation of codes	2
2	Simple algorithms and benchmarking run time Sorting Searching Arithmetic algorithms like GCD, Prime factorisation	4
3	Numerical Integration using Trapezoidal rule, Simpson's rule, Gaussian quadrature. Solve ODE's with Euler and Runge–Kutta method. Solve Poisson's, Laplace's, Diffusion equations using Finite Difference Discretization (Python Implementation of Jacobi method)	4
4	Numerical techniques in linear algebra Python Implementation for Matrix inverse and Eigenvalues. Matrix Compression and Singular Value Decomposition using built in Python libraries.	4
5	Numerical techniques in Probability and Statistics (Pseudo) Random number generation: Implement linear congruential generator in Python. Implementing Central Limit Theorum in Python. Linear and Polynomial Regression in Python. Python implementation for p-value calculation and Hypothesis testing.	6

	Estimating π using Monte Carlo Simulation	
6	Applications to EM theory (e.g. magnetic field simulation) Numerical integration of Poisson's Equations and visualization of fields. Construct Hamiltonian matrix, Compute Eigen energies and simulate Rabi Oscillations.	4
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Demonstrate foundational programming concepts, including OOP, data structures, storage, and code documentation.
2	Develop fundamental algorithms for sorting, searching, and arithmetic operations.
3	Apply numerical methods to solve various ordinary and partial differential equations.
4	Utilize numerical linear algebra techniques to find matrix inverse, Eigenvalues and Eigenvectors and apply SVD for data compression.
5	Perform Statistical data analysis and Hypothesis testing.
6	Simulate Quantum Mechanical and Electromagnetic Systems

Learning Resources:	
1	A Primer on Scientific Programming with Python — Hans Petter Langtangen
2	Numerical Recipes: The Art of Scientific Computing — William H. Press et al.
3	Numerical Linear Algebra — Lloyd N. Trefethen & David Bau III
4	Introduction to Algorithms — Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, and Clifford Stein (CLRS)
5	Computational Physics — Mark Newman

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1			
	Course Link:		

Detailed Curriculum for Minor Degree under Department of Electrical Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

A. Minor Degree in Power Engineering

Course Name:	**Hydro Power Generation**		
Course Code:	MN-EE401A	**Category:**	Minor
Semester:	Second	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce the fundamental concepts of hydro power generation and its global and Indian scenario.
2	To develop understanding of hydrological principles such as runoff, hydrographs, and flow analysis for power estimation.
3	To familiarize students with different types of hydroelectric power plants and their operating principles.
4	To impart knowledge of the design, construction, and operation of major components of hydro power plants.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Hydro power scenario in India and world, its development and future prospect, Hydrology – hydrological cycle, precipitation, run-off and its measurement, hydrograph, unit hydrograph, flow duration and mass curve.	**10L**
2	Site selection – Preparation of DPR, Clearance from various agencies, funding agencies, government rules and subsidies for SHP.	**5L**
3	Classification of hydro electric power plants, pondage and storage, Operating principles of different types hydro plants like run-off river, dam toe type and canal base type.	**8L**

4	Design, construction and operation of different components of a hydro plant like dam, spillways, canals (power canal), penstocks (economical diameter, embedded and exposed type, short and long penstock), surge tank, draft tubes, etc.	**12L**
Total		**35L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain the hydro power generation and their variations
2	Classify various types of hydro power generation scheme and illustrate the different components in them
3	Classify hydro turbines and analyze the flow and energy transfer in them
4	Explain the need for testing of hydro power plants and their methodologies

Learning Resources:	
Recommended Text Books	
1.	Power Plant Engineering" by P.K. Nag, 3rd Edition, Tata McGraw Hill Publishing Company Limited, 2008.
Alternative Text Books	
2.	Fundamentals of Hydropower Engineering, By: Er. Sanjeeb Baral, National Book Centre, Fourth Edition 2023.
Reference Books	
3.	Hydropower Engineering Handbook, by by John S. Gulliver and Roger E.A. Arndt, Mc Graw-Hill, 2018.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Power Plant System Engineering	Prof. Niranjan Sahoo	IIT Guwahati
	Course Link: https://onlinecourses.nptel.ac.in/noc24_me57/preview		
2	Power Plant Engineering	Prof. Ravi Kumar	IIT Roorkee
	Course Link: https://nptel.ac.in/courses/112107291		

B. Minor Degree in High Voltage Engineering

Course Name:	**Physics of Dielectrics**		
Course Code:	MN-EE401B	**Category:**	Basic Science Courses
Semester:	Second	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce the fundamental concepts of dielectric materials and polarization mechanisms under static and alternating electric fields.
2	To develop an understanding of conduction processes in solid and liquid dielectrics, including space charge effects and charge transport mechanisms.
3	To study dielectric behavior, ageing mechanisms, and breakdown phenomena under electrical and thermal stresses.
4	To provide knowledge of partial discharge (PD) phenomena, its generation, detection, and its role in insulation degradation and failure.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Dielectrics and Polarization** Introduction to dielectrics and electrical insulation systems used in high voltage power apparatus: gaseous, vacuum, liquid, solid and composite insulation- Dielectric polarization under static fields-electronic, ionic and dipolar polarizations-behavior of dielectrics in alternating fields, nonlinearity between D and E, complex dielectric constant, dissipation factor-Effect of temperature on dielectric constant- Electrostriction effect-Ferro and piezo electricity-Requirements of good insulating materials, mechanical strength, thermal properties, breakdown strength-Thermal classification of solid insulating materials-ageing of insulators.	**10L**
2	**Dielectric Conduction** Space Charge in dielectrics, Conduction Process in solid dielectrics, Ionic Conduction, electronic conduction, charge injection mechanisms in solid dielectrics, Treeing and Tracking, Conduction in dielectric liquids.	**5L**
3	**Dielectric Formalism** Dielectric Formalism- Equivalent circuits-intrinsic dielectric strength-mechanisms of electrical and thermal breakdown in solids-Phenomenological theory of ageing, mechanisms of ageing under electrical, thermal and combined	**8L**

	stresses- Accelerated ageing tests-Statistical models for Insulation failure, ageing data analysis- Effect of moisture on cellulose aging.	
4	**Basics of Partial Discharges** Ageing and failure due to Partial Discharge-Basics of Partial Discharge: Partial Discharge – how and where, Generation of PD pulses, Stress mechanisms activated by PD- Electrical method of PD detection and the relevant standard, Quantities related to PD measurement, External interference and noise elimination.	**10L**
Total		**33L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Analyze different dielectric polarization processes under static and alternating fields.
2	Identify the fundamental physical mechanism behind given relaxation/permittivity curves.
3	Identify the different mechanisms responsible for conduction in dielectrics.
4	Estimate the life of the insulation subjected to electrical and thermal stress by graphical and analytical method.
5	Identify partial discharge in dielectric materials by the electrical method of measurement.

Learning Resources:	
Recommended Text Books	
1	K.C Kao, Dielectric Phenomena in solids, Elsevier, 2004
2	T. S.Ramu and Chakradhar Reddy, 'Reliability and Life estimation of Power Equipment, New Age International 2009.
Alternative Text Books	
3	Bottcher C.J.F., *Theory of Electric Polarisation*, Elsevier Publication, 1962.
Reference Books	
4	Kuffel and Zaengl, High Voltage Engineering, Newnes,2000.
5	Relevant IS standards and IEC standards.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Physics of Dielectrics	Prof. G. Rangarajan	IIT Madras
	Course Link**:** https://www.youtube.com/watch?v=gtzNdfUD2wc		

Detailed Curriculum for Minor Degree under Department of Electronics and Communications Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

A. Minor Degree in IoT

Course Name:	**Introduction to Security of Cyber-Physical Systems**		
Course Code:	MN-EC401A	**Category:**	Minor
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Knowledge of networking, systems, and security protocols
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To give an introduction to the concepts of vulnerabilities, threats, attacks, and security measures and mechanisms in both computer systems and computer networks.
2	To understand the security challenges presented by mobile devices and information systems access in the cybercrime world.
3	To provide the fundamental skill to understand cyber laws.

Course Contents:		
Module No.	**Description of Topic**	**Contact Hrs.**
1.	**Introduction of Cybercrime:** What is cybercrime? Forgery, Hacking & Ethical Hacking, Software Piracy, Computer Network intrusion. Category of Cybercrime: how criminals plan attacks, passive attack, Active attacks, cyber stalking, Introduction to Cyber Forensics	8L
2.	**Introduction to Cyber Security**: Importance and challenges in Cyber Security, Cyberspace, Cyber threats, Cyber warfare, Cyber Terrorism, Cyber Security of Critical Infrastructure, Cyber security - Organizational implications.	6L
3.	**Cybercrime: Mobile & Wireless devices:** Security challenges posted by mobile devices, Cryptographic security for mobile devices, Attacks on mobile/cell phones, Theft, Virus, Bluetooth; Different viruses on laptop	6L
4.	**Hackers and Cyber Crimes:** Types of Hackers, Hackers and Crackers, Cyber-Attacks and Vulnerabilities **Tools and Methods used in Cyber-crime:** Proxy servers, password checking, Random checking, Trojan Horses and Backdoors; DOS & DDOS attacks; SQL injection: buffer over flow	8L
5.	**Phishing & Identity Theft:** Phishing methods, ID Theft; Online Identity method. **Cybercrime & Cyber security:** Legal aspects, Indian laws, IT act, Public key certificate Cyber Ethics and Laws: Introduction to Cyber Laws, E-Commerce and E-Governance, Certifying Authority and Controller, Offences under IT Act, Computer Offences and its penalty under IT Act 2000	8L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Protect and defend computer systems and networks from Cyber security attacks.
2	Identify vulnerabilities critical to the information assets

3	Define the security controls sufficient to provide a required level of confidentiality, integrity, and availability in an organization's computer systems and networks.

Learning Resources:	
1	Cyber security by Nina Gobole & Sunit Belapune; Pub: Wiley India.
2	Information Security & Cyber laws, Gupta & Gupta, Khanna Publishing House
3	Enterprise Cyber Security -How to Build a Successful Cyber defense Program Against Advanced Threats, A-press by Donaldson, S.Siegel, S.Williams, C.K.Aslam.
4	"Hacking the Hacker", by Roger Grimes, Wiley

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Cyber Security and Privacy	Prof. Saji K Mathew	IIT Madras
	Course Link: https://onlinecourses.nptel.ac.in/noc22_cs53/preview		
2	Introduction to Cyber Security	Dr. Jeetendra Pande	Uttarakhand Open University, Haldwani
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/nou26_cs04		

A. Minor Degree in VLSI Design and Technology

Course Name:	**Analog VLSI**		
Course Code:	MN-EC401B	**Category:**	Minor
Semester:	Fourth	**Credit**:	3
L-T-P:	3-0-0	**Pre-Requisites:**	Analog Electronics Circuits, Electronic Devices
Full Marks:	100		

Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	**To build a strong foundation** in analog VLSI design using MOSFET concepts, device models, and basic circuit analysis techniques.
2	**To analyze and design fundamental analog building blocks** such as current mirrors, amplifiers, biasing circuits, and CMOS operational amplifiers.
3	**To understand practical design aspects** including frequency response, noise, stability, and compensation in analog integrated circuits.
4	**To introduce mixed-signal and system-level concepts**, including ADCs, DACs, comparators, switched-capacitor circuits, and basic layout considerations.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction & MOS Fundamentals:** Introduction to Analog VLSI Design and applications, Analog IC design flow and challenges, Review of MOSFET operation and characteristics (Body Effect, Channel length Modulation), Small signal modeling of MOSFET.	6L
2	**Basic MOS Circuits & Biasing:** MOS Diode, MOS Capacitors, MOS Switch, MOS Current sources and current sink circuits, Passive and Active Current Mirror , Voltage and Current reference circuits, Source follower and basic gain stages, Introduction to noise in MOSFETs.	8L
3	**Amplifiers & Operational Amplifiers:** Single-stage amplifiers, Differential amplifiers (basic analysis), CMOS Operational Amplifiers (concept & working), Frequency response of amplifiers, Introduction to Stability and compensation techniques, Concept of Band-gap reference.	8L
4	**Analog Design Applications:** Design considerations in Op-Amp (gain, bandwidth and power), Introduction to Design Techniques and practical consideration in design of OP-AMP, High Performance CMOS OP-AMP Design, Basic design of MOS comparator, Practical trade-offs in analog circuit design.	6L
5	**Data Converters & Switched Capacitor Circuits:** Fundamentals of data converters, Digital-to-analog Converters, Analog-to- Digital Converters, Introduction to switched-capacitor circuits.	4L

6	**System-Level Concepts & Layout Issues:** Introduction to RF IC design, Basics of power management circuits, Issues in Analog Layouts.	4L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	**Describe** the fundamentals of MOSFET operation, small-signal models, and basic analog VLSI design concepts.
2	**Analyze** MOS-based analog circuits including current mirrors, biasing circuits, single-stage and differential amplifiers.
3	**Apply** design principles to CMOS operational amplifiers, comparators, and evaluate their frequency response, stability, and performance.
4	**Explain and interpret** the working of mixed-signal building blocks such as ADCs, DACs, and switched-capacitor circuits, along with basic layout considerations.

Learning Resources:	
Books	
1	Behzad, Razavi: Design of Analog CMOS Integrated Circuits, MGH, 2001.
2	Allen Holberg: CMOS Analog Integrated Circuit Design, Oxford University Press, 2002
3	VLSI Design 2nd Edition Debaprasad Das, Oxford University Press
4	Sung-Mo Kang & Yusuf Leblebici, CMOS Digital Integrated Circuits Analysis and Design, McGraw-Hill, 1998.
5	Neil H.E.Weste and Kamran Eshraghian, Principles of CMOS VLSI Design, Addison Wesley, 1998

NPTEL	
1	**Analog IC Design** – NPTEL (IIT Madras)
2	**CMOS Analog VLSI Design** – NPTEL (IITs)
3	**Circuit Analysis for Analog Designers** – NPTEL
4	**Digital/Analog VLSI Design Courses** – NPTEL

Course Name:	**Analog VLSI Design Laboratory**		
Course Code:	MN-EC491B	**Category:**	Minor
Semester:	4th	**Credit:**	1
L-T-P:	0-0-2	**Pre-Requisites:**	Analog Electronics Circuits, Circuit simulation tools.
Full Marks:	100		
Examination Scheme:	Semester Examination: 60	Continuous Assessment: 35	Attendance: 05

Course Objectives:	
1	**To familiarize students with SPICE-based simulation tools** for modeling and analysis of MOSFET devices and analog circuits.
2	**To develop the ability to analyze basic analog VLSI circuits** such as current mirrors, amplifiers, and differential pairs through simulation.
3	**To provide hands-on experience in designing simple analog building blocks** using CMOS technology.
4	**To introduce layout concepts and sub-circuit implementation**, including basic exposure to design tools and process considerations.

Course Contents:		
Module No.	**Description of Topic/ Experiment**	**Contact Hrs.**
1.	**Introduction to Simulation Tools:** Introduction to SPICE-based tools (LTspice / Multisim)	3
	DC analysis of MOSFET: I_{DS} Vs. V_{DS} and I_{DS}Vs. V_{GS} characteristics.	3
2.	**MOSFET Modeling and Basic Circuits:** MOSFET modeling using SPICE and Verification of device parameters through simulation.	3
3.	**Sub-Circuit Design:** Introduction to sub-circuit concept (.subckt) and Design and reuse of basic analog building blocks.	3
4.	**CMOS Inverter Design:** Design and simulation of CMOS inverter and DC voltage transfer characteristics (VTC).	3
5.	**Current Mirror Circuits:** Design and simulation of Current Mirror circuits.	3
6.	**Differential Amplifier:** Design and simulation of MOS differential amplifier and Study of gain in common-mode behavior.	3
7.	**CMOS Amplifier / Op-Amp Basics:** Design of single-stage CMOS amplifier and Introduction to Op-Amp characteristics.	3

8.	**Layout Design Basics:** Introduction to layout tools and Layout of CMOS inverter and basic design rules.	3
Total		**24**

Course Outcomes:	
After completion of the course, students will be able to:	
1	**Understand and use SPICE-based simulation tools** to model MOSFET characteristics and basic analog circuits.
2	**Analyze the performance of analog VLSI circuits** such as current mirrors, CMOS inverter, and differential amplifiers through simulation.
3	**Design and simulate simple analog building blocks** including amplifiers and basic memory circuits using CMOS technology.
4	**Demonstrate basic layout concepts and implement sub-circuit designs**, considering practical design constraints.

Learning Resources:	
1	Laboratory Manual.
2	Behzad, Razavi: Design of Analog CMOS Integrated Circuits, MGH, 2001.
3	Allen Holberg: CMOS Analog Integrated Circuit Design, Oxford University Press, 2002.
4	R. Jacob Baker, *CMOS Circuit Design, Layout, and Simulation*, Wiley.

Detailed Curriculum for Minor Degree under Department of Information Technology (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

A. Minor Degree in Software Development

Course Name:	**E-Commerce and ERP**		
Course Code:	MN-IT401A	**Category:**	Minor
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Basic concepts of web application And traditional commerce
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To focus on a strong emphasis upon practices of theory in Applications and Practical Oriented approach of E-Commerce Business
2	To provide a contemporary and forward-looking on the theories and practices of Enterprise Resource Planning Technology
3	To train the students to develop the basic understanding of how ERP enriches the Business organizations in achieving a multidimensional growth
4	To aim at preparing the students technologically competitive and make them ready to self-upgrade with the respective technical skills

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction:** Overview, definitions, advantages & disadvantages of e-commerce over traditional commerce, threats of e-commerce, managerial prospective, rules & regulations for controlling e-commerce, cyber laws.	2L

2	**Business to Business E-commerce:** **Technologies:** Relationship Between E-Commerce & Networking, Different Types of Networking Commerce, Internet, Intranet & Extranet, EDI Systems Wireless Application Protocol: Definition, Hand Held Devices, Mobility & Commerce, Mobile Computing, Wireless Web, Web Security, Infrastructure Requirement For E-Commerce. **Business Models of E-commerce:** Financial, Marketing, Personnel, Production, Materials Information System, DSS, EIS, KMS, GIS, International Information System. **E-strategy:** Security, Testing, Error detection, Controls, IS Vulnerability, Computer Crimes, Securing the Web, Intranets and Wireless Networks, Software Audit, Ethics in IT.	8L
3	**FOUR C'S: (Convergence, Collaborative Computing, Content Management & Call Center):** Convergence: Types of convergence, and its implications. Collaborative Computing: Collaborative product development, CAD, Security. Content Management: Definition of content, Authoring Tools & Content Management, Content-partnership, repositories, convergence, providers, Web Traffic & Traffic Management; Content Marketing. Call Center: Definition, Need, Tasks Handled, Mode of Operation, Equipment, Strength & Weaknesses of Call Center, Customer Premises Equipment (CPE).	6L
4	**Related Issues in E-Commerce:** **Supply Chain Management:** E–logistics, Supply Chain Portal, Supply Chain Planning Tools (SCP Tools), Supply Chain Execution (SCE), SCE - Framework, Internet's effect on Supply Chain Power. **E-Payment Mechanisms:** Payment through card system, E-Cheque, E- Cash, E-Payment Threats & Protections. **E-Marketing:** Home-shopping, E-Marketing, Tele-marketing **Electronic Data Interchange (EDI):** Meaning, Benefits, Concepts, Application, EDI Model	7L
5	**Risk of E-commerce:** Overview, Security for E-Commerce, Security Standards, Firewall, Cryptography, Key Management, Password Systems, Digital Certificates, Digital signatures.	4L
6	**Enterprise Resource Planning (ERP):** Features, capabilities and Commercial Software, re-engineering work processes for IT applications, Knowledge engineering and data warehouse. Business Modules: Finance, Manufacturing, Human Resources, Plant Maintenance, Materials Management, Quality Management. ERP Package. ERP Market Place: SAPAG, PeopleSoft, BAAN, JD Edwards, Oracle Corporation. ERP Future: Enterprise Application Integration (EAI), ERP and Internet, Future Directions in ERP.	9L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Identify the various technologies used in e-commerce, and become familiar with important business, legal, security and ethical issues.
2	Explain the key components of Electronic Commerce purchase-market place, EDI, supply chain and Collaborative Commerce, customer relationship management, EC security and e-Payment schemes.
3	Describe the contemporary ecommerce concepts, terminologies, the processes and management decisions that are involved in launching, operating and managing business activity on the World Wide Web.
4	Use the application software skills such as database creation, webpage designing etc. to solve the real world business problems.

Learning Resources:	
1	E-Commerce, M. M. Oka, EPH
2	Kalakotia, Whinston: Frontiers of Electronic Commerce, Pearson Education.
3	Bhaskar Bharat: Electronic Commerce-Technologies & Applications. TMH
4	Enterprise Resource Planning– A Managerial Perspective by D P Goyal, Tata McGraw Hill Education, 2011
5	Enterprise Resource Planning by Ashim Raj Singla, Cengage Learning, 2008.
6	Enterprise Resource Planning, 2nd Edition by Alexis Leon, Tata McGraw Hill Education, 2008
7	Global E-Commerce, J. Christopher & T. H. K. Clerk, University Press

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1		Prof. Mamata Jenamani	IIT, KGP
	Course Link: https://onlinecourses.nptel.ac.in/noc26_mg41/preview		
2		Dr. Subodh Kesharwani	IGNOU
	Course Link: https://onlinecourses.swayam2.ac.in/e-learning/preview/nou21_cm14		

B. Minor Degree in Smart Computing

Course Name:	**Distributed Computing**		
Course Code:	MN-IT401B	**Category:**	Minor
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Concept of Memory Management
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understand the fundamental concepts, models, and design issues of distributed operating systems.
2	Learn communication mechanisms including message passing, IPC, RPC, synchronization, and distributed shared memory.
3	Study resource, process, and file management techniques used in distributed environments.
4	Develop knowledge of naming services, security mechanisms, and fault tolerance in distributed systems.

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Fundamentals:** Introduction, Models and Features, Concept of distributed operating system, Issues in design of a distributed operating system.	4L
2	**Message Passing:** Good message passing system, IPC, Synchronization, Buffering, Multi datagram messages, Encoding & decoding techniques, Process addressing, Failure handling, Group communication; Remote procedure calls (RPC) - Models, Communication protocols, RPC, Lightweight RPC.	7L
3	**Distributed Shared Memory:** Architecture, Thrashing, Granularity, Advantages.	3L
4	**Synchronization:** Introduction, Clock Synchronization, Event handling, Mutual Exclusion; Deadlock – Conditions, Avoidance, Prevention, Recovery.	3L
5	**Resource & process Management:** Features of a good scheduling algorithm, Task assignment approach, Load balancing & load sharing approach, Introduction to process management, Process migration, Threads.	6L

6	**Distributed Files Systems:** Introduction, Features, Models, Accessing models; sharing Semantics & caching schemes, replication, Fault Tolerance, Atomic transactions.	6L
7	**Naming:** Introduction, Features, Fundamental Terminologies & concepts, System oriented names, Human oriented names, Name caches.	4L
8	**Security:** Potential attacks to computer system, Cryptography, Authentication, digital signatures, Access Control.	3L
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Explain architecture, models, and key challenges of distributed operating systems.
2	Analyze and apply communication techniques such as message passing, RPC, and synchronization methods.
3	Evaluate distributed resource management strategies including scheduling, load balancing, and process migration.
4	Describe distributed file systems, shared memory concepts, and data consistency mechanisms.
5	Apply deadlock handling and synchronization techniques in distributed environments.
6	Identify security threats and implement authentication, cryptography, and access control mechanisms.

Learning Resources:	
1	Distributed operating Systems, Concepts & design – Sinha Pradeep K.; PHI.
2	Distributed Operating System - Tanenbaum Andrews S. – Pearson.
3	Distributed Systems, Concepts & design - Coulouris George, Dollimore Jean, Kindberg Tim; Pearson.
4	Operating System Concepts - Silberschatz Galvin; John Wiley, 5th Edition.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Cloud Computing and Distributed Systems	Prof. Rajiv Misra	IIT Patna
	Course Link: https://onlinecourses.nptel.ac.in/noc26_cs29/preview		

C. Minor Degree in AI and ML

Course Name:	**Introduction to Data Science**		
Course Code:	MN-IT401C	**Category:**	Minor
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Statistics, Python
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	To introduce fundamental concepts of data science, including data types, sources, life cycle, and real-world applications.
2	To develop understanding of data preprocessing, exploratory analysis, and statistical techniques for data interpretation.
3	To provide knowledge of machine learning concepts, learning paradigms, and model evaluation approaches.
4	To enable understanding of data-driven problem solving across various application domains

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Introduction to Data Science, Data Science Lifecycle, Application, Different Types of Data, Data Sources and Collection, Programming Tools, Development Environments, and Platforms.	5
2	Data Preprocessing: Data Cleaning, Handling Missing Values, Removing Duplicates, Exploratory Data Analytics: Univariate Analysis, Multivariate Analysis, Data Visualization, Outlier Detection and Removal, Feature Engineering and Transformation, Statistical Testing for Data-Driven Inference.	10
3	Introduction to Machine Learning and Deep Learning, Model Development Pipeline, Train-Test Split and Cross-Validation, K-Fold Cross-Validation, Learning Paradigms: Supervised, Unsupervised, and Reinforcement Learning.	5
4	Supervised Learning: Regression Problems, Classification Problems, and Evaluation Metrics, Model Selection and Generalization, Bias-Variance Tradeoff, Overfitting vs. Underfitting; Unsupervised Learning: Clustering Techniques and Evaluation Metrics.	10
5	Data-Driven Problem Solving and Decision-Making, Role of Domain Knowledge and Domain Experts, Case Studies in Healthcare, Finance, E-Commerce, Agriculture, and Environment	6
Total		**36**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Understand core data science concepts, including lifecycle, data types, sources, and applications.
2	Apply data preprocessing and exploratory data analysis using statistical measures, visualization techniques.
3	Apply statistical techniques such as hypothesis testing (t-test, z-test, ANOVA) and multivariate analysis to extract meaningful insights from data.
4	Implement supervised and unsupervised learning models with appropriate evaluation metrics.
5	Analyze real-world problems and application of data science techniques on domain-specific solutions in areas such as healthcare, finance, e-commerce, and agriculture.

Learning Resources:	
1	Data Science by Analytics by V.K.Jain, Khanna Publishers.
2	Data Science from Scratch by Joel Grus, O'Reilly
3	An Introduction to Data Science by Jeffrey S. Saltz, Jeffrey Morgan Stanton SAGE Publishers Inc.
4	Doing Data Science: Straight Talk from the Frontline by Cathy o'Neil, Rachel Schutt, O'Reilly.
5	Practical Statistics for Data Scientists: 50+ Essential Concepts Using R and Python Peter Bruce, Andrew Bruce, Peter Gedeck, O'Reilly Media.

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Data Science for Engineers	Prof. Ragunathan Rengasamy, Prof. Shankar Narasimhan	IIT Madras
	Course Link: https://nptel.ac.in/courses/106106179		
2	Python for Data Science	Prof. Ragunathan Rengasamy	IIT Madras
	Course Link: https://nptel.ac.in/courses/106106212		

Detailed Curriculum for Minor Degree under Department of Mechanical Engineering (w.e.f. AY: 2025-26)

Part VII: Detailed Syllabus for Minor Degree

Course Name:	**Energy and its resources**		
Course Code:	MN-ME401A	**Category:**	Minor
Semester:	Fourth	**Credit:**	3
L-T-P:	3-0-0	**Pre-Requisites:**	Nil
Full Marks:	100		
Examination Scheme:	Semester Examination: 70	Continuous Assessment: 25	Attendance: 05

Course Objectives:	
1	Understanding of energy units, unit conversion, unit magnitudes
2	Description and quantification of various energy resources – renewable and non-renewable
3	Understanding energy needs of self, institution, country and world, energy consumption by sector
4	Debate on advantages and disadvantages of energy sources
5	Energy resources of India and World, Sankey diagrams
6	Wind, biomass and solar energy resources
7	Per capita energy consumption and impact on social and economic parameters
8	Future scenarios of energy requirements

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	**Energy and its units:** Role of energy in our lives, various sources of energy that we use, units of energy, small and large units of energy, magnitude of energy units, units for energy consumption of individual, institution and country. Renewable and Non-renewable energy: difference, characteristics of resources, advantages and disadvantages.	**4L**
2	**Understanding individual energy requirements:** Differentiate between energy and power, estimating electrical energy needs, estimating fuel energy needs (petrol/diesel), estimating cooking energy needs, convert all energy sources in single energy units, estimate total energy needs of a person.	**4L**
3	**Energy requirements of a country:** Evolution of energy consumption, population of country, number of demands for energy,	**4L**

	per demand energy, estimating energy consumption of country.	
4	**Renewable energy sources:** What are renewable energy sources? Why they are renewable? Summary of all RE resources, global scenario of these resources.	**4L**
5	**Wind and Biomass resources in India:** Origin of these resources, potential of these resources in India, how these resources are converted into useful energy.	**3L**
6	**Solar energy resources:** Sun as source of energy, solar energy reaching the Earth's surface, solar spectrum, photons of different energy, solar irradiation and solar radiation/insolation, extra-terrestrial solar radiation, global, direct and diffuse solar radiation.	**4L**
7	**Quantifying solar energy resources:** Units of solar energy, air mass, AM1.5 and standard test conditions; hourly, daily, monthly and yearly solar radiation, solar radiation maps of India and world, variation of solar radiation at a given location within a day, over a season and reason behind it, significance of summer and winter solstice.	**6L**
8	**Optimal collection of solar radiation:** Apparent motion of sun and earth, apparent position of sun for an observer, optimal angle of solar collectors for maximum solar radiation collection, optimum angle for summer and winter.	**4L**
9	**Hydrogen energy:** Source and storage medium, generation of hydrogen, storage of hydrogen, conversion of hydrogen into useful energy, future of hydrogen	**3L**
Total		**36L**

Course Outcomes:	
After completion of the course, students will be able to:	
1	Quantify energy usage at various levels.
2	Correlate energy consumption with social and economic parameters.
3	Understand availability of renewable energy resources in a given region.
4	Comment on possible future energy scenario.

Learning Resources:	
1	John Twidell, Tony Weir, Renewable Energy Resources, Taylor & Francis, 2005
2	O.P. Gupta, Energy Technology, Khanna Publishing House, New Delhi, 2020.
3	Chandra & Chandra, Non-Conventional Energy Resources, Khanna Book Publishing, Delhi 2022.
4	Ankur Mathur, Non-Conventional Sources of Energy, Laxmi Publications Pvt. Ltd., 2015

Corresponding NPTEL/SWAYAM Courses:			
Sl. No.	**Course Name**	**Instructor Name**	**Host Institute**
1	Energy Resources, Economics and Environment	Prof. Rangan Banerjee	IIT Bombay
	Course Link: https://nptel.ac.in/courses/109101171		
2	Energy Resources, Economics, and Sustainability	Prof. Pratham Arora	IIT Roorkee
	Course Link: https://onlinecourses.nptel.ac.in/noc24_hs77/preview		

Annexure-IV

Reimbursement of Registration Fees for attending Conference by the Staff Members and Students of MCKVIE

Sl. No.	Academic Year	Date of Submission of Application	Name of Applicant	Designation	Dept.	Event Details	Type of Event	Paper Title	SCOPUS Indexed?	Actual Registration Fee (INR)	TA Claimed (INR)	Total Amount Claimed (INR)	Approved Registration Fee (INR)	Approved TA (INR)	Total Amount Approved (INR)	Date of Approval by Dean, Academics/ IQAC
1	2025-26	28-04-2026	Mr. Sekhar Rana	Asst. Prof.	ECE	Presented Research Paper in 2025 International Conference on Sustainable Technology in Energy and Power Systems STEPCon-2025) held during 20th to 21st November, 2025 at Narula Institute of Technology, Kolkata	International Conference	Comparative Analysis of Grating Structured Free-Standing ModeTENGs using Sustainable Material Pairs for Green Energy Harvesting	Yes	9,000	-	9,000	4,000	-	4,000	12-05-2026
2	2025-26	28-04-2026	Ms. Debasree Maity	Asst. Prof.	ECE	Presented Research Paper in 2nd International Conference on Green Technology & Smart Systems 2025 held during 19th to 20th December 2025 at Abacus Institute of Engineering & Management, Mogra, Hooghly	International Conference	Design, Development and Testing of a Capacitive Type Soil Moisture Sensor for IoT Based Smart Agriculture	Not yet	9,500	-	9,500	4,000	-	-	-
3	2025-26	07-05-2026	Ms. Mahua Raha Patra	Asst. Prof.	ECE	Presented Research Paper in 2nd International Conference on Emerging Trends in Electronic Devices and Computational Techniques held during 20th to 21st November 2025 at Guru Nanak Institute of Technology, Kolkata	International Conference	Electrothermal Simulation of A1GaN/GaN HEMT for Assessment of Electrical Response of the Device	Not yet	6,500	-	6,500	4,000	-	-	-
4	2025-26	08-05-2026	Mr. Avijit Bose	Asst. Prof.	CSE	Presented Research Paper in 3rd International Conference on Power Electronics and Energy (ICPEE 2025) held during 14th to 16th December 2025 at KIIT Deemed to be University, Bhubaneswar	International Conference	Optimization of Live Electrode Design for Desired Field Distribution in GITL using ANN	Yes	11,800	1,378	13,178	4,000	1,378	5,378	12-05-2026
											Total Reimbursement Claimed:	**38,178**		**Total Reimbursement Approved:**	**9,378**	

Annexure-V

MCKV Institute of Engineering

Staff Matters: Feb - Apr 2026

(i) STAFF APPOINTMENT STATUS

Sl.No.	Name	Department	Designation	Qualification	Experience (in years)	Date of Joining
1	MR. ROUNAK SINGH	ADMINISTRATION	ACCOUNTS ASSISTANT	B. Com	5	01-Feb-26
2	MR. ARUNAVA CHAKRABORTY	MS	ASSISTANT PROFESSOR	M.Com, MBA (Finance)	18	02-Feb-26
3	MR.ASIM KUMAR PANDA	IT	ASSISTANT PROFESSOR	M.Tech	14	02-Feb-26
4	MS. EPSITA DAS	CSE	ASSISTANT PROFESSOR	M. Tech	15	02-Feb-26
5	MR. HIMADRI SEKHAR MONDAL	CSE	ASSISTANT PROFESSOR	ME	3.4	02-Feb-26
6	MR. KAUSHIK ROY CHOUDHURY	CSE	ASSISTANT PROFESSOR	M. Tech	20	02-Feb-26
7	DR.SUMANA KUNDU	CSE	ASSOCIATE PROFESSOR	PhD	15.5	02-Feb-26
8	MR. MANAB KUMAR DAS	IT	ASSISTANT PROFESSOR	M.Tech, MBA	15	06-Feb-26
9	MS. ISHITA GHOSH	ADMINISTRATION	OFFICE ASSISTANT	MHM	1.5	09-Mar-26
10	MS. ANANYA CHAKRABORTY	ADMINISTRATION	HR MANAGER	MA (Eng), MBA	16	16-Mar-26
11	DR.TANMOY MAJUMDER	MS	ASSISTANT PROFESSOR	MBA, PhD	15	23-Mar-26
12	MR. JAYANTA ROY	ECE	SR LAB INSTRUCTOR	Diploma in ETCE	24	06-Apr-26
13	MS. USHASHI CHATTOPADHYAY	ECE	LAB INSTRUCTOR - TRAINEE	B. Tech	1 month	06-Apr-26
14	MS. DYUTI BANERJEE	ECE	JR LAB INSTRUCTOR	Diploma in ETCE	13	27-Apr-26
15	MS. ANUSHRI GHOSH	CSE	JR LAB INSTRUCTOR	B. Tech	4.3	27-Apr-26

(ii) STAFF CONFIRMATION STATUS

Sl.No.	Name	Department	Designation	Qualification	Experience (in years)	Date of Confirmation

(iii) PROMOTION STATUS -NIL

(iv) MATERNITY LEAVE - NIL

(v) STAFF RESIGNATION / RETIREMENT STATUS

SL. No.	Name	Department	Designation	Qualification	Experience in MCKVIE	Last Working Day
1	MS. SUDIPA POLLEY	ADMINISTRATION	OFFICE ASSISTANT	BA (History Hons)	1 month 9 days	17-04-2026

(v) STAFF RE-DESIGNATED

SL. No.	Name	Department	Designation	Qualification	Experience in MCKVIE	Last Working Day

Annexure-VI

MCKV INSTITUTE OF ENGINEERING

(An Autonomous Institute under UGC Act 1956,
Approved by AICTE & affiliated to MAKAUT)
243, G.T.Road (N), Liluah, Howrah-711204, Ph.2654 9315/17

IIC-NISP Calendar Activities for Academic Year 2025-26			
Semester I			
Quarter 1 (SEPT-NOV)		**Event Coordinator**	**Conducted on**
Sl. No.	**Activity**		
1	**Awareness Workshop: "Entrepreneurship & Innovation" as Career Opportunities**	**Mrs. Anwsea Das (Coordinator)**	**31/10/2025 & 03/11/2025**
2	**My Story/ Motivational Expert Sessions by Successful innovators & Entrepreneurs**	**Start-up Club/ Mr. Uddalok Sen (Coordinator)**	**19/11/2025 & 20/11/2025**
3	**Boot camp on Problem Solving/Ideation: "Problem-solving and ideation workshop"**	**Dept-ME Ajit Pandey**	**19/11/2025 & 20/11/2025**
4	**Workshop on AI and I4.0 Tools for Innovators and Entrepreneurs**	**Mr. Soham Goswami (Coordinator)**	**19/12/2025**
5	**IPR Basics for Innovators & Entrepreneurs**	**Mr. Sudeep Samanta & Dr. Debopoma Kar Ray (Coordinator + Speaker)**	**30/01/2026**
6	**Session on Achieving Problem –Solution Fit**	**Dept-ME**	
7	**Inter/Intra Institutional Hackathon/ Idea Challenge**	**Ms. Moumita Goswami (Coordinator)**	**16/09/2025 to 18/09/2025**
8	**Demo Day/ Idea Showcase: Srijanam-2026, an Intra-College Innovative Idea Showcase**	**Dr. Abhijit Pramanik (Coordinator)/ Mr. Milan Chakrabortty**	**24/02/2026, 25/02/2026**
9	5 days FDP on "INDUSTRY 4.0: READINESS, SKILLS AND FUTURE DIRECTIONS"	DEPT-IT	
10	Expert Talk	DEPT- AUE	
11	Expert Talk on Emerging Technologies	DEPT-ME	
12	Industry Visit	DEPT-CSE	
13	Electronic Circuit Design Workshop	DEPT-ECE	
14	National Entrepreneurship Day/9th November 2024	Dr. Sasmita Subhadarsinee Choudhury **(Coordinator)**	
15	National Education Day /11th November 2024	Dr. Sasmita Subhadarsinee Choudhury (**Coordinator)**	

	Five-Day Online FDP on AI Tools, Techniques, and Transformative Practices in Management and Technology Research	Dr. Arindam Ghosh	**10/11/2025 to 14/11/2025**
	Orientation Session on IIC 8.0 Calendar & R&D Cell Activities for AY 2025-26 (MIC activity)	Dr. Abhijit Pramanik	**22-10-2025**
	Micro-Shift: Small Change with a Big Impact	Dr. Abhijit Pramanik	**27/11/2025 & 28/11/2025**
	IIC Regional Meet 2025 (MIC Activity)	Mr. Milan Chakrabortty	**25/11/2025**
Quarter 2 (DEC-FEB)		**Event Coordinator**	**Conducted on**
1	**Workshop on Design Thinking, Critical thinking and Innovation Design**	**Dr. TRC (BSH) (Speaker + Coordinator)**	
2	**Innovation & Entrepreneurship Outreach Program in Schools**	**Mr. Ajoy Ghosal+ Joydeep Banerjee (Speaker + Coordinator)**	**24/02/2026**
3	**AI & Innovation Sprints: Rapid Prototyping for Digital Transformation**	**Dept ME (3D printing)**	
4	**Expert Talk on Technology Readiness Level (TRL), MRL, IRL, IP Commercialization, Tech-Transfer**	**Mr. Milan Chakrabortty + Mr. Partha Pratim Saha (Coordinator + Speaker)**	**14/01/2026**
5	**Workshop: Effective Sales and Marketing Strategies for Start-ups**	**Dr. Arindam Ghosh + Dr. Soumyajit Das (Coordinator)**	**23/02/2026**
6	**Field/Exposure Visit to Preincubation Units (e.g., AICTE Idea Lab, Fab Lab, MSME clusters)**	**Mr Sourav Ghorai (Coordinator)**	**26/02/2026, 27/02/2026**
7	**Organize Inter/Intra-Institution Innovation Competition/Hackathon & Reward Best Innovations (YUKTI repository)**	**Mr. Milan Chakrabortty + Mr. Partha Pratim Saha (Coordinator + Speaker)**	
8	**Innovation Showcase: Demo Day/Exhibition/Poster Presentation of Innovations/Prototypes : Rupantar-2026, an Intra-College Prototype Demonstration Contest**	**Dr. TRC (BSH)/ Milan Chakrabortty Coordinator)**	**24/02/2026 & 25/02/2026**
9	**Training on Technology Commercialization, Licensing and Transfer Practices & Strategy**	**Mr. Sudeep Samanta, Dr. Debopama Kar Ray (Coordinator)**	**29/01/2026**
9	FDP-Emerging Trends in Research and its Application in Engineering	DEPT-ECE	

10	Innovative Project Contest	DEPT-IT	
11	Workshop on Paving Way to Innovation	DEPT-BSH	**14/01/2026 to 16/01/2026**
12	Industry Visit	DEPT-AUE	
13	AI & ML Innovations for Power System Networks: A 5-Day Intensive Workshop	DEPT-EE	
14	Industrial tour or company visit	DEPT-EE	
15	IPR Awareness Session (Intellectual Property Rights)	DEPT-ME	
16	Insignia 2K26	DEPT-CSE	
17	National Pollution Control Day	Dr. Sasmita Subhadarsinee Choudhury**(Coordinator)**	
18	National Youth Day	Dr. Sasmita Subhadarsinee Choudhury**(Coordinator)**	**12/01/2026**
19	National Science Day	Dr. Sasmita Subhadarsinee Choudhury**(Coordinator)**	
	Workshop on Safe, Trusted and Ethical AI (Challenges and Best Practices for Students and Educators)	Dr. Abhijit Pramanik	**02/02/2026**
	Expert Talk on Applications of Generative AI Tools in Research	Dr. Abhijit Pramanik	**03/02/2026**
	Workshop on "Artificial Intelligence: From Scientific Foundations to Start-up Innovation and Social Impact"	Dr. Abhijit Pramanik	**05/02/2026**
	Expert Talk Agentic AI – The Next Frontier of Intelligent Systems	Mr. Puspen Lahiri	**20/02/2026**
	Biz-Venture (Inter-institutional competition on Implementation of Effective Sales & Marketing Strategies for Start-ups)	Dr. Arindam Ghosh	**23/02/2026**
	AI and Innovation Sprints- Rapid Prototyping for Digital Transformation	Dr. Ajit Pandey	**25/02/2026 & 26/02/2026**
	Idea Competition	Ms. Jayanti Mahata	**11/02/2026, 12/02/2026**
Semester II			
Quarter 3		**MAR-MAY**	**Conducted on**
1	**Workshop on Product- Market fit; Prototype/Process Design and MVP Development**	**Mr. Sumit Majumder (Speaker)/ Ms. Moumita Goswami (Coordinator)**	Not completed yet
2	**Session/Workshop on Business Model Canvas (BMC) & Business Model Fit**	**Dr. Arindam Ghosh + Dr. Soumyajit Das (Coordinator + Speaker)**	Not completed yet
3	**AI-Powered Solution Expo: Demo Days for AI/I4.0 Prototypes**	**ME Dept. (3D Printing)**	Not completed yet

4	**Field/Exposure Visit to Incubation Units/Patent Facilitation/Tech Transfer Centres**	**Mr Nirveek Banerjee (Coordinator)**	Not completed yet
5	**Session on Start-up Legal & Ethical Steps**	**Mr. Sudeep Samanta, Dr. Debopama Kar Ray (Coordinator)**	Not completed yet
6	**Workshop on Raising Capital and Finance Management for Start-ups**	**Dr. Arindam Ghosh + Dr. Soumyajit Das (Coordinator + Speaker)**	Not completed yet
7	**Workshop: Protecting IPR and IP Management for Start-ups**	**Mr. Sudeep Samanta, Dr. Debopama Kar Ray (Coordinator)**	Not completed yet
8	**Organize Inter/Intra Institutional B-Plan Competition, Reward Best Innovations**	**Dr. Arindam Ghosh + Dr. Soumyajit Das (MBA) (Coordinator)**	Not completed yet
9	**Mentoring Event: Demo Day/Poster Presentation of Business Plans & Mentor Linkages**	**Dr. Arindam Ghosh + Dr. Soumyajit Das (MBA) (Coordinator)**	Not completed yet
10	Expert Lecture	DEPT-CSE	Not completed yet
11	Expert Talk on Robotics and Autonomous Systems	DEPT-ME	Not completed yet
12	Invited Lecture on Robotics Innovation: Engineering the Future	DEPT-EE	Not completed yet
13	Practical Workshop on innovative Electric Circuit Design: Hands-On Experience	DEPT-EE	Not completed yet
14	PRAYAS 2025: Student Paper Contest	DEPT-ECE	Not completed yet
15	Innovative Idea Contest	DEPT-IT	Not completed yet
16	Celebration of International Pi Day and Competition	DEPT-BSH	Not completed yet
17	Innovative Idea Contest under "Nurturing Innovation"	DEPT-BSH	Not completed yet
18	Anharmonicity	DEPT-BSH	Not completed yet
19	Workshop	DEPT-AUE	Not completed yet
20	International Women's Day/8th March	Dr. Sasmita Subhadarsinee Choudhury	
21	World Intellectual Property Day/26th April	Dr. Sasmita Subhadarsinee Choudhury(Coordinator)	
22	National Technology Day/11th May	Dr. Sasmita Subhadarsinee Choudhury(Coordinator)	Not completed yet

	Post Budget Webinar 2026-27 on "Sabka Saath, Sabka Vikas - Fulfilling Aspirations of People" - Address by Hon'ble PM, on 9th March 2026	Dr. Abhijit Pramanik	**09/03/2026**
	Entrepreneurship Awareness Programme (EAP)	Dr. Arindam Ghosh	**10/03/2026**
Quarter 4		**JUNE-AUG**	**Conducted on**
1	**Session: Innovation/Prototype Validation & "Value Proposition Fit & Business fit"**	**Dr. Debopama Kar Ray (Speaker)/ Mr. Sudeep Samanta (Coordinator)**	Not completed yet
2	**Workshop: Using AI for Fundraising & Investor Pitch Preparation**	**MBA Dept. + DPC**	Not completed yet
3	**Session on Accelerators/Incubation Opportunities**	**Start-up Club/ Mr. Uddalok Sen (Coordinator)**	Not completed yet
4	**Organize Session on "Lean Start-up & MVP Boot Camp/Mentoring**	**Start-up Club/ Mr. Uddalok Sen (Coordinator)**	Not completed yet
5	**Session on Angel Investment/VC Funding Opportunities**	**Start-up Club/ Mr. Uddalok Sen (Coordinator)**	Not completed yet
6	**Panel Discussions with Regional/National Startup Ecosystem Enablers**	**Mr. Nilay Nag + DPC (Coordinator)**	Not completed yet
7	**Innovation & Entrepreneurship Outreach Program in Schools/ Community**	**Mr. Ajoy Ghosal + Joydeep Banerjee (Coordinator + Speaker)**	Not completed yet
8	**Organize Inter/Intra Institutional Start-up Competition & Reward Best Start-ups**	**MBA Dept.**	Not completed yet
9	**Startup Summit: Demo Day/Exhibition/Poster Presentation of Start-Ups & Linkage with Innovation Ambassadors/Experts for Mentorship Support**	**Mr. Uddalok Sen & Mr. Nilay Nag (Coordinators) +Ajoy Sir**	Not completed yet
10	Colloquium on "Agentic AI"	DEPT-IT	Not completed yet
11	Workshop on Circuit Design using LT Spice	DEPT-ECE	Not completed yet
12	Seminar on Entrepreneurship	DEPT-AUE	Not completed yet
13	**One day seminar on Future Drive: Innovating Mobility Solutions**	**DEPT-EE**	Not completed yet
14	Career-Oriented Skill Enhancement Program	**DEPT-ME**	Not completed yet
15	Kodikas 2K26	DEPT-CSE	Not completed yet
16	World Environment Day/5th June	Dr. Sasmita Subhadarsinee Choudhury(Coordinator)	Not completed yet

17	Independence Day- Celebrating Aazadi Ka Amritkal/15th August	Dr. Sasmita Subhadarsinee Choudhury(Coordinator)	Not completed yet
18	World Entrepreneurs Day/21st August	Dr. Sasmita Subhadarsinee Choudhury(Coordinator)	Not completed yet

Annexure-VII

Placement Summary for 2026 POB								Record up to 07-05-2026			
2026 POB	**AUE**	**CSE**	**ECE**	**EE**	**IT**	**ME**	**CSE-DS**	**CSE-AIML**	**MBA**	**MTech**	**Total**
Total Students **	**11**	**136**	**62**	**53**	**62**	**47**	**66**	**67**	**14**	**8**	**526**
Interested in Entrepreneurship / Higher Study	**3**	**32**	**12**	**24**	**20**	**21**	**23**	**26**	**0**	**0**	**161**
Final Student Count ***	**8**	**104**	**50**	**29**	**42**	**26**	**43**	**41**	**14**	**8**	**365**
Total Placement - Offered	**6**	**62**	**33**	**21**	**29**	**30**	**19**	**17**	**10**	**0**	**227**
Eligible Students * - (60% through-All Subject, No Year Gap, Without Backlogs & B Tech - 6.75)	**4**	**80**	**40**	**19**	**28**	**11**	**30**	**28**	**2**	**0**	**242**
Overall Placed % - Offerwise [On Final Students] ***	**75%**	**60%**	**66%**	**72%**	**69%**	**115%**	**44%**	**41%**	**71%**	**0%**	**62%**
Unique Student Count - Placed	**6**	**51**	**26**	**20**	**24**	**21**	**16**	**17**	**10**	**0**	**191**
Unique Student - Placement %	**75%**	**49%**	**52%**	**69%**	**57%**	**81%**	**37%**	**41%**	**71%**	**0%**	**52%**

Annexure-VIII

CERTIFICATE
OF E-WASTE RECYCLING

This certificate is proudly presented to

MCKV Institute of Engineering

for the ethical collection and channelization for recycling of

1293.30 kgs of E-waste.

This document certifies that all materials/equipment have been channelized for recycling under standards set down in the E-waste (Management) Rules, 2022 and amendments thereafter.

Sanjam Mall

Chief Executive Officer

Certificate No.:**1901/25-26/03081**
Date: **22-Apr-2026**

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