

मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान
जयपुर

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY
JAIPUR



Agenda
Senate
63rd Meeting

Date: 29th July, 2026

Time: 4:00 PM

Venue: Niti Sabhagar, Prabha Bhawan
MNIT Jaipur

मलवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

**AGENDA FOR THE 63RD MEETING OF THE SENATE TO BE HELD ON
29TH JULY 2026 (WEDNESDAY) AT 4.00 PM**

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MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Agenda for 63rd Meeting of Senate
(to be held on 29th July 2026 at 4.00 PM in the Niti Sabhagar, Prabha Bhawan, MNIT, Jaipur)

Item No. 63-1.0: To confirm the minutes of 62nd meeting of the Senate.

The minutes of the 62nd meeting of the Senate, held on 08th April 2026, were circulated to all the members. No comments were received; the minutes are placed for confirmation Annexure-A (Page-24 to 30).

The minutes are placed before the Senate for confirmation.

Item No. 63-2.0: To note the "Action Taken" on the decisions taken in the 62nd meeting of the Senate.

Action Taken on the decisions made in the 62nd meeting of the Senate.

ACTION TAKEN REPORT (62nd Senate meeting)

Item No.	Particulars	Decision	Action Taken
62-1.0	To confirm the minutes of the 61 st meeting of the Senate.	The Senate confirmed the minutes of the 61 st meeting with the following minor modifications: 1. Resolution No. 61-3.2: The introduction of the self-financed admission category is also extended to the M.Plan program in addition to the M.Tech programs. 2. Resolution No. 61-3.6: The Senate recommended expanding the UG Curriculum Review Committee by including at least one faculty member from each department. It was further suggested to include four meritorious UG students in the committee.	Noted. Implemented and notified vide Office Order No. 25 dated 18-05-2026.
62-2.0	To note the "Action Taken" on the decisions taken in the 60 th meeting of the Senate.	The Senate noted the action taken report on the decision/resolutions taken in its 61 st meeting.	Noted

62-3.0	Items for consideration		
62-3.1	To consider the Academic Calendar for Academic Year 2026-27.	The Senate considered the Academic Calendar for the Academic Year 2026-27 and approved the same.	Implemented
62-3.2	To consider the revised Scheme and Syllabi of the M.Tech. Programme “Semiconductor Materials and Devices” proposed by the Materials Research Centre (MRC).	After due deliberation, the Senate approved the revised Scheme and Syllabi, along with the eligibility criteria for admissions to the programme. The Senate also recommended that the programme be started with an intake of 15 seats.	Implemented
62-3.3	To consider the proposal for a new PG Open Elective course titled “Advanced Qualitative Research Methods in Social Sciences” by the Department of Humanities and Social Sciences.	After due deliberation, the Senate has returned the proposal to the department for submission through the DPGC.	Noted and informed to the concerned department vide endorsement no. 5790 dated:28-04-2026
62-3.4	To consider the increase in student intake in M.Tech. (Renewable Energy) from 16 to 26 in the Centre for Energy and Environment.	After due deliberation, the Senate approved the increase in student intake from 16 to 26 seats for the M.Tech. (Renewable Energy) programme.	Implemented
62-3.5	To consider offering a single M.Tech. programme in Chemical Engineering and Sustainability in the Department of Chemical Engineering in place of the earlier two programmes.	Upon consideration, the Senate approved the proposal to offer a single M.Tech. programme in “Chemical Engineering and Sustainability,” replacing the existing two programmes.	Implemented
62-3.6	To consider the proposal for initiating a merit-based scholarship for meritorious students admitted through JoSAA at MNIT Jaipur.	Following detailed discussion, the Senate approved the introduction of a merit-based scholarship scheme titled ‘Malaviya Ratna Award’ with the following provisions: • Number of Recipients: Top five students per academic year for B.Tech, and one top student per academic year for B.Arch. • Financial Support: ₹2,00,000 per annum per student to cover tuition fees, hostel charges, institute fees, and mess expenses. • Eligibility Criteria: ◦ B.Tech: Candidates admitted under the Open Category (gender-neutral) with an All India Rank (AIR) of up to 1500 through JoSAA. ◦ B. Arch: Candidates admitted under the Open Category (gender-	Implemented After approval of FC & BoG and notified vide office order issued No. 26 dated 18-05-2026 for its implementation.

		neutral) with an AIR of up to 200 through JoSAA. Continuation: Scholarship renewal is subject to maintaining a minimum CGPA of 8.0 each semester and satisfactory conduct. The Senate further recommended that the financial implications and the proposed source of funding, from Institute Revenue Generation (IRG) funds, be placed before the Finance Committee (FC) and the Board of Governors (BoG) of MNIT Jaipur for consideration and approval.	
62-3.7	To consider the revised minimum qualification for PG admissions through CCMT in Mechanical Engineering Department.	As per the directions of the Senate, the department has reviewed the GATE papers along with the qualifying degrees required for admission to the M.Tech programs in Industrial Engineering and Thermal Engineering through CCMT. The revised list of applicable GATE papers and corresponding qualifying degrees for these programs was circulated to all Senate members and subsequently approved.	Implemented
62-3.8	To consider the matter regarding Inactive UG Students who were not registered/absent for more than 2 semesters.	The Senate approved the termination of enrolment of the listed undergraduate students who had remained unregistered/absent for more than two semesters.	Implemented and Notified vide Office Order No. 5792 dated 28-04-2026.
62-3.9	To consider the mercy request of Ms. Prity Kumari (2025PCE5323).	The Senate approved the mercy request, permitting Ms. Prity Kumari to re-register in the first semester and repeat all courses. Her eligibility for promotion shall be assessed based on her performance after re-registration.	Notified vide Office Order No. 5394 dated 28-04-2026.
62-3.10	To consider the mercy request of Mr. Vankudothu Vamshi (2020UCH1915).	The Senate approved the mercy request, permitting the reinstatement of Mr. Vankudothu Vamshi.	Notified vide Office Order No. 5793 dated 28-04-2026.
62-3.11	To consider the seat matrix for admission to PG programs through CCMT and CCMN for the Academic Session 2026-27.	Upon consideration, the Senate approved the seat matrix for PG admissions through CCMT and CCMN for the Academic Session 2026-27.	Implemented
62-4.0	Items for ratification		
62-4.1	To ratify the seat matrix for admission to various UG programs through JoSAA for the Academic Session 2026-27.	Item was ratified.	Noted
62-4.2	To ratify the seat matrix for admission in UG and PG programs through DASA for	Item was ratified.	Noted

	the Academic Session 2026-27.		
62-4.3	To ratify the termination of 10 Inactive UG students who were not registered/absent for more than 2 semesters.	Item was ratified.	Noted
62-4.4	To ratify the mercy request submitted by Mr. Lalit Choudhary (2021UCH1833).	Item was ratified.	Notified vide Office Order No. 5791 dated 28-4-2026
62-5.0	Items for reporting		
62-5.1	To note the minutes of the 75 th meeting of SPGB.	Noted	Noted
62-5.2	To note the minutes of the 53 rd meeting of SUGB.	Noted	Noted
62-5.3	To note the minutes of the meetings of the Unfair Means Committee.	Noted	Noted
62-5.4	To note the commencement of 02 new Undergraduate programmes (B.Tech.) from Academic Session 2026-27.	Noted	Noted
62-5.5	To note the cases of Ph.D. students for termination from the Institute roles due to absence without authorized leave.	Noted	Noted
62-5.6	To note the list of PG students for termination of enrolment who secured a CGPA of less than 5.5 in the academic session 2025-26.	Noted	Noted
62-5.7	To note the case of PG students allotted MNIT Jaipur through CCMT/CCMN 2025 who have not reported and/or have not deposited the balance fee.	Noted	Noted
62-5.8	To note the case of PG students allotted MNIT Jaipur through CCMN 2025-26 who were unable to produce the qualifying degree certificate with the minimum required percentage.	Noted	Noted

62-6.0	Any other items with permission of chair	
62-6.1	To consider the Panel of Experts for Faculty Selection.	Upon consideration, the Senate approved the Panel of Experts for Faculty Selection and also authorised Chairperson Senate to extend the Panel of Experts with additional names as per additional requirements from time to time.
		Noted

Item No. 63-3.0: Items for consideration.

Item No. 63-3.1 To consider the request of the former Ph.D. student, Mr. Vikas Sangwan (ID: 2018RME9100), for the grant of mercy for the revival of his terminated Ph.D. registration.

Mr. Vikas Sangwan (ID: 2018RME9100) was admitted to the Part-Time Ph.D. programme in the Department of Mechanical Engineering under the joint supervision of Prof. G.S. Dangayach (Retired), Prof. Makkhan Lal Meena, Department of Mechanical Engineering, MNIT Jaipur, and Prof. Kuldeep Singh Sangwan, Department of Mechanical Engineering, BITS Pilani, as the External Joint Supervisor.

The details of his Ph.D. programme are as follows:

1.	Date of Admission	July 2018
2.	Course work status	Completed (09 credits with 7.67 CGPA)
3.	Comprehensive Exam status	Completed (March 2021)
4.	Fee submitted status	Fee submitted till 9 th semester (Odd Semester 2022-23) (July 2022 to December 2022)
5.	Status of Progress Report submitted	Submitted till 8 th semester (Even Semester 2021-22) Not submitted the progress report for Odd Semester 2022-23.
6.	Total number of X accumulated in progress Report	04
7.	Status of Ph.D. Synopsis	Not submitted

The scholar's Ph.D. registration was terminated vide Office Order No. F4/T-1-1/22-23/Acad.-Ph.D./2578 dated 01.05.2023, pursuant to the approval of the 56th SPGB (Item No. 56-2.11), on account of his absence without authorized leave. The scholar neither deposited the semester fee for the Even Semester 2022-23 (January 2023 to June 2023) nor established any communication with the Institute during the said period.

The scholar has now submitted a mercy application through the Departmental Post Graduate Committee (DPGC), Department of Mechanical Engineering, and seeking compassionate consideration for the revival of his Ph.D. registration. In his application, the scholar has stated that during the ninth semester of his Ph.D. programme, he encountered severe and unavoidable family-related circumstances that caused significant mental stress and emotional distress. As a consequence, he was unable to devote the necessary time and attention to

his research work, could not deliver the mandatory semester progress presentation for the Odd Semester 2022–23, and failed to deposit the semester fee for the subsequent semester. The scholar has requested the Institute to consider his case sympathetically and permit the revival of his Ph.D. registration. The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Mr. Vikas Sangwan (ID:2018RME9100)	The DPGC in its meeting dated 27-05-2026 recommended the following:- 1. Sympathetic consideration regarding grant of mercy attempt and revival of his Ph.D. registration. 2. Prof. Makkhan Lal Meena shall act as Main Supervisor 3. Dr. Surendra Singh Godara shall act as Co-supervisor. 4. Prof. Kuldeep Singh Sangwan, Department of Mechanical Engineering, BITS Pilani as the External Joint Supervisor.	Since the student was enrolled in the Ph.D. program eight years ago, the SPGB, considering his severe and unavoidable family-related circumstances and the recommendations of the DPGC, recommended to the senate that Mr. Vikas Sangwan (ID: 2018RME9100) may be permitted to register afresh and complete the coursework requirements again. His eligibility for promotion to the subsequent semester shall be evaluated based on his academic performance after re-registration under the supervision of proposed supervisors.

Item is placed for consideration and approval.

Item No. 63-3.2: To consider the mercy requests of M.Sc. first-semester students Ms. Madhu Saini (ID: 2025PPH5259) (CGPA: 3.8) and Ms. Neelam Lora (ID: 2025PPH5294) (CGPA: 2.0) against termination due to a CGPA below 5.5 in AY 2025–26.

Ms. Madhu Saini (ID: 2025PPH5259) and Ms. Neelam Lora (ID: 2025PPH5294) were admitted to the M.Sc. Physics programme during the Academic Session 2025–26. At the end of the First Semester, Ms. Madhu Saini secured a CGPA of 3.8, while Ms. Neelam Lora secured a CGPA of 2.0. Since both students obtained a CGPA of less than 5.5, their admissions were terminated in accordance with the provisions of the Institute's academic regulations on account of unsatisfactory academic performance.

Subsequently, both students submitted separate applications requesting the grant of a mercy attempt against the termination of their admissions. In their applications, they stated that their unsatisfactory performance in the First Semester examinations was primarily due to their inadequate proficiency in the English language, which adversely affected their comprehension of the course content and, consequently, their overall academic performance.

The Departmental Post Graduate Committee (DPGC), while examining their requests, observed that both students possess consistently good academic records in their previous qualifying examinations. Taking into consideration their academic background and the reasons furnished in their applications, the DPGC recommended that their requests be considered sympathetically and that they be granted a

mercy attempt to continue/re-register in the programme, subject to the provisions of the Institute's academic regulations. The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Ms. Madhu Saini (2025PPH5259) (CGPA-3.8)	The DPGC has recommended sympathetic consideration of her request for the grant of a mercy attempt to continue in or re-register for the programme, as per Institute norms.	The SPGB, considering their inadequate proficiency in the English language and the recommendations of the DPGC, recommended that Ms. Madhu Saini (ID: 2025PPH5259) and Ms. Neelam Lora (ID: 2025PPH5294) be permitted to re-register in the programme and repeat all the first-semester courses. Their eligibility for promotion to the subsequent semester shall be evaluated based on their academic performance after re-registration.
2.	Ms. Neelam Lora (2025PPH5294) (CGPA-2.0)	The DPGC has recommended sympathetic consideration of her request for the grant of a mercy attempt to continue in or re-register for the programme, as per Institute norms.	

Item is placed for consideration and approval.

Item No. 63-3.3 To consider the mercy application of Ms. Ritu Ankodiya (ID: 2025PPD5360) for continuation in the M.Tech. (Power Electronics and Drives) programme.

Ms. Ritu Ankodiya (ID: 2025PPD5360) was admitted to the M.Tech. (Power Electronics and Drives) programme during the Academic Session 2025-26. At the end of the Even Semester 2025-26, she secured a CGPA of 5.25, which is below the minimum CGPA prescribed under the Institute's academic regulations for continuation in the programme.

Subsequently, Ms. Ritu Ankodiya submitted a mercy application requesting permission to continue her registration in the III Semester (Odd Semester 2026-27). In her application, she stated that she had been facing health issues and adverse family circumstances, which prevented her from devoting adequate time to her studies and consequently affected her academic performance. The Departmental Post Graduate Committee (DPGC), Department of Electrical Engineering, examined her application and deliberated on the matter. After due consideration of the circumstances presented by the student, the DPGC recommended that her mercy appeal be accepted and that she be permitted to continue her registration in the III Semester (Odd Semester 2026-27) as a special case, subject to the approval of the competent authority. The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Ms. Ritu Ankodiya (2025PPD5360)	The DPGC recommended that her mercy appeal be accepted and that she be permitted to continue her registration in the III Semester (Odd Semester 2026-27) as a special case.	The SPGB, considering her health issues, adverse family circumstances, and the recommendations of the DPGC, recommended that Ms. Ritu Ankodiya (ID: 2025PPD5360) be permitted to re-register in the programme and repeat all the first-semester courses. Her eligibility for promotion to the subsequent semester shall be evaluated based on her academic performance after re-registration.

Item is placed for consideration and approval.

Item No. 63-3.4 To consider the mercy application of Mr. Jayesh Singh Sagar (2023PES5426) for continuation of M.Tech. (Power Systems) programme.

Mr. Jayesh Singh Sagar (ID: 2023PES5426) was admitted to the M.Tech. (Power Systems) programme during the Academic Session 2023-24. At the end of the First Semester (Odd Semester 2023-24), he secured an SGPA/CGPA of 3.00, which was below the minimum CGPA prescribed under the Institute's academic regulations for continuation in the programme. Subsequently, on compassionate grounds, the competent authority approved his mercy application and permitted him to re-register in the Odd Semester of the Academic Session 2024-25. Thereafter, at the end of the V Semester (Odd Semester 2025-26), the student secured a CGPA of 5.41, which was again below the minimum CGPA prescribed for continuation in the programme. The matter was deliberated upon by the Departmental Post Graduate Committee (DPGC) in its meeting held on 6 March 2026. The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Mr. Jayesh Singh Sagar (2023PES5426)	The DPGC recommended that the matter to be forwarded to Academic Section for the necessary action.	The SPGB, after due deliberation, did not recommend the mercy application of Mr. Jayesh Singh Sagar (ID: 2023PES5426) to the Senate, as he had already been granted a one-time mercy opportunity for re-registration in the Odd Semester of the Academic Session 2024-25.

Item is placed for consideration and approval.

Item No. 63-3.5: To consider the mercy application of Mr. Vishal Kumar Naveen (ID: 2024PPD5131) for continuation in M.Tech. (Power Electronics and Drives) programme.

Mr. Vishal Kumar Naveen (ID: 2024PPD5131) was admitted to the M.Tech. (Power Electronics and Drives) programme in the Department of Electrical Engineering during the Odd Semester of the Academic Session 2024-25. During the III Semester (Odd Semester 2025-26), the student submitted an application seeking conversion of his registration status from Full-Time to Part-Time after receiving an employment offer from Jaipur Vidyut Vitran Nigam Limited (JVNL).

The student in his III semester was awarded FP grades in the Seminar Course (21EES602) and the Dissertation Course (21EED601). As a result, he secured a CGPA of 4.83, which is below the minimum CGPA prescribed under the Institute's academic regulations for continuation in the programme. Mr. Vishal Kumar Naveen has now submitted a mercy application through supervisor requesting permission to continue in the M.Tech. (Power Electronics and Drives) programme. After examining the facts of the case and the submissions made by the student, the DPGC recommended that his mercy application be considered and that he be permitted to continue in the programme as a special case, subject to the approval of the competent authority. The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Mr. Vishal Kumar Naveen (2024PPD5131)	The DPGC recommended the mercy appeal of Mr. Vishal Kumar Naveen (2024PPD5131) be considered to allow him to continue in the M.Tech. programme.	The SPGB, after due deliberation, recommended to the Senate that the mercy appeal of the candidate be accepted and that the candidate be permitted to continue in the M.Tech. (Power Electronics and Drives) programme. The Committee noted that the candidate had successfully completed all the coursework requirements of the programme and that only the Seminar and Dissertation components remained. It was further observed that the candidate's CGPA had fallen below 5.50 solely due to the award of FP grades in the Seminar and Dissertation courses. In view of these circumstances, the SPGB recommended that the candidate be allowed to continue in the programme.

Item is placed for consideration and approval.

Item No. 63-3.6: To consider the mercy request for extension of Ph.D. registration period beyond 7 years.

The following Ph.D. scholars have requested the grant of a mercy extension for continuation of their Ph.D. programme beyond the maximum permissible duration of seven years:

Name	Recommendation of DPGC	Recommendation of SPGB
Ms. Aruna Chouhan (2019REC9037)	The DPGC noted that the scholar has completed her research work, submitted her research paper to a journal, and is awaiting the publisher's decision. She has also completed the compilation of her thesis. Accordingly, the DPGC recommended forwarding her application for a six-month mercy extension, as recommended by the supervisors and the DREC, for further consideration.	The SPGB, after due deliberation, noted that the scholar has completed her research work, submitted her research paper to a journal, and compiled her thesis. Accordingly, the SPGB recommended forwarding her application for a six-month mercy extension to the Senate for consideration, as recommended by the supervisors, the DREC, and the DPGC.
Mr. Rajkumar (2019REC9161)	The DPGC noted that the scholar has completed his research work, submitted his research paper to a journal, and is awaiting the publisher's decision. He has also completed the compilation of his thesis. Accordingly, the DPGC recommended forwarding his application for a six-month mercy extension, as recommended by the supervisors and the DREC, for further consideration.	The SPGB, after due deliberation, noted that the scholar has completed his research work, submitted his research paper to a journal, and compiled his thesis. Accordingly, the SPGB recommended forwarding his application for a six-month mercy extension to the Senate for consideration, as recommended by the supervisors, the DREC, and the DPGC.
Mr. Subhash Chand Pal (2019RME9089)	The DPGC noted that the scholar has published one conference paper and has two SCI-indexed journal manuscripts under review. Considering the progress made in the research work, the DPGC strongly recommended that his request for a one-semester extension be considered favourably.	The SPGB, after due deliberation, considered the progress made by the scholar and recommended forwarding his request to the Senate for granting a one-semester mercy extension to enable him to complete the remaining requirements of his Ph.D. programme.
Mr. Puneet Sharma (2019RME9163)	The DPGC noted that the scholar has published one conference paper and submitted one SCI-indexed journal paper, for which the revised manuscript has already been submitted after the second round of review. Considering the substantial progress made, the advanced stage of the research work, and the likelihood of thesis submission within the requested period, the DPGC recommended granting a one-semester extension to enable him to complete the remaining requirements of his Ph.D. programme.	The SPGB, after due deliberation, considered the substantial progress made by the scholar, the advanced stage of his research work, and the strong recommendation of the DPGC. Accordingly, the SPGB recommended forwarding the mercy application of Mr. Puneet Sharma (2019RME9163) to the Senate with its recommendation for granting a one-semester mercy extension to complete the remaining requirements of his Ph.D. programme.

Item is placed for consideration and approval.

Item No. 63-3.7 To consider the request of Ms. Ruchika Arora, Ph.D. Scholar (ID: 2026RHS9091), to carry forward the Ph.D. coursework credits completed under her previous registration (ID: 2025RHS9055).

Ms. Ruchika Arora was admitted to the Ph.D. programme in the Department of Humanities and Social Sciences (HSS), MNIT Jaipur, during the Odd semester 2025-26 admission cycle under the supervision of Dr. Preeti Bhatt and was allotted Scholar ID 2025RHS9055.

On 9 April 2026, Dr. Preeti Bhatt forwarded the scholar's request for a change of research supervisor to the DPGC. After due deliberation, the Departmental Postgraduate Committee (DPGC) recommended the change of supervision from Dr. Preeti Bhatt to Prof. Vibhuti Singh Shekhawat and forwarded the recommendation for further administrative consideration. As per the Institute regulations, a change of Ph.D. supervisor is permissible only under exceptional circumstances.

Subsequently, Ms. Ruchika Arora applied afresh for admission to the Ph.D. programme under the supervision of Prof. Vibhuti Singh Shekhawat during the Odd Semester 2026-27 admission cycle. She appeared before the Departmental Selection Committee (DSC), was selected through the prescribed admission process, accepted the fresh admission, withdrew her earlier Ph.D. registration (Scholar ID 2025RHS9055), and was allotted a new Scholar ID 2026RHS9091.

The scholar had registered her Ph.D. research in the area of "Gender" under her previous registration and continues to pursue research in the same area under the fresh registration. The coursework completed under the earlier registration is fully aligned with her current research programme. Accordingly, following her fresh registration, Ms. Ruchika Arora requested that the Ph.D. coursework credits earned under her previous registration (Scholar ID 2025RHS9055) be carried forward to her current registration (Scholar ID 2026RHS9091). The Departmental Postgraduate Committee (DPGC) examined the request and strongly recommended the transfer of the coursework credits.

After detailed deliberation, the SPGB recommended to the Senate that the Ph.D. coursework credits earned by Ms. Ruchika Arora under her previous registration (Scholar ID 2025RHS9055) be considered towards the fulfilment of the coursework requirements under her current registration (Scholar ID 2026RHS9091), as she is continuing her research in the same research area and the coursework completed under her previous registration remains fully relevant to her present Ph.D. programme.

Item is placed for consideration and approval.

Item No. 63-3.8: To consider the matter of Mr. Rahul (2018UCH1663) regarding termination after completing the maximum permissible duration.

The matter regarding undergraduate students who remained inactive and absent for one or more semesters was discussed in the 53rd Meeting of the Standing Undergraduate Board (SUGB) held on 16.03.2026 under Agenda Item No. 53-3.3. The SUGB advised the concerned DUGC Conveners to personally interact with such students and encourage them to complete the degree requirements within the maximum permissible duration prescribed under the Institute rules.

Subsequently, few responses were received from the Departments. Based on the information received, it has been reported that Mr. Rahul (2018UCH1663) has exhausted the maximum permissible duration for completion of the B.Tech. programme at the Institute. Further, Mr. Rahul has not submitted any request seeking extension of the maximum permissible duration or any other relief as provided under the Institute rules.

As per Clause 14 ("Termination of Enrolment to the Program"), sub-clause (c), of the Institute's Undergraduate Rules and Regulations, 2024, the enrolment of a student who fails to complete the programme within the maximum permissible duration is liable to be terminated.

The matter was deliberated by the 55th Meeting of the SUGB which recommended the termination of the enrolment of Mr. Rahul (2018UCH1663) and its placement before the Senate for consideration.

Item is placed for consideration and approval.

Item No. 63-3.9: To consider the request of Mr. Ambuj Singh (ID: 2019UME1291) regarding Semester withdrawal from previous semesters and registration in the upcoming semester.

Mr. Ambuj Singh (2019UME1291), a B.Tech. student of the Department of Mechanical Engineering, submitted an application dated 30.12.2025, duly forwarded by the DUGC Convener, requesting permission to treat his 12th and 13th semesters as withdrawal semesters and allow him to register in the forthcoming semester to complete the remaining degree requirements.

The student has completed 175 out of the required 197 credits for the award of the B.Tech. degree. During the 12th semester, although the Institute fee was paid, he did not register for any course. During the 13th semester, he neither paid the Institute fee nor registered for any course, resulting in the deactivation of his ERP account.

As per Clause 8.7 of the Institute's Undergraduate Rules and Regulations, continuation of registration after a gap semester is permissible upon payment of the prescribed Institute fees, tuition fees, and applicable penalty. However, the same clause also stipulates that "A maximum of two semester withdrawals can be availed during the entire duration of the programme."

The records indicate that the student had already availed semester withdrawals during his 10th and 11th semesters. The present request to treat the 12th and 13th semesters as withdrawal semesters would increase the total number of semester withdrawals to four, which is beyond the permissible limit prescribed under the Institute Rules.

The matter was initially considered by the 53rd Meeting of the SUGB under Agenda Item No. 53-3.7. The SUGB referred the case back to the Department of Mechanical Engineering for submission of specific recommendations along with adequate justification in support of the student's request. Subsequently, the Department submitted its recommendations, and the matter was placed before the 55th Meeting of the SUGB for consideration.

S. No.	Name & ID	Recommendation & Justification of DUGC, if any	Recommendation & Justification of SUGB
1.	Mr. Ambuj Singh (2019UME1291)	Considering the gravity of the situation, DUGC in its meeting dated 30.03.2026 strongly recommended that the mercy pleas of Mr. Ambuj Singh (2019UME1291) may be considered and he may be granted a two-semester extension to complete his pending credits.	The SUGB after detailed deliberation and considering the recommendations of DUGC, recommended the Mercy request of Mr. Ambuj Singh to allow two semester withdrawals (beyond the permissible limit) and thus extension of two semesters to complete his B.Tech. considering the earlier semester withdrawal, this extension will not exceed the maximum permissible duration for completion of B.Tech.

Item is placed for consideration and approval.

Item No. 63-3.10: To consider the matter of Mr. Harsh Meena (2022UMT1882) regarding promotion to the 2nd year B.Tech.

Mr. Harsh Meena (2022UMT1882) was terminated from the rolls of the Institute after completion of his IV semester due to his inability to secure the minimum 30 credits required for promotion to the Second Year, in accordance with Clause 13.1 of the Institute's Undergraduate Rules and Regulations, 2024.

Subsequently, upon consideration of his mercy request, the Senate, in its 57th meeting held on 29.01.2025 under Agenda Item No. 57-1.3, permitted him to re-register in the First Year B.Tech. programme as a year-back student, with all provisions of the Institute's UG Rules and Regulations remaining applicable. The Senate also approved the withdrawal of the Odd and Even semesters of the Academic Year 2024-25 (V and VI semesters). Accordingly, the student was re-registered for the First Year courses during the VII and VIII semesters (Odd and Even semesters of AY 2025-26).

Despite being granted this mercy, the student has earned only 09 credits during the VII and VIII semesters.

Accordingly, the student is ineligible for promotion to the Second Year and does not satisfy the academic requirements prescribed under the Institute's Undergraduate Rules and Regulations, 2024.

The matter was considered by the 55th Meeting of the SUGB. In view of the above facts and the provisions of Clause 13.1 of the Institute's Undergraduate Rules and Regulations, 2024, the SUGB recommended that the enrolment of Mr. Harsh Meena (2022UMT1882) be terminated from the rolls of the Institute.

Item is placed for consideration and approval.

Item No. 63-3.11: To consider the revised curriculum and syllabus of the Program M.Tech. in Structural Engineering.

A proposal has been received from the Department of Civil Engineering regarding the revision and updation of the curriculum and syllabi of the M.Tech. (Structural Engineering) programme.

The Department has submitted that, pursuant to the deliberations held during the Industry-Institute Conclave and Curriculum Development Workshop conducted on 10 April 2026, a committee was constituted under the convensorship of Prof. Arun Gaur, Convener, DPGC, with all Programme Advisors as members, to review, update, and harmonize the curricula of all postgraduate programmes offered by the Department. The Programme Advisors were requested to consult the faculty members in their respective areas of specialization and finalize the programme curriculum and structure within the credit limits approved by the Senate. The revised curricula were subsequently circulated among all faculty members of the Department for their review and comments. After incorporating the suggestions received, the final curriculum and programme structure, prepared in the prescribed format, was approved by the Department. Subsequently the revised scheme and syllabi of the M.Tech. (Structural Engineering) was circulated to all faculty for comments, no comments received. The revised scheme and syllabi of the M.Tech. (Structural Engineering) programme are placed at **Annexure-B (Pages 31 to 57)** for consideration.

The SPGB, after due deliberation, directed the Department to prepare a comparative statement clearly highlighting the proposed changes in the existing curriculum and to circulate the revised curriculum, along with the comparative statement, among all SPGB members for their review and comments. The SPGB further authorized the Chairman, SPGB, to recommend the revised curriculum to the Senate after incorporating the comments received from the members. Subsequently, the revised curriculum and the comparative statement were circulated among all SPGB members. Since no comments or objections were received within the stipulated time, the Chairman, SPGB, in accordance with the authorization granted by the SPGB, recommended the proposal to the Senate for its consideration and approval.

Item is placed for consideration and approval.

Item No. 63-3.12: To consider the revised curriculum and syllabus of the M.Tech. Programme in Earthquake Engineering.

A proposal has been received from the National Centre for Disaster Mitigation and Management (NCDMM) regarding the revision and updation of the curriculum and syllabi of the M.Tech. (Earthquake Engineering) programme.

The NCDMM has submitted that the existing curriculum of the programme has been comprehensively reviewed and revised in accordance with the recommendations of the Industry-Institute Conclave and Curriculum Development Workshop held on 10 April 2026. The revised curriculum has been designed to align the programme with contemporary developments in earthquake engineering and to address the evolving requirements of industry, academia, research organizations, and government agencies.

As part of the revision, the programme structure has been reorganized by introducing new Programme Core courses, including Computational Methods for Structural Engineering, Dynamics of Structures, Earthquake Analysis and Testing of Structures, Earthquake Analysis Computational Laboratory, and Earthquake Testing Laboratory. The elective basket has also been expanded to include contemporary courses such as Earthquake Analysis of Concrete Dams, Earthquake Analysis of Earthen Dams and Embankments, Earthquake Protection of Nonstructural Elements, Earthquake Nonlinear Analysis of Buildings, and Displacement-Based Design of Structures, among others.

The proposed revision harmonizes the curriculum with recent advances in earthquake engineering, structural dynamics, computational analysis, seismic testing, and dam engineering. It also incorporates feedback received from academia and industry, strengthens the computational and laboratory components of the programme, promotes interdisciplinary learning, and enhances academic flexibility through a broader range of contemporary elective courses.

Subsequently the revised scheme and syllabi of the M.Tech. (Earthquake Engineering) was circulated to all faculty for comments, no comments received. The revised scheme and syllabi of the M.Tech. (Earthquake Engineering) programme are placed at **Annexure-C (Pages 58 to 82)** for consideration.

The SPGB, after due deliberation, directed the NCDMM to prepare a comparative statement clearly highlighting the proposed changes in the existing curriculum and to circulate the revised curriculum, along with the comparative statement, among all SPGB members for their review and comments. The SPGB further authorized the Chairman, SPGB, to recommend the revised curriculum to the Senate after incorporating the comments received from the members. Subsequently, the revised curriculum and the comparative statement were circulated among all SPGB members. As no comments or objections were received within the stipulated time, the Chairman, SPGB, in accordance with the authorization granted by the SPGB, recommended the proposal to the Senate for its consideration and approval.

Item is placed for consideration and approval.

Item No. 63-3.13: To consider the proposal submitted by the Department of Electrical Engineering regarding the interconversion of vacant seats between the Full-Time (Sponsored) and Part-Time (Sponsored) categories for admission to the M.Tech. (Power Systems) and M.Tech. (Power Systems Management) programmes for the Academic Session 2026-27.

The Department of Electrical Engineering has submitted a proposal for the interconversion of vacant seats between the Full-Time (Sponsored) and Part-Time (Sponsored) categories for the M.Tech. (Power Systems) and M.Tech. (Power Systems Management) programmes for the Academic Session 2026-27. As per the approved admission brochure, the sanctioned intake for each programme comprises 5 seats under the Full-Time (Sponsored) category and 6 seats under the Part-Time (Sponsored) category.

The Department has proposed that, during the admission process, vacant seats in one sponsored category may be interconverted to the other sponsored category within the same programme, i.e., from Full-Time (Sponsored) to Part-Time (Sponsored) or vice versa, subject to the availability of eligible candidates, fulfilment of the prescribed admission criteria, and approval of the competent authority. The overall sanctioned intake of each programme shall remain unchanged. The proposed interconversion mechanism is intended to ensure optimum utilization of the sanctioned intake, maximize admissions against the approved seats without any additional financial implication, and maintain compliance with the approved intake while preserving the academic standards and quality of the programmes. The SPGB, after due deliberation, recommended the proposal submitted by the Department of Electrical Engineering for the interconversion of vacant seats between the Full-Time (Sponsored) and Part-Time (Sponsored) categories in the M.Tech. (Power Systems) and M.Tech. (Power Systems Management) programmes for the Academic Session 2026-27, subject to the condition that the overall sanctioned intake of each programme remains unchanged.

Item is placed for consideration and approval.

Item No. 63-3.14: To consider the approval for preparation and issuance of an original Degree Certificate in respect of ex-student Mr. Chiranjeev Singh (2017UEC1772).

The facts of the case are as follows:

- Academic Record: Mr. Chiranjeev Singh was admitted to the B.Tech. Electronics and Communication Engineering programme at MNIT Jaipur in the academic session 2017-18. He remained a bonafide student of the Institute from the academic session 2017-18 to 2020-21 and successfully completed the programme in May 2021. The relevant grade tabulation record and the copy of the 15th convocation scroll are enclosed for ready reference.

- Degree Conferment: He was awarded the B. Tech. Degree at the 15th Annual Convocation held on 11.10.2021. The Convocation was conducted in online mode in compliance with guidelines issued during the COVID-19 pandemic, conferring degrees simultaneously upon graduates of two academic years (2019–20 and 2020–21).
- Status of Degree Certificate: Out of 1389 undergraduate degrees awarded at the 15th Convocation, 1310 undergraduate degrees were received by the candidates' concerned (in-person, via Letter of Authority, or through Indian Speed Post). The remaining 78 Degrees are available in the Academic Section, while one (01) degree certificate is not traceable. During that period, Institute staff attended office duties with 50% attendance as per prevailing COVID-19 guidelines, and Degree Certificates were issued with digital signatures.
- Current Situation & Lost Article Reporting: In December 2025, Mr. Chiranjeev Singh visited the Academic Section to collect his graduation-related documents. He was issued all semester Grade Sheets, the Provisional Degree Certificate, and the Migration Certificate. However, his original Degree Certificate could not be traced. As directed, a thorough search was conducted once again, but the certificate remained untraceable in the Academic Section.

Note: The reporting of lost document to the Rajasthan Police is under process for information, official record, and necessary compliance.

In view of the above facts and considering that the original Degree Certificate is presently untraceable in the Academic Section, another Degree Certificate may be prepared and issued in favour of Mr. Chiranjeev Singh (Student ID: 2017UEC1772).

However, in the event that the original certificate of the Degree awarded at the 15th Convocation held on 11.10.2021 to Mr. Chiranjeev Singh is traced at a later date, the same shall be destroyed in the presence of the Registrar and Dean (Academic), MNIT Jaipur.

Item is placed for consideration and approval.

Item No. 63-3.15: To consider the recommendations of the UG Curriculum Review Committee for approval by the Senate.

The Senate, in its 59th Meeting held on 16 July 2025, vide Resolution No. Senate-59/2025/22, constituted a UG Curriculum Review Committee to review the scheme and structure of the Undergraduate (UG) programmes in accordance with the provisions and recommendations of the National Education Policy (NEP)-2020.

Subsequently, in its 61st Meeting, vide Agenda Item No. 61-3.6, the Senate approved the recommendations of the UG Curriculum Review Committee for ensuring compliance with NEP-2020. The Senate further resolved that the discipline-wise distribution of the overall credit requirement (160–166 credits) among the various curricular components, namely Institute Core, Programme Core, Programme Electives, Open Electives, PLEAS/BS Courses, Projects, and other components, shall be finalized in consultation with the respective Departments.

While confirming the minutes of the 61st Meeting, the 62nd Senate recommended expansion of the UG Curriculum Review Committee by including at least one faculty representative from each Department to facilitate wider participation in the curriculum revision process.

Subsequently, based on representations received from faculty members and under the directions of the Chairman, Senate, an Open House was organized on 08 May 2026 at Neeiti Sabhagar, MNIT Jaipur to deliberate on the proposed UG curriculum framework. The Open House witnessed participation of approximately 100 faculty members and 15 students, and provided a platform for detailed discussion on the proposed curriculum structure.

The suggestions and observations received during the Open House were subsequently examined by the UG Curriculum Review Committee, Heads of the Departments, and the SUGB. Based on the feedback received from all stakeholders and after a series of deliberations, the UG Curriculum Review Committee finalized the revised Undergraduate Curriculum Framework, ensuring compliance with the provisions and recommendations of NEP-2020 while addressing the academic requirements and concerns raised during the consultative process.

The revised Undergraduate Curriculum Framework, as recommended by the UG Curriculum Review Committee and endorsed by the SUGB, is placed before the Senate for its consideration.

Item is placed for consideration and approval.

Item No. 63-3.16: To consider the New UG Schemes and New/revised Syllabi for UG programmes.

The Departments have submitted the revised schemes of their respective undergraduate programmes in accordance with proposed the curriculum framework. The revised schemes also include the newly introduced B.Tech. in Mathematics and Computing and B.Tech. in Engineering Physics programmes.

The undergraduate programme schemes submitted by the Departments were considered by the 55th SUGB. SUGB recommended grouping the B.Tech programmes as follows:

- **Modern Physics Group:** Artificial Intelligence & Data Engineering, Computer Science & Engineering, Electronics & Communication Engineering, Electrical Engineering, and Mathematics & Computing.
- **Classical Physics Group:** Civil Engineering, Chemical Engineering, Mechanical Engineering, Metallurgical & Materials Engineering, and Engineering Physics.

The Senate is requested to consider the revised undergraduate programme schemes of all Departments, including the schemes for the newly introduced B.Tech. in Mathematics and Computing and B.Tech. in Engineering Physics, for implementation from the Academic Session 2026-27.

The revised programme schemes and syllabi are enclosed as **Annexure-D (Page. 83 to 91), D1, D2 and D3).**

Item is placed for consideration and approval.

Item No. 63-3.17: To consider the recommendations regarding the one-credit Industry Connect (AUDIT) Course.

The proposal for introducing a one-credit Industry Connect Course was initially considered by the 54th Meeting of the SUGB. The proposed course is intended to strengthen industry-academia interaction by providing students with exposure to contemporary industrial practices, emerging technologies, entrepreneurship, and professional experiences through interactions with industry experts, entrepreneurs, alumni, and professionals from reputed organizations. To examine the proposal and develop the course framework, a committee comprising Dr. Gunjan Soni, Dr. Kuldeep Singh, and Dr. Swati Sharma was constituted. The recommendation of the committee were subsequently placed before the 55th Meeting of the SUGB for further consideration. The SUGB deliberated on the objectives, implementation mechanism, and approval process for offering such courses.

The SUGB observed that, owing to the nature of the proposed course, opportunities to engage eminent industry experts may arise at short notice. Therefore, a simplified approval mechanism is desirable to facilitate the timely offering of such courses. At the same time, the SUGB emphasized that the Departments/Centres should, as far as practicable, recommend such courses preferably before the last date of the course add/drop window of the concerned semester.

The SUGB recommended the Proposal for Offering the Industry Connect Course. The Board further recommended that, upon the recommendations of the concerned Department Faculty Board (DFB) and the SUGB, the Chairperson, Senate be authorized to approve such Industry Connect Courses to facilitate their timely offering, and that such approvals be reported to the Senate in its subsequent meeting.

Item is placed for consideration and approval.

Item No. 63-3.18: To consider the recommendations for introducing Institutional Minor Programmes.

The 54th meeting of SUGB deliberated on the need for introducing Institutional Minor Programmes to promote multidisciplinary learning in emerging areas requiring expertise from multiple Departments, Centres, and Virtual Centres. The SUGB constituted a committee comprising of Prof. Lava Bhargava, Dr. Yogesh Kumar Meena and Dr. Ram Dayal to develop an appropriate framework for such programmes.

The recommendations of the Committee were subsequently placed before the 55th Meeting of the SUGB for consideration. The SUGB observed that Institutional Minor Programmes would provide undergraduate students with an opportunity to pursue structured multidisciplinary specializations through courses jointly offered by multiple academic units, in alignment with the objectives of the National Education Policy (NEP)-2020.

After detailed deliberations, the SUGB recommended the following framework for Institutional Minor Programmes:

1. Each Institutional Minor Programme shall comprise a basket of six courses jointly offered by the participating Departments/Centres/Virtual Centres.
2. Each participating Department/Centre/Virtual Centre shall ordinarily contribute not more than two courses.
3. The basket of courses for each Institutional Minor Programme shall be notified at the end of the second semester along with the Minor courses offered by individual Departments.
4. Each participating Department/Centre/Virtual Centre shall ordinarily include not more than one Programme Core course in the Institutional Minor basket.
5. Undergraduate students shall be eligible to register for Institutional Minor courses after completion of the first year.
6. A student shall successfully complete at least four courses from Departments/Centres/Virtual Centres other than the parent Department to earn an Institutional Minor.
7. Students fulfilling the prescribed requirements shall be awarded the corresponding Institutional Minor specialization in accordance with the prevailing Institute regulations.

Item is placed for consideration and approval.

Item No. 63-3.19: To consider the names of student representatives in the Senate.

As per first statute of NITs clause 8 (xiv) two student representatives should be invited during discussions of general nature in Senate meeting. In this regard, it is proposed that Mr. Tuhin (2025UEE1820), overall topper in UG programme among all branches (CGPA 9.94

after first year B.Tech.) and Sh. Ayush Bisht (2025PC5146), overall topper in PG programmes among all branches (CPGA 9.84 after first year PG programme).

Item is placed for consideration and approval.

Item No. 63-4.0: Items for ratification.

Item No. 63-4.1: To ratify the Grade Modification of Mr. Akash Y S (2024PCY5350) in course Biochemistry (Course code 21CYT802).

The department of Chemistry was submitted a request for the Grade Modification of Mr. Akash Y S (2024PCY5350) in course Biochemistry (Course code 21CYT802). The Chairperson Senate has permitted to change the grade of Mr. Akash Y S.

Item is placed for ratification.

Item No. 63-4.2: To ratify the seat matrix for PG and Ph.D. for the academic year 2026-27.

The seat matrix for admission in PG and Ph.D. programs for the Academic Session 2026-27 is placed at Annexure-E (Page- 93 to 96). and the total admitted students in Ph.D. programme (last 5 years) are as under:

Year	Semester	No of Ph.D. seats advertised with Institute Assistantship	No of students admitted with Institute Assistantship	Total Number of students admitted in all categories
2025-26	Odd	196	44	67
	Even	185	35	58
2024-25	Odd	198	57	107
	Even	155	26	64
2023-24	Odd	159	30	59
	Even	147	16	43
2022-23	Odd	172	54	75
	Even	134	17	42
2021-22	Odd	149	70	94
	Even	132	45	65

Item is placed for ratification.

Item No. 63-5.0: Items for reporting.

Item No. 63-5.1: To note the minutes of the 76th meeting of SPGB.

Minutes of the 76th meeting of SPGB held on 14th July 2026 is placed before the Senate for information. (Annexure -F, Page-97 to 104).

Item is placed for information.

Item No. 63-5.2: To note the minutes of the 55th meeting of SUGB.

Minutes of the 55th meeting of SUGB held on 09th July 2026 is placed before the Senate for information. (Annexure-C, Page-105 to 110).

Item is placed for information.

Item No. 63-5.3 To report the 04 Ph.D. students proposed for termination from the Ph.D. program.

The SPGB, after due deliberation, recommended the termination of the following students:

S. No.	Student Id	Student Name	Supervisor Name	Fees/ registration status	Remarks
1.	2025REC9566	Sandesh Singh Shekhawat	Dr. Sarthak Singhal Prof. M.M. Sharma	1 st semester fees submitted in January 2026	CGPA below 07 (0) DPGC recommendation not required. Termination as per PG RR 14.7 (i) (Minimum Academic Performance for Semester Promotion in PhD Program)
2.	2025RMA9073	Ajay Kumar	Dr. Om P. Suhar Dr. Manjinder Singh	1 st semester fees submitted in June 2025	CGPA below 7 (6.9), DPGC recommendation not required. Termination as per PG RR 14.7 (i) (Minimum Academic Performance for Semester Promotion in PhD Program)

3.	2025RME9074	Pradhuman Chahar	Dr. Naresh Kumar Raghuwanshi Dr. Preeti Gulia	Last fees submitted in January 2026 for second semester	CGPA below 7 (4.4), DPGC recommendation not required. Termination as per PG RR 14.7 (i) (Minimum Academic Performance for Semester Promotion in PhD Program)
4.	2024REE9502	Neeraj Verma	Dr. Dipti Saxena Dr. Surender Hans	Fees submitted till the 3rd Semester in January 2026	Failed the comprehensive examination twice. As per PG RR 14.3 (G-II,III) If the student fails to clear the comprehensive exam in two attempts, the student shall be deemed terminated from the program. (The information has already been received through the Supervisor and the DPGC convenor)

Item is placed for information.

Item No. 63-6.0: Any other items with permission of chair.

Annexures



मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर
Malaviya National Institute of Technology Jaipur
 (An Institute of National Importance under Ministry of Education, Govt. of India)

MINUTES OF 62ND SENATE MEETING HELD 08TH APRIL 2026

The 62nd meeting of the Senate was held on 08th April 2026 from 4:00 PM onwards in Niti Sabhagar, Prabha Bhawan of the Institute. The attendance list is placed at **Annexure-A**.

The Chairman Senate, in his opening remarks, welcomed all members attending the meeting.

The agenda items were discussed one by one, and resolutions for each agenda items are as follows:

Item No. 62-1.0	:	To confirm the minutes of 61 st meeting of the Senate. The Senate confirmed the minutes of the 61 st meeting with the following minor modifications: 1. Resolution No. 61-3.2: The introduction of the self-financed admission category is also extended to the M.Plan program in addition to the M.Tech programs. 2. Resolution No. 61-3.6: The Senate recommended expanding the UG Curriculum Review Committee by including at least one faculty member from each department. It was further suggested to include four meritorious UG students in the committee.
Item No. 62-2.0	:	To note the "Action Taken" on the decisions taken in the 61 st meeting of the Senate. The Senate noted the action taken report on the decision/resolutions taken in its 61 st meeting.
Item No. 62-3.0	:	Item for consideration.
Item No. 62-3.1	:	To consider the Academic Calendar for Academic Year 2026-27. The Senate considered the Academic Calendar for the Academic Year 2026-27 and approved the same.
Item No. 62-3.2	:	To consider the revised Scheme and Syllabi of the M.Tech. Programme "Semiconductor Materials and Devices" proposed by the Materials Research Centre (MRC). After due deliberation, the Senate approved the revised Scheme and Syllabi, along with the eligibility criteria for admissions to the programme. The Senate also recommended that the programme be started with an intake of 15 seats.
Item No. 62-3.3	:	To consider the proposal for a new PG Open Elective course titled "Advanced Qualitative Research Methods in Social Sciences" by the Department of Humanities and Social Sciences.

Dharmendra

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		After due deliberation, the Senate has returned the proposal to the department for submission through the DPGC.
Item No. 62-3.4	:	To consider the increase in student intake in M.Tech. (Renewable Energy) from 16 to 26 in the Centre for Energy and Environment. After due deliberation, the Senate approved the increase in student intake from 16 to 26 seats for the M.Tech. (Renewable Energy) programme.
Item No. 62-3.5	:	To consider offering a single M.Tech. programme in Chemical Engineering and Sustainability in the Department of Chemical Engineering in place of the earlier two programmes. Upon consideration, the Senate approved the proposal to offer a single M.Tech. programme in "Chemical Engineering and Sustainability," replacing the existing two programmes.
Item No. 62-3.6	:	To consider the proposal for initiating a merit-based scholarship for meritorious students admitted through JoSAA at MNIT Jaipur. Following detailed discussion, the Senate approved the introduction of a merit-based scholarship scheme titled 'Malaviya Ratna Award' with the following provisions: • Number of Recipients: Top five students per academic year for B.Tech, and one top student per academic year for B.Arch. • Financial Support: ₹2,00,000 per annum per student to cover tuition fees, hostel charges, institute fees, and mess expenses. • Eligibility Criteria: ◦ B.Tech: Candidates admitted under the Open Category (gender-neutral) with an All India Rank (AIR) of up to 1500 through JoSAA. ◦ B.Arch: Candidates admitted under the Open Category (gender-neutral) with an AIR of up to 200 through JoSAA. • Continuation: Scholarship renewal is subject to maintaining a minimum CGPA of 8.0 each semester and satisfactory conduct. The Senate further recommended that the financial implications and the proposed source of funding, from Institute Revenue Generation (IRG) funds, be placed before the Finance Committee (FC) and the Board of Governors (BoG) of MNIT Jaipur for consideration and approval.
Item No. 62-3.7	:	To consider the revised minimum qualification for PG admissions through CCMT in Mechanical Engineering Department. As per the directions of the Senate, the department has reviewed the GATE papers along with the qualifying degrees required for admission to the M.Tech programs in Industrial Engineering and Thermal Engineering through CCMT. The revised list of applicable GATE papers and corresponding qualifying degrees for these programs is attached as Annexure B.
Item No. 62-3.8	:	To consider the matter regarding Inactive UG Students who were not registered/absent for more than 2 semesters.

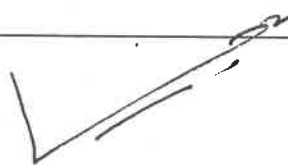
Dr. Arun Kumar

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		The Senate approved the termination of enrolment of the listed undergraduate students who had remained unregistered/absent for more than two semesters.
Item No. 62-3.9	:	To consider the mercy request of Ms. Prity Kumari (2025PCE5323). The Senate approved the mercy request, permitting Ms. Prity Kumari to re-register in the first semester and repeat all courses. Her eligibility for promotion shall be assessed based on her performance after re-registration.
Item No. 62-3.10		To consider the mercy request of Mr. Vankudothu Vamshi (2020UCH1915). The Senate approved the mercy request, permitting the reinstatement of Mr. Vankudothu Vamshi.
Item No. 62-3.11		To consider the seat matrix for admission to PG programs through CCMT and CCMN for the Academic Session 2026-27. Upon consideration, the Senate approved the seat matrix for PG admissions through CCMT and CCMN for the Academic Session 2026-27.
Item No. 62-4.0	:	Items for ratification
Item No. 62-4.1	:	To ratify the seat matrix for admission to various UG programs through JoSAA for the Academic Session 2026-27. Item was ratified.
Item No. 62-4.2	:	To ratify the seat matrix for admission in UG and PG programs through DASA for the Academic Session 2026-27. Item was ratified.
Item No. 62-4.3		To ratify the termination of 10 Inactive UG students who were not registered/absent for more than 2 semesters. Item was ratified.
Item No. 62-4.4		To ratify the mercy request submitted by Mr. Lalit Choudhary (2021UCH1833). Item was ratified.
Item No. 62-5.0	:	Items for reporting
Item No. 62-5.1	:	To note the minutes of the 75 th meeting of SPGB. Noted
Item No. 62-5.2	:	To note the minutes of the 53 rd meeting of SUGB. Noted
Item No. 62-5.3	:	To note the minutes of the meetings of the Unfair Means Committee. Noted
Item No. 62-5.4	:	To note the commencement of 02 new Undergraduate programmes (B.Tech.) from Academic Session 2026-27. Noted

Dharmendra



Item No. 62-5.5	:	To note the cases of Ph.D. students for termination from the Institute roles due to absence without authorized leave. Noted
Item No. 62-5.6	:	To note the list of PG students for termination of enrolment who secured a CGPA of less than 5.5 in the academic session 2025-26. Noted
Item No. 62-5.7	:	To note the case of PG students allotted MNIT Jaipur through CCMT/CCMN 2025 who have not reported and/or have not deposited the balance fee. Noted
Item No. 62-5.8	:	To note the case of PG students allotted MNIT Jaipur through CCMN 2025-26 who were unable to produce the qualifying degree certificate with the minimum required percentage. Noted
Item No. 62-6.0	:	<i>Any other items with permission of chair</i>
Item No. 62-6.1	:	To consider the Panel of Experts for Faculty Selection. Upon consideration, the Senate approved the Panel of Experts for Faculty Selection and also authorised Chairman Senate to extend the Panel of Experts with additional names as per additional requirements from time to time.

The meeting ended with a vote of thanks to the Chair.

Shafinul

9/4/2026
Registrar & Secretary

Annexure-A

List of Senate members who attended the 62nd Senate meeting offline/online:

S.No.	Name
1.	Prof.N. P. Padhy
2.	Dr. Ramachandran C. N.
3.	Prof. Umakant Dash
4.	Prof. A. B. Gupta
5.	Prof. Amar Patnaik
6.	Prof. Arun Gaur
7.	Prof. D. Boolchandani
8.	Prof. Dilip Sharma
9.	Prof. Dinesh Kumar
10.	Prof. Dinesh Gopalani
11.	Prof. Dipti Saxena
12.	Prof. G. D. Agarwal
13.	Prof. Girdhari Singh
14.	Prof. Harlal Singh Mali
15.	Prof. Jyoti Joshi
16.	Prof. Jyotirmay Mathur
17.	Prof. K. K. Sharma
18.	Prof. Kailash Singh
19.	Prof. Kanupriya Sachdev
20.	Prof. Kusum Verma
21.	Prof. Lava Bhargava
22.	Prof. M. K. Shrimali
23.	Prof. M. L. Meena
24.	Prof. M. L. Mittal
25.	Prof. M. M. Sharma
26.	Prof. Madhu Agarwal
27.	Prof. Manish Vashishtha
28.	Prof. Manju Singh
29.	Prof. Monica Sharma
30.	Prof. Nand Kumar
31.	Prof. Neeta Nain
32.	Prof. Nupur Tandon
33.	Prof. Pilli E. S.
34.	Prof. Prerna Jain
35.	Prof. R. C. Gupta
36.	Prof. R. P. Yadav
37.	Prof. Ragini Gupta
38.	Prof. Raj Kumar Vyas
39.	Prof. Rajeev Agrawal
40.	Prof. Rajeev Shringi
41.	Prof. Rajendra Kumar Goyal
42.	Prof. Rajive Tiwari
43.	Prof. Rakesh Jain
44.	Prof. Ritu Sharma
45.	Prof. Rohit Bhakar

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46.	Prof. Rohit Goyal
47.	Prof. Sanjay Mathur
48.	Prof. Satish Pipraliya
49.	Prof. Sudhir Kumar
50.	Prof. Suja George
51.	Prof. Sumit Khandelwal
52.	Prof. Sushant Upadhyay
53.	Prof. Tarush Chandra
54.	Prof. Upendra Pandel
55.	Prof. Urmila Brighu
56.	Prof. Vibhuti Singh Shekhawat
57.	Prof. Vijay Janyani
58.	Prof. Vijay Laxmi
59.	Dr. Bhagwati Sharma
60.	Dr. Divesh Kumar
61.	Dr. Kamendra Awasthi
62.	Dr. Kapil Pareek
63.	Dr. Mushtaq Ahmed
64.	Dr. Rajeev Kumar Dohre
65.	Dr. Santosh Chaudhary
66.	Dr. Sumanta Kuma Meher
67.	Dr. Yogesh Kumar Meena (ADPG)
68.	Dr. Ram Dayal (ADUG)

List of members who had submitted leave of absence for the 62nd Senate Meeting:

S.No.	Name
1.	Prof. Tripta Thakur
2.	Prof. Namita Mittal

The list of members who could not attend the 62nd Senate meeting:

S.No.	Name
1.	Prof. A.K. Vyas
2.	Prof. Ajay Singh Jethoo
3.	Prof. Ghanshyam Singh
4.	Prof. Jinesh Kumar Jain
5.	Prof. K. R. Niazi
6.	Prof. Mahesh Kumar Jat
7.	Prof. Manoj Fozdar
8.	Prof. Nikhil Gupta
9.	Prof. S. D. Bharti
10.	Prof. S. K. Tiwari
11.	Prof. S. P. Chaurasia
12.	Prof. Vineet Sahula
13.	Dr. Nishant Roy

Shamla

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Revised Eligibility Criteria for Admission to M.Tech.

1. Revision of Eligibility Criteria for Admission to M.Tech. (Industrial Engineering)

Eligible candidates must possess either:

- A Bachelor's degree in Engineering/Technology (Code: T999) OR
- A Master's degree in any branch of Mathematics (S519), Statistics (S525), Computer Applications (S509), or equivalent.

Existing Minimum Qualifications (GATE Paper)	Revised Minimum Qualifications (GATE Paper)
• Mechanical Engineering (ME) • Aerospace Engineering (AE) • Agricultural Engineering (AG) • Naval Architecture & Marine Engineering (NM) • Production & Industrial Engineering (PI) • Engineering Sciences (XE)	• Mechanical Engineering (ME) • Agricultural Engineering (AG) • Mathematics (MA) • Civil Engineering (CE) • Mining Engineering (MN) • Chemical Engineering (CH) • Computer Science & Information Technology (CS) • Data Science & Artificial Intelligence (DA) • Electrical Engineering (EE) • Production & Industrial Engineering (PI) • Statistics (ST)

2. Revision of Eligible Qualifying Branches and GATE Papers for Admission to M.Tech. (Thermal Engineering).

Eligible candidates must possess either:

- A Bachelor's degree in Engineering/Technology in Mechanical Engineering (Code: T158), Aerospace Engineering (Code: T102), Automotive Engineering (Code: T195), Automobile engineering (Code: T108), Energy engineering (Code: T139), Chemical Engineering (Code: T117), Agricultural Engineering (Code: T504), Metallurgical Engineering (Code: T162).

Existing Minimum Qualifications (GATE Paper)	Revised Minimum Qualifications (GATE Paper)
• Mechanical Engineering (ME) • Aerospace Engineering (AE) • Naval Architecture & Marine Engineering (NM) • Engineering Sciences (XE)	• Mechanical Engineering (ME) • Aerospace Engineering (AE) • Chemical Engineering (CH) • Engineering Sciences (XE)

Updated & Revised Course Curriculum

M.Tech. (Structural Engineering)



DEPARTMENT OF CIVIL ENGINEERING
Malaviya National Institute of Technology Jaipur
(5 June 2026)

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1. Revision Summary (M. Tech., Structural Engg.)

As per the discussion held during the *Industry-Institute Conclave & Curriculum Development Workshop* held on 10 April 2026, the curriculum of the program M.Tech. (Structural Engineering) has been updated and revised.

The revision introduces *reorganising the courses in a logical sequence* to better understand the subject domain. That includes teaching a structural analysis course in the opening semester, followed by an application-oriented design course in the subsequent semester.

The courses have been appropriately renamed to reflect their content; for instance, the Advanced Structural Analysis course has been renamed "Matrix Approach to Structural Analysis". In line with industry demand, emphasis has been placed on utilising new, state-of-the-art laboratory facilities, and course content related to computer simulation has been incorporated.

New courses have been introduced based on input from industry practitioners and faculty members. To broaden student choice and specialisation, several elective courses have been introduced, including Earthquake Resistant Design of Steel Structures, Earthquake-Resistant Design of Concrete Structures, Safety Assessment and Retrofit of Buildings, Operations Research Methods & Project Economics, and Seismic Hazard Assessment.

2. Credit Structure (As Per the Regulation)

The requirements of *M.Tech. Programs* as per the *PG Regulations* of MNIT Jaipur are:

- (1) Minimum credits required to be earned are **54-60** (Table 1.1).
- (2) Four different types of courses should be credited (Table 1.2).

Table 1.1: Minimum credits to be earned during *four semesters* of M.Tech. Program

Semester	Courses	Total Credits
I	Taught Courses	15 - 18
II	Taught Courses	15 - 18
III	Dissertation, Seminar, Research Project	9 - 15
IV	Dissertation	12 - 16

Table 1.2: Minimum credits to be earned in *four types* of courses of M.Tech. Program

S.No.	Course Type	Min Credits to be earned
1	Program Core	18 - 21
2	Program Elective	15 - 21
3	Open Elective	0 - 6
4	Research Project, Dissertation	16 - 24

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3.Course Structure (M.Tech., Structural Engineering)

(i)Semester- I

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Matrix Approach to Structural Analysis [@]	Program Core	Theory	3	3	0	0
2		Dynamics of Structures [#]	Program Core	Theory	4	3	1	0
3		Computational Methods for Structural Engineering ^s	Program Core	Theory	3	3	0	0
4		Structural Testing & Simulation Laboratory ^s	Program Core	Practical	2	0	0	4
5		Elective 1	Program Elective	Theory	3	3	0	0
6		Elective 2	Program Elective	Theory	3	3	0	0
Total 1st Semester Credits					18			

[@]Course title modified

[#]Moved from Semester 2 to Semester 1

^sNew Course as per the feedback from the industry

(ii) Semester-II

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Theory of Plates and Shells	Program Core	Theory	3	3	0	0
2		Earthquake Behaviour of Buildings ^s	Program Core	Theory	3	3	0	0
3		Concrete Technology	Program Core	Theory	3	3	0	0
4		Elective 3	Program Elective	Theory	3	3	0	0
5		Elective 4	Program Elective	Theory	3	3	0	0
6		Elective 5	Program Elective	Theory	3	3	0	0
Total 2nd Semester Credits					18			

^sNew Course as per the feedback from the industry

(iii) Semester-III

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Seminar/Minor Research Project	Program Core	Seminar	4	0	0	8
2		Dissertation	Program Core	Dissertation	8	0	0	16
Total 3rd Semester Credits					12			

(iv) Semester-IV

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Dissertation	Program Core	Dissertation	12	0	0	24
Total 4th Semester Credits					12			
Total Program Credits					60			

4. Program Elective Courses (PE)

S.No.	Course Code	Course Title	Type	Credit	L	T	P
1.		Advanced Foundation Engineering ²	Elective	Theory	3	0	0
2.		Bridge Engineering	Elective	Theory	3	0	0
3.		Design of Composite Structures	Elective	Theory	3	0	0
4.		Ground Improvement Techniques ^{2,3}	Elective	Theory	3	0	0
5.		Design of Tall Buildings	Elective	Theory	3	0	0
6.		Soil Structure Interaction	Elective	Theory	3	0	0
7.		Sustainable Materials and Construction ¹	Elective	Theory	3	0	0
8.		Sustainable Materials and Construction Lab ¹	Elective	Practical	0	0	2
9.		Earthquake-Resistant Design of Steel Structures ⁵	Elective	Theory	3	0	0
10.		Earthquake-Resistant Design of Concrete Structures ⁵	Elective	Theory	3	0	0
11.		Safety Assessment and Retrofit of Buildings ⁵	Elective	Theory	3	0	0
12.		Seismic Hazard Assessment ⁵	Elective	Theory	3	0	0

⁵New Course as per the feedback from the industry

¹ Open to all PG programs of Civil Engineering

² Open to M.Tech. (Geotechnical Engineering)

³ Open to M.Tech. (Transportation Engineering)

5.Detailed Syllabus
M.Tech. (Structural Engineering)

(i) Matrix Approach to Structural Analysis (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Matrix Approach to Structural Analysis
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Degree of Static and Kinematic indeterminacy; Released and restrained structure; Matrix method using system approach – flexibility and stiffness method for analysis of continuous beams, rigid – jointed plane frame and pin-jointed plane frame; Introduction to Direct Stiffness method; Formation of member stiffness matrix; Transformation of load vector and displacement vector Assembly of global stiffness matrix and load vectors; Boundary condition and solutions; Application to planer structures –beam and plane truss.

Course Outcomes

1. Knowledge of the basics of the matrix method of structural analysis
2. Knowledge of the development of the stiffness matrix of the skeletal element
3. Use the Direct Stiffness Method to solve beams and plane trusses.

References

1. Pandit, G.S. and Gupta, S.P., “*Structural Analysis- A Matrix Approach (2/e)*”, McGraw Hill Education.
2. Weaver, W.Jr., and Gere, G.M., “*Matrix Analysis of Framed Structures (2/e)*”, CBS Publishers.
3. Menon, D., “*Advanced Structural Analysis*”, Narosa Publishing House.
4. Hibbeler, R.C., “*Structural Analysis (10/e)*”, Pearson Education India.

(ii) Dynamics of Structures (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Dynamics of Structures
Credit: 3	L-T-P: 3-1-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Nature of Dynamic Loading: Types of Oscillation; Nature of Time-Dependent Phenomenon; Dynamic Equilibrium; Inertial and Dynamic Equilibrium; Energy Dissipation Mechanism; Dynamics of Single-Degree-of-Freedom Systems: Equation of Motion; Single Degree of Freedom System; Free Vibration (Undamped and Damped); Forced Vibration (Harmonic Loading, Periodic Excitation, and Pulse Loading); Steady-State and Transient Response; Force Transmission and Vibration Isolation; Theory of Vibration-Measuring Instruments; Solutions of the Equation of Motion; Duhamel's Integral; Numerical Evaluation of Dynamic Response (Central Difference Method, Newmark's β Scheme); Earthquake Response of Linear Systems; Response Spectrum Concept; Fourier Transforms and Frequency Domain Analysis; Dynamics of Multi-Degree-of-Freedom Systems: Multi Degree of Freedom System; Equation of Motion; Eigen Value Problem and Free Vibration Analysis; Basics (Modes, Natural Periods, Mode Shapes, and Modal Damping); Modal Analysis (Input, Number of Modes, and Combination Rules); Time Domain Analysis; Loading History; Modal Superposition Method; Mode-Truncation and Correction for Missing Mass

Course Outcomes

1. Relate the structural idealisation to the properties of real structures
2. Understand analytical procedures to estimate the dynamic response of structures
3. Perform earthquake analysis in time and frequency domains
4. Application of structural dynamics theory in earthquake design of structures

References:

1. Chopra, A.K., (2007), "*Dynamics of Structures*", Pearson Education, 3rd Edition, India
2. Clough, R.W. and Penzien, J. (1993). "*Dynamics of Structures*", McGraw Hill, USA
3. Paz, M. and Kim, Y.H., "*Structural Dynamics*, (6/e)", Springer

(iii) Computational Methods for Structural Engineering (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Computational Methods for Structural Engineering
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Numerical Linear Algebra for FEM: Solution of linear systems, Gauss elimination, Gauss-Seidel iterative method, Matrix inversion (Gauss-Jordan method). Fundamentals of FEM & Error Analysis: Historical development and need for FEM in structural engineering, Real-life and field applications (civil engineering systems). Method & Structural Elements: Direct stiffness method (member approach), Formulation of stiffness matrices of truss elements, beam elements. Energy Methods & Weighted Residual Methods: Principle of Minimum Potential Energy (MPE), Derivation of stiffness matrix using energy methods; Application to: 1D truss elements; Beam elements; Introduction to Weighted Residual Methods (WRM); Galerkin method; Physical interpretation in FEM; Connection between MPE and FEM formulation. Theory of Elasticity & Element Formulation: Strain-displacement relations, Compatibility conditions, Stress-strain relations (2D problems); Plane stress and plane strain formulations. Displacement functions and shape functions for: Triangular elements (CST, LST); Rectangular elements; 3D Element Formulation: Tetrahedral elements; Hexahedral (brick) elements.

Course Outcomes

1. Develop a strong foundation in computational methods for structural applications.
2. Introduce energy principles and weighted residual methods.
3. Bridge the gap between mathematical modelling and computational structural analysis.

References

1. J.N. Reddy, "An Introduction to the Finite Element Method", TATA McGraw-Hill Publishing Co. Ltd.
2. Chandrupatla & Belegundu, "Introduction to Finite Elements in Engineering", Prentice Hall of India Pvt. Ltd.
3. Hughes T J R, "The Finite Element Method: Linear Static and Dynamic Finite Element Analysis".

(iv) Structural Testing and Simulation Laboratory (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Structural Testing & Simulation Laboratory
Credit: 2	L-T-P: 0-0-4
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Material Tests: mix design of concrete, non-destructive and other relevant tests of concrete quality, determination of material strength and other relevant parameters of steel and concrete, durability tests of concrete, use of SEM and XRD; Element Tests: flexure test of beam, axial compression test of column, load-deformation behavior; Test Planning and Implementation: similitude and size effect, finalization of test specimen, loading devices and their control, sensors for response measurement, data acquisition system, data post-processing; Vibration Tests for Modal Parameter Estimation: free and forced vibration tests, shake table tests, time and frequency domain analysis. Linear and nonlinear analysis of structures: modelling structural elements; discretisation; boundary conditions; material and geometric nonlinearities; plastic hinges, pushover analysis; soil structure interaction

Course Outcomes

1. Fundamental understanding of material behaviour through basic strength and durability tests
2. Characterize the load-deformation behavior of structural elements under static load
3. Understand the laboratory test planning, design, and implementation
4. Identify key dynamic parameters from vibration tests
5. Idealize and simulate the behaviour of structures using computational tools

References:

1. Neville, A.M. and Brooks, J.J. (2010), Concrete Technology, Pearson Education Limited, UK
2. Bungey, J.H., Millard, S. and Grantham, M.G. (20026), Testing of Concrete in Structures, CRC Press, London
3. FEMA 461 (2007), Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components, Applied Technology Council, USA
4. SAC (1997), Protocol for Fabrication, Inspection, Testing, and Documentation of Beam-Column Connection Tests and Other Experimental Specimens, SAC Joint Venture Report No. SAC/BD-97/02, Version 1.1, Applied Technology Council, USA
5. Sullivan, T., Pinho, R., and Pavese, A. (2004). An Introduction to Structural Testing Techniques in Earthquake Engineering, Report No. ROSE-2004/01, Iuss Press, Pavia, Italy.

(v) Theory of Plates and Shells (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Theory of Plates and Shells
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Plate equation and behaviour of thin plates in Cartesian, polar and skew coordinates; Curvilinear coordinates and coordinate transformation; Isotropic and orthotropic plates, bending and twisting of plates; Numerical solutions. Shell behaviour, shell surfaces and characteristics, classifications of shells, equilibrium equations in curvilinear coordinates, force displacement relations; Membrane analysis of shells of revolution and cylindrical shells under different loads, shallow shells, membrane solution of elliptic paraboloids and hyperboloids, solutions of typical problems.

Course Outcomes

1. Understand plate behaviour and governing equations in different coordinate systems.
2. Analyse isotropic/orthotropic plates and shell structures under various loads.
3. Apply numerical and membrane methods to solve plate and shell problems.

References:

1. Timoshenko, S.P. and Woinowsky-Kreiger, S., "*Theory of Plates and Shells*", McGraw-Hill Inc.
2. Ventsel, E. and Krauthammer, T., "*Thin Plates and Shells*", CRC Press
3. Krishna Raju, N., "*Advanced Reinforced Concrete Design*", CBS Publishers and Distributors Pvt. Ltd.
4. Varghese, P.C., "*Design of Reinforced Concrete Shells and Folded Plates*", PHI
5. Ugural, Ansel C., "*Plates and Shells: Theory and Analysis*", CRC Press.

(vi) Earthquake Behaviour of Buildings (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Earthquake Behaviour of Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake-Resistant Behaviour of Buildings: Seven Virtues; Earthquake Demand versus Earthquake Capacity; Force-based Design to Displacement-based Design; Earthquake Demand on Buildings; Seismic Design Force; Dynamic Characteristics of Buildings; Natural Period; Mode Shape; Damping; Ground Motion Characteristics; Accelerograms; Response Spectrum. Earthquake Capacity of Buildings: Elastic Behaviour; Configuration; Overall Geometry, Plan Shape, Plan Aspect Ratio, Slenderness Ratio; Structural Systems and Components; Moment Frames, Structural Wall-Frames, Braced Frames, Tube, Tube-in-Tube, and Bundled Tube Systems; Flat Slab Building; Load Paths; Frames; Structural Walls; Mass; Mass Asymmetry in Plan; Mass Irregularity in Elevation; Initial Stiffness; Stiffness Irregularity in Plan; Stiffness Irregularity in Elevation; Open or Flexible Storeys, Plinth and Lintel Beams ; Buildings on Slope; Set-back and Step-back Buildings; Adjacency; Soil Flexibility; Inelastic Behaviour: Strength; Strength Hierarchy; Beam-Column Joints; Structural Plan Density; Strength Asymmetry in Plan; Strength Discontinuity in Elevation; Open/Flexible/ Weak Storeys in a Building; Discontinuous Structural Walls in a Building; Short Column Effect; Ductility; Contributors to Ductility in Reinforced Concrete Buildings; Achieving Ductility in Reinforced Concrete Buildings; Assessing Ductility available in Buildings; Strength Provided in Building and Overall Ductility Demand.

Course Outcomes

1. Covers the fundamental aspects of earthquake-resistant design of buildings
2. Characterise various parameters to demonstrate the earthquake capacity of buildings
3. Provide a comprehensive understanding of earthquake-resistant design methods

References

1. Villaverde,R., (2009), "*Fundamental Concepts of Earthquake Engineering*", CRC Press, Boca Raton, USA
2. Elnashai,A.S., and Sarno,L.D., (2008), "*Fundamentals of Earthquake Engineering*", John Wiley & Sons, New York, USA
3. Paulay,T., and Priestley,M.J.N., (1992), "*Seismic Design of Reinforced Concrete and Masonry Buildings*", John Wiley & Sons, New York, USA

(vii) Concrete Technology (PC)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Concrete Technology
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Constituent materials, Admixtures, Microstructure properties. Properties of concrete in the fresh state, mixing, transportation, placing, and curing. Properties of concrete in hardened state, maturity of concrete, Strength of concrete, Factors affecting strength, load and displacement control tests, Fatigue. Concrete mix design including mineral and chemical admixtures. Mix design for high-strength concrete. Quality control of concrete. Special concretes. Methods of concreting, pumping, underwater concreting, shotcrete, mass concreting, and concreting under extreme weather conditions. Durability of concrete; deterioration mechanisms; alkali-aggregate reaction; chloride attack; carbonation; assessment and control of corrosion in concrete structures. In-situ assessment of concrete structures, Various NDT techniques and their applications, reliability of tests, distress identification, condition evaluation, repair materials, and repair of concrete structures.

Course Outcomes

1. To acquire knowledge of concrete-making materials/ingredients and various parameters affecting the properties of concrete. Comprehend the behaviour of fresh and hardened concrete.
2. To be able to design a concrete mix for different grades and with mineral admixtures. Explore special concretes for construction.
3. To acquire knowledge of various Non-destructive testing and concrete repair methods.

References:

1. Neville, A.M. and Brooks, J.J. "*Concrete Technology*", Pearson.
2. Gambhir, M.L., "*Concrete Technology*", McGraw-Hill Education.
3. Li, Z., "*Advanced Concrete Technology*", John Wiley & Sons.
4. Bungey, J.H., Millard, S. and Grantham, M.G., "*Testing of concrete in structures*", (4/e), Taylor and Francis.
5. Mehta P. K. and Monteiro P., "*Concrete: Microstructure, Properties, and Materials*", McGraw-Hill Publishing.

(viii) Advanced Foundation Engineering (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Advanced Foundation Engineering
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Soil Exploration and Foundation Requirements: Planning of geotechnical site investigation; subsurface exploration methods; in-situ testing (SPT, CPT, pressure meter, plate load test); geotechnical site characterisation; performance requirements of foundations. Shallow Foundations: Ultimate bearing capacity theories (Terzaghi, Meyerhof, Hansen, Vesic); safe bearing pressure; bearing capacity under eccentric and inclined loading; settlement analysis of shallow foundations in layered soils; combined and strap footings; raft/mat foundations—types and design considerations; uplift capacity of shallow foundations. Deep Foundations: Pile types and installation methods; axial load capacity of piles using static and dynamic methods; pile load tests and integrity tests; settlement of single piles; negative skin friction; piles subjected to uplift and lateral loads; analysis of laterally loaded piles (Broms method, p-y curves); pile groups—efficiency, settlement, and block failure. Special Foundation Systems: Drilled piers and caisson foundations; micropiles and their applications; foundations on rock; rock socketed piles; foundations on expansive, collapsible, and organic soils.

Course Outcomes

1. Develop an advanced understanding of shallow and deep foundation behaviour under static and dynamic loading.
2. Apply analytical, empirical, and numerical methods in foundation design.
3. Design foundations under challenging ground conditions such as expansive soils, rock, and vibration-prone environments.

References

1. Coduto, D., Kitch, W. and Yeung, M.R., “*Foundation Design Principles and Practices*”, Pearson.
2. Murthy, V.N.S., “*Advanced Foundation Engineering*”, CBS Publishers.
3. Bowles, Joseph E., “*Foundation Analysis and Design*”, McGraw-Hill.
4. Reese, L.C. and Van Impe, W.F., “*Single Piles and Pile Groups under Lateral Loading*”, CRC Press.
5. Das, B.M., “*Shallow Foundations Bearing Capacity and Settlement*”, CRC Press

(ix) Bridge Engineering (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Bridge Engineering
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Types of Bridges, choice of bridge type, criteria for selection of bridge site, economic span, bridge loadings, slab bridges, effect of skew, load distribution theories for multi-beam bridges, design of R.C. beam bridges, design of R.C. box culverts, introduction to PSC girder bridges, bridge bearings, inspection and maintenance procedures, rehabilitation of bridges.

Course Outcomes

1. Understand bridge types, site selection criteria, economic span, and bridge loadings.
2. Analyse load effects, skew influence, and load distribution in multi-beam bridges.
3. Design R.C. bridges and culverts
4. Inspection, maintenance procedures and rehabilitation of bridges

References

1. Nagarajan Praveen, "*Design of Concrete Bridges*", Wiley India
2. Ponnuswamy, S., "*Bridge Engineering*", McGraw-Hill Education.
3. Victor, D.J., "*Essentials of Bridge Engineering*", Oxford.
4. Krishna Raju, N. "*Design of Bridges*", (5/e), Oxford & IBH Publishing.
5. Jagadeesh, T.R. and Jayaram, M.A., "*Design of Bridge Structures*", PHI.
6. Raina, V.K., "*Concrete Bridge Practice: Analysis, Design and Economics*", (4/e), Shroff Publishers and Distributors.

(x) Design of Composite Structures (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Design of Composite Structures
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Types of composite construction, design criteria, material properties, partial shear connection, partial interaction, buckling, shear lag, elastic analysis of composite beams, rigid plastic analysis of simply supported beams, mechanical shear connectors, transfer of longitudinal shear forces, stocky columns, slender columns, composite beams with service ducts.

Course Outcomes

1. Understand types of composite construction, material properties, design criteria, and shear connection concepts.
2. Analyse composite members considering partial interaction, buckling, shear lag, and elastic/plastic behaviour.
3. Design of composite beams and columns

References:

1. Oehlers, D. J. and Bradford, M. A., "*Elementary Behaviour of Composite Steel and Concrete Structural Members*", Butterworth-Heinemann, Elsevier Science
2. Johnson, R. P., "*Composite Structures of Steel and Concrete*", (3/e), Blackwell Publishing
3. Narayanan, R., "*Steel-Concrete Composite Structures*", Elsevier Applied Science Publishers Ltd.
4. Collings, D., "*Steel Concrete Composite Bridges*", Thomas Telford Ltd.

(xi) Ground Improvement Techniques (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Ground Improvement Techniques
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Ground improvement potential, drainage methods, precompression and vertical drains, vibration methods, grouting and injection, mechanical cementing and chemical stabilization; granular piles, stone columns, diaphragm walls; Soil reinforcement, Geosynthetics and their application cost effective design of retaining walls with geosynthetics, Stability analysis of reinforced soil slopes, Design of Embankments for highways, Civil engineering applications of extruded polymer grids, Geomembranes with landfill closures, Thermal methods of ground improvement, Improving Rock stability and Quality.

Course Outcomes

1. To be able to identify, classify, and characterise difficult site conditions.
2. To be able to determine the suitability of a ground modification technique to a particular site condition with respect to the proposed project from a number of options based on its engineering viability.
3. To be able to design and execute a ground modification scheme for given site conditions and the nature of the civil engineering project.

References:

1. Koerner, R.M. "*Construction and Geotechnical Methods in Foundation Engineering*", McGraw-Hill
2. Sivakumar Babu, G.L. "*An Introduction to Soil Reinforcement and Geosynthetics*", University Press
3. Purushottam Raj, P., "*Ground Improvement Techniques*", (2/e), Laxmi Publications
4. Patra, N.R., "*Ground Improvement Techniques*", Vikas Publishing House
5. Rao, G.V. and Raju, G.V.S.S., "*Engineering with Geo-synthetics*", Tata McGraw-Hill

(xii) Design of Tall Buildings (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Design of Tall Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Structural systems and concepts. Frame, shear wall, Frame shear wall Interaction, coupled shear walls, Braced frames, Tubular Buildings, Diagrids, Exoskeleton. Approximate and Matrix methods of Analysis; Foundation superstructure interaction; Wind Effects on tall structures, Review of relevant Indian Standards; Earthquake effects and design for ductility; Review of relevant Indian standards; Case history of Tubular buildings, Diagrids and Exoskeleton buildings.

Course Outcomes

1. To get the knowledge about different types of structural systems.
2. To be able to analyse tall building systems through approximate and matrix-oriented methods of design of all buildings, including the substructure.
3. To be able to get the knowledge of various Indian standards like IS 875, 1893, 16700, latest versions.
4. To be able to analyse and design the tall building system by manual calculations as well as with the latest soft computing techniques.
5. To be able to write technical reports and present topics related to advanced RC structures

References

1. Fintel, M., "*Handbook of Concrete Engineering*", Van Nostrand Reinhold
2. Weaver, W.Jr. and Gere, J.M., "*Matrix Analysis of Framed Structures*", Springer.
3. Taranath, B.S., "*Reinforced Cement Concrete Design of Tall Buildings*", CRC Press.
4. Taranath, B.S., "*Tall Building Design: Steel, Concrete, and Composite Systems*", CRC Press.

(xiii) Soil Structure Interaction (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Soil Structure Interaction
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Fundamentals of Soil-Structure Interaction (SSI): Direct and substructure methods of analysis; Equation of motion for flexible and rigid base; Kinematic interaction, Inertial interaction, and effect of embedment. Modelling of Soil-Structure system: Continuous models, discrete models, Modelling of Soil: Dynamic stiffness coefficients for different types of foundations – surface foundation, embedded foundation, shallow foundation, and deep foundation, Modelling of Boundaries: Elementary, local, consistent, and transmitting boundaries. Analysis of Soil-Structure system: Introduction, Analysis of infinite beam, semi-infinite beam, finite beam, plates (rectangular and circular) on elastic half space; Introduction of Finite Difference Method (FDM) and Finite Element Method (FEM), Application of FDM and FEM in soil-structure interaction problems: Low-rise and high-rise buildings, bridges, dams, nuclear power plants, and offshore structures.

Course Outcomes

1. Fundamental understanding of SSI and its effect on structural response.
2. Understand different approaches for modelling the Soil-Structure system and Boundaries
3. Apply different methods for the solutions of static and dynamic SSI problems

References

1. Wolf, J. P. (1985). *"Dynamic Soil-Structure Interaction"*, Prentice Hall
2. Wolf, J. P. (1988). *"Soil-Structure Interaction in the Time-Domain"*, Prentice Hall
3. Chowdhury, I. and Dasgupta, S.P. (2008). *"Dynamics of Structure and Foundation - A Unified Approach: Fundamentals"*, CRC Press
4. Chowdhury, I. and Dasgupta, S.P. (2008). *"Dynamics of Structure and Foundation - A Unified Approach: Applications"*, CRC Press
5. Selvadurai, A.P.S. (1979). *"Elastic Analysis of Soil-Foundation Interaction"*, Elsevier Scientific, Amsterdam
6. Jones, G. (1997). *"Analysis of Beams on Elastic Foundations"*. Thomas Telford
7. Kolář, V. and Němec, I. (1989). *"Modelling of Soil-Structure Interaction"*, Elsevier

(xiv) Sustainable Materials and Construction (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Sustainable Materials and Construction
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction to Sustainable development and sustainable Construction; Concept of sustainable products, materials and Infrastructure systems; reuse-recycle construction materials and technologies; Circularity concept in civil engineering, Construction and demolition waste utilization, Waste to resource in construction, Construction waste recovery techniques, sustainable material properties and characterization, Material resource efficiency, challenges and opportunities in use and construction, codes and policies Design for life cycle concept, whole system design concept, Low carbon and low embodied materials and systems, Life cycle costing in construction; Life cycle performance improvement techniques, Impact of repair and maintenance on life cycle, Service life concept; Climate change adaptive strategies for materials and construction, Construction techniques for sustainable material and system, Sustainability Index for construction materials and techniques, Introduction to green buildings and rating systems, green building materials and construction techniques.

Course Outcomes

1. To understand sustainable development, sustainable materials, their development, and properties.
2. To understand various sustainability assessment methods for materials/designs and their comparison.
3. To be able to get the knowledge of various guidelines/codes for alternate material/product utilisation in construction to analyse the performance of materials, technology and systems with respect to sustainability performance.
4. To investigate local materials/wastes and to understand their sustainability performance and their applications in green infrastructure

References

1. Addis, B., *"Building with Reclaimed Components and Materials: A Design Handbook for Reuse and Recycling"*, CRC Press.
2. Sabnis, G.M., *"Green Building with Concrete: Sustainable Design and Construction"*, CRC Press.
3. Siddique, R., *"Waste Materials and By-Products in Concrete"*, Springer.
4. Winkler, G., *"Recycling Construction Demolition Waste"*, McGraw-Hill Education

(xv) Sustainable Materials and Construction Lab (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Sustainable Materials and Construction Lab
Credit: 1	L-T-P: 0-0-2
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Practical:

1. Physical Properties of Coarse Recycled Concrete Aggregates/ Alternative Materials
2. Physical Properties of Fine Recycled Concrete Aggregates/ Alternative Materials
3. Pozzolanic Action Testing of Waste Materials as a Replacement for Cement
4. Physical and Mechanical testing of Solid Bricks/Blocks made with Alternate materials
5. Physical and Mechanical Testing of Hollow Blocks Made with Alternative Materials
6. Physical and Mechanical testing of Tiles/Pavers made with Alternate materials
7. Properties of Low Slump/Precast, suitable/Innovative concrete
8. Sustainability Properties Assessment of Green Buildings/Construction Materials
9. Sustainability assessment based on durability and service life tests

Course Outcomes

1. To develop an understanding of the properties of sustainable materials.
2. To develop an understanding of the application of waste and its utilisation in precast materials.
3. To test and investigate the properties of precast materials.
4. To test and investigate the sustainability properties of construction materials

References

1. Addis, B., *"Building with Reclaimed Components and Materials: A Design Handbook for Reuse and Recycling"*, CRC Press.
2. Sabnis, G.M., *"Green Building with Concrete: Sustainable Design and Construction"*, CRC Press.
3. Siddique, R., *"Waste Materials and By-Products in Concrete"*, Springer.
4. Winkler, G., *"Recycling Construction Demolition Waste"*, McGraw-Hill Education

(xvi) Earthquake Resistant Design of Steel Structures (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Earthquake Resistant Design of Steel Structures
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Properties of steel; Ductility at 4 levels (Material, Section, Member and Structure); Philosophy of Earthquake Resistant Design; Strong Ground Motions; Response spectra; Methods of Analysis; Equivalent Static Analysis; Nonlinear Static Analysis (Plastic Analysis); Dynamic Analysis; Nonlinear Dynamic Analysis; Methods of Design; Force-based (Capacity Design); Displacement-based. Member Design: Tension Members; Compression Members; (Stability, Axial-Flexural-Torsion Buckling); Bending Members Beams and Plate Girders; (Lateral Torsional Buckling, Plastic Hinges); Beam-columns; Beam-Column joints, Connections, Braces. Design Frame Buildings for Ductility: Moment Frames; Braced Frames

Course Outcomes

1. Develop an understanding of the properties and behaviour of structural steel
2. Gain expertise in various methods of analysis and design of steel structures
3. Acquire in-depth understanding of provisions in design codes for eq. resistant design of steel structures

References

1. Gaylord, E.H., Jr., Gaylord, C., N., and Stallmeyer, J.E., (1992), "*Design of Steel Structures*", Tata McGraw Hill Publication, India
2. Englekirk, R., (2003), "*Steel Structures: Controlling Behaviour Through Design*", John Wiley & Sons, USA
3. Salmon, C.G., and Johnson, J.E., (1980), "*Steel Structures: Design and Behaviour*", Harper & Row Publishers, New York, USA
4. Bruneau, M., Uang, C.M., and Whittaker, A., (1998). "*Ductile Design of Steel Structures*", McGraw Hill, New York, USA
5. Mazzolani, F.M. and Piluso, V., (1996), "*Theory and Design of Seismic Resistant Steel Frames*", E&FN Spon
6. Gionncu, V., and Mazzolani, F.M., (2002), "*Ductility of Seismic Resistant Steel Structures*", SPON Press

(xvii) Earthquake Resistant Design of Concrete Structures (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Earthquake Resistant Design of Concrete Structures
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction to Earthquake Resistant Design of Structures: Earthquake-Resistant Design Philosophy; 7 Virtues; Need for Ductility in Structures; Ductility; 4 Levels (Material, Section, Member, Structure); Contribution to Ductility of Seven Virtues (Confinement of concrete). Earthquake Resistance: Types of Design; Stiffness-based Design; Strength-based Design; Displacement-based Design; Energy-based Design; Capacity Design; Concept (Chain Analysis); Strength Hierarchy; Intra-Member (Flexure Design versus Shear Design); Inter-Member (Strong-Column Weak-Beam Concept); Demand-Capacity Ratios (Incremental DCRs); Beam-Column Joints (Beam Bar Anchorage). Collapse Mechanisms: Modelling Nonlinear Response of Structural Components and Systems; Pushover Analysis; Storey and Sway Mechanisms; Concept of Overstrength.

Course Outcomes

1. Understand the basics of Earthquake Design Philosophy
2. Understand the Significance of Nonlinear Analysis for Earthquakes

References

1. Paulay, T., and Priestley, M.J.N. (1992), "*Seismic Design of Reinforced Concrete and Masonry Buildings*", John Wiley & Sons, Inc.
2. Penelis, G.G., and Kappos, A.J. (1997), "*Earthquake-resistant Concrete Structures*", E & FN Spon
3. Priestley, M.J.N., Seible, F., and Calvi, G.M., (1996), "*Seismic Design and Retrofit of Bridges*", John Wiley & Sons, Inc.
4. Murty, C.V.R., Goswami, R., Viajanarayanan, A.R., and Mehta, V.V., (2012), "*Some Concepts in Earthquake Behaviour of Buildings*", Gujarat State Disaster Management Authority, India
5. Naeim, F., (Ed.), (2001), "*The Seismic Design Handbook*", Kluwer Academic Publishers, Boston, USA
6. Eibl, J., (1988), "*Concrete Structures under Impact and Impulsive Loading*", Bulletin Information No.187, Comité Euro-International du Béton (CEB), Lausanne, EU
7. Codes and Standards of India, US, Japan, New Zealand and Europe

(xviii) Safety Assessment and Retrofit of Buildings (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Safety Assessment and Retrofit of Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Philosophy of Retrofit; Provisions of Indian Standards; Building Typologies; Current Health of the Building; Material Level; Structure Level (Ambient and Forced Vibration Tests); Behaviour under Earthquake Ground Motions; Five Levels of Vulnerability Assessment; Level 0, 1, 2 and 3; Level 4 (Damage Level, Intensity Level, Fragility Curve); Retrofitting of an Existing Building: Strategy; Global versus Local Levels (Stiffness, Strength, Deformability); Increasing Capacity versus Reducing Demand (Base isolation & Energy Dissipation Systems); Techniques; Structure Level Retrofit (Walls, Braces); Member Retrofit (Beams, Columns – Jacketing, Wrapping); Risk Assessment; Level 4 (Damage Level, Probability Level, Risk Curve)

Course Outcomes

1. Understand and evaluate the earthquake safety of existing buildings
2. Implement retrofitting strategies to enhance earthquake resistance

References

1. Costa,A., Arede,A., and Varum,H., (2018), “*Strengthening and Retrofitting of Existing Structures*”, Springer Nature Singapore Private Limited
2. ASCE/SEI 41, (2017), “*Seismic Evaluation and Retrofit of Existing Buildings*”, American Society of Civil Engineers, USA
3. IS 13928 (1993), “*Improving Earthquake Resistance of Low Strength Masonry Buildings*”, Bureau of Indian Standards, New Delhi, India
4. BSSC, (2000), FEMA 356: “*Pre-Standard and Commentary for the Seismic Rehabilitation of Buildings*”, Building Seismic Safety Council, Washington DC, USA
5. Malhotra, V.M., and Carino,N.J. (2007), “*Handbook on Non-destructive Testing of Concrete*”, 2nd Edition, CRC Press, Boca Raton, USA

(xix) Seismic Hazard Assessment (PE)

UG/PG: PG	Department: Civil Engineering
Course Code:	Course Name: Seismic Hazard Assessment
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake Basics: Plate tectonics; Elastic rebound theory; Earthquake waves; Magnitude versus Intensity; Strong Ground Motions; Instruments (Accelerograph, Velocity-meter, Displacement-meter); Influences (Source, Path, Site and Structure); Severity (Near Field versus Far Field); Characteristics (Amplitude, Duration and Frequency Content); Attenuation Relations; Near Field Motions; Mechanics of Faulting (Fault-Normal and Fault-Parallel); Directivity of Faulting; Peak Ground Displacements (PGD and PGRD). Methods of Earthquake Hazard Assessment: Earthquake Hazard at Bedrock; Faults; Seismicity Catalogue; Ground Motion Prediction Equations; Seismogenic Source Regions; Recurrence Relation for Each Source Zone; Probabilistic Hazard Assessment; Deterministic Hazard Assessment; Earthquake Zoning of India; Design Peak Ground Acceleration (PGA) for Different Structures; Design Pseudo-Spectral Acceleration (PSA)

Course Outcomes

1. Fundamental understanding of the genesis and propagation of earthquakes
2. Understand the significance of site conditions, specifically under earthquake-induced ground shaking
3. Perform deterministic and probabilistic earthquake hazard assessment

References

1. Baker, J.W., Bradley, B.A., and Stafford, P.J. (2021). "*Seismic Hazard and Risk Analysis*", Cambridge University Press, UK
2. McGuire, R.K. (2004). "*Seismic Hazard and Risk Analysis*", Earthquake Engineering Research Institute MNO-10, Oakland, CA, USA
3. Kramer, S.L. (1996). "*Geotechnical Earthquake Engineering*", Prentice Hall International, Upper Saddle River, USA
4. Prakash, S. (1981). "*Soil Dynamics*", McGraw-Hill Book Company, USA
5. Towhata, I. (2008). "*Geotechnical Earthquake Engineering*", Springer Series in Geomechanics and Geoengineering, Berlin, Heidelberg, GER

Updated & Revised Course Curriculum
M.Tech. (Earthquake Engineering)



**NATIONAL CENTRE FOR DISASTER MITIGATION AND
MANAGEMENT**
Malaviya National Institute of Technology Jaipur
(June 2026)

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1. Revision Summary (M. Tech., Earthquake Engg.)

As per the discussion held during the Industry-Institute Conclave & Curriculum Development Workshop held on 10 April 2026, the curriculum of the program M.Tech. (Earthquake Engineering) has been updated and revised.

The revision reorganises the Core Courses and introduces new Program Core courses —Computational Methods for Structural Engineering, Dynamics of Structures, Earthquake Analysis Computational Laboratory, and Earthquake Testing Laboratory — covering the full spectrum of earthquake engineering from hazard to testing.

New elective courses have been introduced based on input from industry practitioners and faculty members, including Earthquake Analysis of Concrete Dams, Earthquake Analysis of Earthen Dams and Embankments,.

Note: A fraction of any of the courses can be handled either through Experts from Industry or Academia or through MOOCs as per the PG Regulation after due approval from the DPGC.

2. Credit Structure (As Per the Regulation)

The requirements of M.Tech. Programs as per the PG Regulations of MNIT Jaipur are:

(1) Minimum credits required to be earned are 54-60 (Table 1.1).

(2) Four different types of courses should be credited (Table 1.2).

Table 1.1: Minimum credits to be earned during four semesters of M.Tech. Program

<i>Semester</i>	<i>Courses</i>	<i>Total Credits</i>
I	Taught Courses	15 – 18
II	Taught Courses	15 – 18
III	Dissertation, Seminar, Research Project	9 – 15
IV	Dissertation	12 – 16

Table 1.2: Minimum credits to be earned in four types of courses of M.Tech. Program

<i>S.No.</i>	<i>Course Type</i>	<i>Min Credits to be earned</i>
1	Program Core	18 – 21
2	Program Elective	15 – 21
3	Open Elective	0 – 6
4	Research Project, Dissertation	16 – 24

3. Course Structure (M.Tech., Earthquake Engineering)

(i) Semester-I

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Seismic Hazard Assessment*	Program Core	Theory	3	3	0	0
2		Earthquake Analysis and Testing of Structures	Program Core	Theory	4	3	1	0
3		Computational Methods for Structural Engineering#	Program Core	Theory	3	3	0	0
4		Dynamics of Structures#	Program Core	Theory	4	3	1	0
5		Earthquake Analysis Computational Laboratory#	Program Core	Practical	2	0	0	4
6		Earthquake Testing Laboratory*	Program Core	Practical	2	0	0	4
Total Semester Credits: 18								

*Course title and contents modified to include the application of earthquake data and AI

#New Course based on feedback from Industry-Institute Conclave

(ii) Semester-II

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Elective 1	Program Elective	Theory	3	3	0	0
2		Elective 2	Program Elective	Theory	3	3	0	0
3		Elective 3	Program Elective	Theory	3	3	0	0
4		Elective 4	Program Elective	Theory	3	3	0	0
5		Elective 5	Program Elective	Theory	3	3	0	0
Total Semester Credits: 15								

(iii) Semester-III

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Seminar/Minor Research Project	<i>Program Core</i>	Seminar	4	0	0	8
2		Dissertation	<i>Program Core</i>	Dissertation	8	0	0	16
Total Semester Credits: 12								

(iv) Semester-IV

S.No.	Course Code	Course Title	Course Category	Type	Credit	L	T	P
1		Dissertation	<i>Program Core</i>	Dissertation	12	0	0	24
Total Semester Credits: 12								
Total Program Credits: 57								

4.Program Elective Courses (PE)

S.No.	Course Code	Course Title	Type	Credit	L	T	P
1		Earthquake Safety Assessment and Retrofit of Buildings	Elective	3	3	0	0
2		Earthquake Resistant Design of Concrete Structures	Elective	3	3	0	0
3		Earthquake Resistant Design of Steel Structures	Elective	3	3	0	0
4		Earthquake Behaviour of Buildings	Elective	3	3	0	0
5		Earthquake Behaviour of Bridges	Elective	3	3	0	0
6		Soil Structure Interaction*	Elective	3	3	0	0
7		Earthquake Resistant Design of Precast Buildings	Elective	3	3	0	0
8		Earthquake Nonlinear Analysis of Buildings	Elective	3	3	0	0
9		Displacement-based Design of Structures	Elective	3	3	0	0
10		Earthquake Protection of Nonstructural Elements	Elective	3	3	0	0
11		Earthquake Analysis of Concrete Dams#	Elective	3	3	0	0
12		Earthquake Analysis of Earthen Dams and Embankments#	Elective	3	3	0	0

*Course title and contents modified to include the application of earthquake data

#New Course based on feedback from Industry-Institute Conclave

5. Detailed Syllabus

(i) Seismic Hazard Assessment (PC)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Seismic Hazard Assessment
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake Basics: Plate tectonics; Elastic rebound theory; Earthquake waves; Magnitude versus Intensity. Strong Ground Motions: Instruments (Accelerograph, Velocity-meter, Displacement-meter); Influences (Source, Path, Site and Structure); Severity (Near Field versus Far Field); Characteristics (Amplitude, Duration and Frequency Content); Attenuation Relations. Near Field Motions: Mechanics of Faulting (Fault-Normal and Fault-Parallel); Directivity of Faulting; Peak Ground Displacements (PGD and PGRD). Methods of Earthquake Hazard Assessment: Earthquake Hazard at Bedrock; Faults; Seismicity Catalogue; Ground Motion Prediction Equations; Seismogenic Source Regions; Recurrence Relation for Each Source Zone; Probabilistic Hazard Assessment; Deterministic Hazard Assessment. Earthquake Zoning of India; Design Peak Ground Acceleration (PGA) for Different Structures; Design Pseudo-Spectral Acceleration (PSA).

Course Outcomes

1. Fundamental understanding of the genesis and propagation of earthquakes
2. Understand the significance of site conditions, specifically under earthquake-induced ground shaking
3. Perform deterministic and probabilistic earthquake hazard assessment

References

- Baker, J.W., Bradley, B.A., and Stafford, P.J. (2021). Seismic Hazard and Risk Analysis, Cambridge University Press, UK
- McGuire, R.K. (2004). Seismic Hazard and Risk Analysis, Earthquake Engineering Research Institute MNO-10, Oakland, CA, USA
- Kramer, S.L. (1996). Geotechnical Earthquake Engineering, Prentice Hall International, Upper Saddle River, USA
- Prakash, S. (1981). Soil Dynamics, McGraw Hill Book Company, USA
- Towhata, I. (2008). Geotechnical Earthquake Engineering, Springer Series in Geomechanics and Geoengineering, Berlin, Heidelberg, GER

(ii) Earthquake Analysis and Testing of Structures (PC)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Analysis and Testing of Structures
Credit: 4	L-T-P: 3-1-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake Loading: Governing Equation; Displacement Problem to Force Problem; Types of Ground Motion (Near-Field and Far-Field). Dynamics of Fixed Base Structures: Single Degree of Freedom System — Dynamic Equilibrium, Dynamic Characteristics (Natural Period and Damping), Free Vibration (Undamped and Damped), Forced Vibration (Harmonic Loading, Pulse Loading, Resonance, and Beating), Response History Analysis using Duhamel's Integral (Newmark's β Scheme), Earthquake Ground Motion Response Spectrum (Elastic for Design; Inelastic for Assessment). Multi-Degree of Freedom System — Dynamic Equilibrium, Frequency Domain Analysis, Modal Analysis (Modes, Natural Periods, Mode Shapes, Modal Damping, Combination Rules), Modal and Matrix Time History Analysis. Earthquake Testing of Structures: Quantities in Focus (Dynamic Characteristics, Seven Virtues); Scale of Earthquake Testing (Full Scale Prototype and Laboratory Scale Model, Dynamic Similitude); Types of Earthquake Testing — Material Tests, Equivalent Static Tests (Monotonic and Cyclic), Pseudo-Dynamic Tests, Dynamic Tests (Ambient Vibration, Forced Vibration, Shake Table Test).

Course Outcomes

1. Understand earthquake behaviour of idealised structures
2. Perform earthquake analysis in time and frequency domains
3. Identify important quantities to be determined through testing
4. Recognise the strengths and limitations of various types of earthquake tests

References

- Chopra, A.K. (2007). Dynamics of Structures, Pearson Education, 3rd Edition, India
- Clough, R.W. and Penzien, J. (1993). Dynamics of Structures, McGraw Hill, USA
- Humar, J.L. (1990). Dynamics of Structures, Balkema Publishers, Tokyo, Japan
- Krawinkler, H. (1992). Guidelines for Cyclic Seismic Testing Components of Steel Structures (ATC-24), Applied Technology Council, California, USA
- FEMA 461 (2007). Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components, Applied Technology Council, California, USA
- SAC (1997). Protocol for Fabrication, Inspection, Testing, and Documentation of Beam-Column Connection Tests and Other Experimental Specimens, SAC Joint Venture Report No. SAC/BD-97/02, Version 1.1

(iii) Computational Methods for Structural Engineering (PC)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Computational Methods for Structural Engineering
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Numerical Methods: Solution of Linear Systems (Gauss Elimination, Matrix Inversion by Gauss-Jordan); Solution of Non-Linear Systems (Newton-Raphson); Numerical Differentiation and Integration. Differential Equations: Ordinary Differential Equations (Euler Methods, Trapezoidal Methods, Runge-Kutta Methods); Partial Differential Equations (Finite Difference Methods for Laplace Equation). Finite Element Methods: Introduction (Virtual Work, Minimum Potential Energy); Derivation of FE Equations (1D, 2D, and 3D Elements) — Stiffness Matrices, Global Assembly, Coordinate Transformation, Boundary Conditions, Displacement and Shape Functions; Weighted Residual Methods (Collocation, Least Square, Galerkin Techniques); Applications — 2D Trusses and Frames, Plate Bending Elements, Thin Shell Elements, Nonlinear Static and Dynamic Problems. Convergence, Stability and Possible Errors.

Course Outcomes

1. Illustrate numerical methods to solve system of equations
2. Identify convergence, stability, and possible errors in numerical solutions
3. Understand FE techniques to solve system of equations
4. Application of FE method to solve nonlinear dynamic problems

References

Chapra, S.C. and Canale, R.P. (2014). Numerical Methods for Engineers, McGraw-Hill Science Engineering, UK
Reddy, J.N. (2020). Introduction to Finite Element Method, 4th Edition, McGraw Hill, India
Chandrupatla & Belegundu. Introduction to Finite Elements in Engineering, Prentice Hall of India Pvt. Ltd.
Hughes, T.J.R. The Finite Element Method: Linear Static and Dynamic Finite Element Analysis

(iv) Dynamics of Structures (PC)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Dynamics of Structures
Credit: 4	L-T-P: 3-1-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Nature of Dynamic Loading: Types of Oscillation; Nature of Time-Dependent Phenomenon; Dynamic Equilibrium; Inertial and Dynamic Equilibrium; Energy Dissipation Mechanism. Dynamics of Single-Degree-of-Freedom Systems: Equation of Motion; Free Vibration (Undamped and Damped); Forced Vibration (Harmonic Loading, Periodic Excitation, and Pulse Loading); Steady-State and Transient Response; Force Transmission and Vibration Isolation; Theory of Vibration-Measuring Instruments; Solutions of Equation of Motion — Duhamel's Integral, Numerical Evaluation (Central Difference Method, Newmark's β Scheme); Earthquake Response of Linear Systems — Response Spectrum Concept, Fourier Transforms and Frequency Domain Analysis. Dynamics of Multi-Degree-of-Freedom Systems: Equation of Motion; Eigen Value Problem and Free Vibration Analysis; Basics (Modes, Natural Periods, Mode Shapes, and Modal Damping); Modal Analysis (Input, Number of Modes, and Combination Rules); Time Domain Analysis — Loading History, Modal Superposition Method, Mode-Truncation and Correction for Missing Mass. Earthquake Engineering: Earthquake Analysis of Linear Systems — Response Spectrum Analysis, Response History Analysis, Torsional Response of Buildings; Earthquake Analysis of Inelastic Buildings — Structural Modelling, Modal Pushover Analysis, Nonlinear Response History Analysis.

Course Outcomes

1. Relate the structural idealisation to the properties of real structures
2. Understand analytical procedures to estimate the dynamic response of structures
3. Perform earthquake analysis in time and frequency domains
4. Application of structural dynamics theory in earthquake design of structures

References

- Chopra, A.K. (2007). Dynamics of Structures, Pearson Education, 3rd Edition, India
- Clough, R.W. and Penzien, J. (1993). Dynamics of Structures, McGraw Hill, USA
- Humar, J.L. (1990). Dynamics of Structures, Balkema Publishers, Tokyo, Japan
- Villaverde, R. (2009). Fundamental Concepts of Earthquake Engineering, CRC Press, Boca Raton, USA

(v) Earthquake Analysis Computational Laboratory (PC)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Analysis Computational Laboratory
Credit: 2	L-T-P: 0-0-4
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Modelling of Structural Systems: Discretisation of structures into SDOF and MDOF systems; formulation of mass, stiffness, and damping matrices; idealisation of boundary conditions. Earthquake Ground Motion Processing: Baseline correction; filtering; scaling of ground motions. Linear Dynamic Analysis: Modal Analysis (natural frequencies, mode shapes, modal participation factors); Response Spectrum Analysis (modal combination rules); Time History Analysis (direct integration methods; comparison with response spectrum analysis). Nonlinear Analysis: Nonlinear Static Analysis — modelling of plastic hinges, pushover analysis, capacity curves, performance point determination; Nonlinear Dynamic Analysis — material and geometric nonlinearities, time history analysis of nonlinear systems, collapse mechanisms. Soil-Structure Interaction: Modelling Approaches (spring-dashpot systems, impedance functions); Influence on Response (effect of SSI on natural period, damping, and seismic demand). Fragility and Seismic Risk Analysis: Fragility Curves — development of fragility relationships based on demand and capacity; Probabilistic Methods — Probabilistic Seismic Demand Models (PSDM), Monte Carlo simulation; Performance-Based Earthquake Engineering (PBEE) framework for seismic risk assessment.

Course Outcomes

1. Implement numerical methods for dynamic analysis of structures
2. Perform linear and nonlinear earthquake analysis using computational tools
3. Process and interpret earthquake ground motion data
4. Evaluate seismic performance using fragility and risk analysis methods
5. Apply computational techniques for advanced research in earthquake engineering

References

- Chopra, A.K. (2007). Dynamics of Structures, Pearson Education, 3rd Edition, India
- Clough, R.W. and Penzien, J. (1993). Dynamics of Structures, McGraw Hill, USA
- FEMA 461 (2007). Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components, Applied Technology Council, California, USA

(vi) Earthquake Testing Laboratory (PC)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Testing Laboratory
Credit: 2	L-T-P: 0-0-4
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake Testing of Structures: Types of Earthquake Testing — Material Tests, Equivalent Static Tests, Pseudo-Dynamic Tests, Dynamic Tests. Experimental Set-up: Scale of Earthquake Testing (Full Scale Prototype and Laboratory Scale Model, Dynamic Similitude); Application of External Actions (Loading Devices); Measurement Sensors and Data Acquisition Systems. Lab Exercises: Estimation of Dynamic Parameters (Natural Period, Mode Shape, and Damping Ratio) — Ambient Vibration Test, Free Vibration Test, Forced Vibration Test; Quasi-Static Testing (Structural Elements, Sub-Assemblages, and Systems) — Load-Deformation Behaviour, Failure Modes; Shake Table Testing (Scaled Silo and Shear Building Models) — Estimation of Modal Parameters, Evaluation of Dynamic Responses (Displacement, Velocity, and Acceleration).

Course Outcomes

1. Identify important quantities to be determined through testing
2. Recognise the strengths and limitations of various types of earthquake tests

References

- Krawinkler, H. (1992). Guidelines for Cyclic Seismic Testing Components of Steel Structures (ATC-24), Applied Technology Council, California, USA
- FEMA 461 (2007). Interim Testing Protocols for Determining the Seismic Performance Characteristics of Structural and Nonstructural Components, Applied Technology Council, California, USA
- SAC (1997). Protocol for Fabrication, Inspection, Testing, and Documentation of Beam-Column Connection Tests and Other Experimental Specimens, SAC Joint Venture Report No. SAC/BD-97/02, Version 1.1
- Pan, P., Wang, T., and Nakashima, M. (2016). Development of Online Hybrid Testing: Theory and Applications to Structural Engineering, Elsevier Inc., USA

6. Program Elective Courses — Detailed Syllabi

(i) Earthquake Safety Assessment and Retrofit of Buildings (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Safety Assessment and Retrofit of Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Basics: Philosophy; Provisions of Indian Standards. Earthquake Hazard at a Site: Probabilistic Earthquake Hazard Analysis; Hazard Curve — Probability Level, Intensity Levels. Earthquake Vulnerability of Existing Buildings: Building Typologies; Current Health of the Building — Material Level, Structure Level (Ambient and Forced Vibration Tests); Behaviour under Earthquake Ground Motions; Five Levels of Vulnerability Assessment — Level 0, 1, 2 and 3; Level 4 (Damage Level, Intensity Level, Fragility Curve). Earthquake Retrofitting of an Existing Building: Strategy — Global versus Local Levels (Stiffness, Strength, Deformability), Increasing Capacity versus Reducing Demand (Base isolation & Energy Dissipation Systems); Techniques — Structure Level Retrofit (Walls, Braces), Member Retrofit (Beams, Columns — Jacketing, Wrapping). Risk Assessment: Level 4 (Damage Level, Probability Level, Risk Curve).

Course Outcomes

1. Understand and evaluate the earthquake safety of existing buildings
2. Implement retrofitting strategies to enhance earthquake resistance

References

- Costa, A., Arede, A., and Varum, H. (2018). Strengthening and Retrofitting of Existing Structures, Springer Nature Singapore Private Limited
- ASCE/SEI 41 (2017). Seismic Evaluation and Retrofit of Existing Buildings, American Society of Civil Engineers, USA
- IS 13928 (1993). Improving Earthquake Resistance of Low Strength Masonry Buildings, Bureau of Indian Standards, New Delhi, India
- BSSC (2000). FEMA 356: Pre-Standard and Commentary for the Seismic Rehabilitation of Buildings, Building Seismic Safety Council, Washington DC, USA
- Malhotra, V.M. and Carino, N.J. (2007). Handbook on Non-destructive Testing of Concrete, 2nd Edition, CRC Press, Boca Raton, USA

(ii) Earthquake Resistant Design of Concrete Structures (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Resistant Design of Concrete Structures
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction to Earthquake Resistant Design of Structures: Earthquake-Resistant Design Philosophy; 7 Virtues; Need for Ductility in Structures. Ductility: 4 Levels (Material, Section, Member, Structure); Contribution to Ductility of Seven Virtues (Confinement of concrete). Earthquake Resistance: Types of Design — Stiffness-based, Strength-based, Displacement-based, Energy-based. Capacity Design: Concept (Chain Analysis); Strength Hierarchy — Intra-Member (Flexure Design versus Shear Design), Inter-Member (Strong-Column Weak-Beam Concept); Demand-Capacity Ratios (Incremental DCRs); Beam-Column Joints (Beam Bar Anchorage). Collapse Mechanisms: Modelling Nonlinear Response of Structural Components and Systems; Pushover Analysis; Storey and Sway Mechanisms; Concept of Overstrength.

Course Outcomes

1. Understand the basics of Earthquake Design Philosophy
2. Understand the significance of Nonlinear Analysis for Earthquake

References

- Paulay, T. and Priestley, M.J.N. (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, Inc.
- Penelis, G.G. and Kappos, A.J. (1997). Earthquake-resistant Concrete Structures, E & FN Spon
- Priestley, M.J.N., Seible, F. and Calvi, G.M. (1996). Seismic Design and Retrofit of Bridges, John Wiley & Sons, Inc.
- Murty, C.V.R., Goswami, R., Viajanarayanan, A.R. and Mehta, V.V. (2012). Some Concepts in Earthquake Behaviour of Buildings, Gujarat State Disaster Management Authority, India
- Naeim, F. (Ed.) (2001). The Seismic Design Handbook, Kluwer Academic Publishers, Boston, USA

(iii) Earthquake Resistant Design of Steel Structures (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Resistant Design of Steel Structures
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Basics: Properties of steel; Ductility at 4 levels (Material, Section, Member and Structure); Philosophy of Earthquake Resistant Design; Strong Ground Motions; Response spectra. Methods of Analysis: Equivalent Static Analysis; Nonlinear Static Analysis (Plastic Analysis); Dynamic Analysis; Nonlinear Dynamic Analysis. Methods of Design: Force-based (Capacity Design); Displacement-based; Energy-based. Member Design: Tension Members; Compression Members (Stability, Axial-Flexural-Torsion Buckling); Bending Members — Beams and Plate Girders (Lateral Torsional Buckling, Plastic Hinges); Beam-columns; Beam-Column Joints, Connections, Braces. Design of Frame Buildings for Ductility: Moment Frames; Braced Frames.

Course Outcomes

1. Develop an understanding of the properties and behaviour of structural steel
2. Gain expertise in various methods of analysis and design of steel structures
3. Acquire in-depth understanding of provisions in design codes for earthquake resistant design of steel structures

References

- Gaylord, E.H. Jr., Gaylord, C.N. and Stallmeyer, J.E. (1992). Design of Steel Structures, Tata McGraw Hill Publication, India
- Englekirk, R. (2003). Steel Structures: Controlling Behaviour Through Design, John Wiley & Sons, USA
- Salmon, C.G. and Johnson, J.E. (1980). Steel Structures: Design and Behaviour, Harper & Row Publishers, New York, USA
- Bruneau, M., Uang, C.M. and Whittaker, A. (1998). Ductile Design of Steel Structures, McGraw Hill, New York, USA
- Mazzolani, F.M. and Piluso, V. (1996). Theory and Design of Seismic Resistant Steel Frames, E&FN Spon
- Gionncu, V. and Mazzolani, F.M. (2002). Ductility of Seismic Resistant Steel Structures, SPON Press

(iv) Earthquake Behaviour of Buildings (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Behaviour of Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake-Resistant Buildings: Seven Virtues of Earthquake Resistant Buildings; Earthquake Demand versus Earthquake Capacity; Force-based Design to Displacement-based Design. Earthquake Demand on Buildings: Seismic Design Force; Dynamic Characteristics of Buildings (Natural Period, Mode Shape, Damping); Ground Motion Characteristics (Accelerograms, Response Spectrum). Earthquake Capacity — Elastic Behaviour: Configuration (Overall Geometry, Plan Shape, Plan Aspect Ratio, Slenderness Ratio); Structural Systems and Components (Moment Frames, Structural Wall-Frames, Braced Frames, Tube Systems); Load Paths; Mass; Initial Stiffness; Stiffness Irregularity in Plan and Elevation; Adjacency; Soil Flexibility. Earthquake Capacity — Inelastic Behaviour: Strength; Strength Hierarchy; Structural Plan Density; Strength Asymmetry and Discontinuity; Short Column Effect; Ductility — Contributors to Ductility in Reinforced Concrete Buildings, Achieving and Assessing Ductility; Strength Provided in Building and Overall Ductility Demand. Earthquake-Resistant Design Methods: Stiffness Design Stage, Strength Design Stage, Ductility Design Stage.

Course Outcomes

1. Cover the fundamental aspects of earthquake-resistant design of buildings
2. Characterise various parameters to demonstrate the earthquake capacity of buildings
3. Provide a comprehensive understanding of earthquake-resistant design methods

References

- Villaverde, R. (2009). Fundamental Concepts of Earthquake Engineering, CRC Press, Boca Raton, USA
- Elnashai, A.S. and Sarno, L.D. (2008). Fundamentals of Earthquake Engineering, John Wiley & Sons, New York, USA
- Paulay, T. and Priestley, M.J.N. (1992). Seismic Design of Reinforced Concrete and Masonry Buildings, John Wiley & Sons, New York, USA
- Bruneau, M., Uang, C.M. and Sabelli, S.E. (2011). Ductile Design of Steel Structures, McGraw-Hill Education, New York, USA

(v) Earthquake Behaviour of Bridges (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Behaviour of Bridges
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction: Background and classification of bridges. Bridge Components and Systems: Structural Behaviour; Materials; Modelling; Loads and Load Effects; Methods of Analysis. Structural Design: Tenets of Bridge Design; Levels of Earthquake Shaking; Design for Earthquake Ground Shaking; Design of Superstructures, Bearings, Substructures, Foundations, and Soil. Structural Safety Assessment and Retrofit Design: Reasons for Retrofit; Condition Assessment; Earthquake Safety Assessment (Levels L1, L2, L3, and L4); Structural Analysis; Retrofit Measures. New Directions: Hazard Assessment; Structural Analysis; Structural Design.

Course Outcomes

1. Understand concepts involved in design of bridges
2. Design and detail short and medium span bridges for earthquake loading

References

- Chen, W.-F. and Duan, L. (Eds.) (2000). Bridge Engineering Handbook, Parts 1-5, CRC Press LLC, Florida, USA
- Priestley, M.J.N., Seible, F. and Calvi, G.M. (1996). Seismic Design and Retrofit of Bridges, John Wiley & Sons, Inc.
- Zhao, J.J. and Tonnas, D.E. (2012). Bridge Engineering — Design, Rehabilitation and Maintenance of Modern Highway Bridges, 3rd Edition, McGraw Hill, New York
- Victor, D.J. (2007). Essentials of Bridge Engineering, 6th Edition, Oxford & IBH Publishing Company Private Limited, New Delhi
- Ponnuswamy, S. (1999). Bridge Engineering, Tata McGraw-Hill Publishing Company Limited, New Delhi

(vi) Soil Structure Interaction (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Soil Structure Interaction
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Dynamic Earthquake Behaviour of Soil Systems: Dynamic Behaviour of Soils — Hysteresis Loops, Shear Modulus, Damping Ratio, Behaviour at Low and High Strain Levels; Laboratory Tests (Resonant Column, Bender Element, Cyclic Simple Shear, Cyclic Triaxial); Model Tests (Shaking table, Centrifuge); Field Tests for Estimating Dynamic Properties (Seismic Cross-hole Test, Seismic Reflection and Refraction Tests); Dilatancy; Stress-strain Behaviour of Cyclically Loaded Soils — Equivalent Linear Model, Cyclic Nonlinear Model, Hyperbolic Models. Dynamic Soil-Structure Interaction: Levels of SSI — Inertial Interaction, Kinematic Interaction; Stiffness and Damping Considerations; Significance of SSI in Force-based, Displacement-based, and Response History Procedures; Examples (Low-rise residential buildings, multistory buildings, bridges, dams, nuclear power plants, offshore structures). Liquefaction: Mechanism and Effects of Liquefaction; Assessment of Liquefaction Potential — Factor of Safety, Shear Stress Demand, Shear Strength of Soil (In-situ Tests), Estimation of Permanent Displacement; Mitigation of Liquefaction Potential.

Course Outcomes

1. Understand dynamic behaviour of soils under earthquake ground shaking
2. Identify significance of dynamic soil properties in evaluating dynamic response of soil systems
3. Idealise soil properties for simulating their earthquake response
4. Understand the significance of Soil-Structure Interaction

References

- Kramer, S.L. (1996). Geotechnical Earthquake Engineering, Prentice Hall International, Upper Saddle River, NJ, USA
- Towhata, I. (2008). Geotechnical Earthquake Engineering, Springer-Verlag Berlin Heidelberg, GER
- Prakash, S. (1981). Soil Dynamics, McGraw Hill Book Company, USA
- Wolf, J.P. (1985). Dynamic Soil-Structure Interaction, Prentice Hall, NJ, USA
- Wolf, J.P. (1988). Soil-Structure Interaction in the Time-Domain, Prentice Hall, NJ, USA

(vii) Earthquake Resistant Design of Precast Buildings (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Resistant Design of Precast Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction: Basic principles of earthquake-resistant design (Strength-based Design, Displacement-based Design); State of Precast Construction Practice (Performance Criteria, Advantages and Disadvantages); Lessons from previous earthquakes. Precast Construction Concepts: Basic Concepts — Structural Ductility of Precast-Frame Systems, Behaviour Factors, Confinement, Shear Strength and Shear Transfer Mechanism; Component Behaviour and Design — Precast Beams, Combined Beam-Column Systems, Beam-Column Joints; Performance requirements (Damage-limitation, Collapse-prevention limit states), Detailing for ductility. System Design: Precast-building systems — Large-panel wall systems, Wall-frame systems (dual systems), Floor-framing systems, Double-wall systems, Precast-cell systems.

Course Outcomes

1. Understand earthquake behaviour of precast buildings
2. Understand the significance of precast structural systems for mass housing

References

- Englekirk, R.E. (2003). Seismic Design of Reinforced and Precast Concrete Buildings, John Wiley & Sons, Inc.
- fib Bulletin 27 (2003). Seismic Design of Precast Concrete Building Structures
- fib Bulletin 43 (2008). Structural Connections for Precast Concrete Buildings
- fib Bulletin 78 (2016). Precast-Concrete Buildings in Seismic Areas
- Eliot, K.S. (2002). Precast Concrete Structures, Butterworth-Heinemann

(viii) Earthquake Nonlinear Analysis of Buildings (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Nonlinear Analysis of Buildings
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction to Frame Buildings and Dynamic Nonlinear Actions: Structural Systems and Moment-Resisting Frames; Sources of Nonlinearities in Frame Structures under Earthquake and Impact. Classical Linear Static Analysis: Assumptions and Considerations; Coordinate Frames; Review of Slope Deflection Method; General Procedure for Linear Elastic Static Analysis; Special Issues (Real Hinges, Specified Deformations at Supports, Flexible Restraints). Geometric Nonlinear Static Analysis: Effect of Axial Deformation on Bending; Effect of Bending on Axial Stiffness; Stability and Buckling; Solving Nonlinear Systems; Effective Length of Frame Members. Material Nonlinear Static Analysis: Stress-Strain Relations; Plastic Actions (Lumped Plasticity, Distributed Plasticity); Inelasticity in Frames — Lumped Plasticity Approach; General Procedure for Nonlinear Inelastic Static Analysis. Combined Geometric-Material Static and Dynamic Nonlinear Analysis: History Dependence (Cyclic Loading, Hysteresis Rules); Uniaxial Cyclic Models, Strain Hardening, Multi-axial Cyclic Models; Plastic Moment Hinges under Cyclic Loading; General Procedure for Nonlinear Inelastic Dynamic Analysis; Special Issues (Beam-Column Joints, Connections, Damping).

Course Outcomes

1. Understand behaviour of frame members and frame structures under inelastic actions
2. Perform hand-calculation based nonlinear analysis of small structures

References

- Yang, Y.-B. and Kuo, S.-R. (1994). Theory and Analysis of Nonlinear Framed Structures, Prentice Hall India Private Limited, New Delhi, India
- Kassimali, A. (1999). Matrix Analysis of Structures, Brooks/Cole Publishing Company, USA
- McGuire, W., Gallagher, R.H. and Ziemian, R.D. (2000). Matrix Structural Analysis, 2nd Edition, John Wiley and Sons Publishers, New York, USA
- Satyamoorthy, M. (1998). Nonlinear Analysis of Structures, CRC Press, Boca Raton, USA

(ix) Displacement-based Design of Structures (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Displacement-based Design of Structures
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Earthquake Basics: Strong Ground Motions — Instruments, Influences (Source, Path, Site and Structure), Severity (Near Field versus Far Field), Characteristics, Attenuation Relations; Near Field Motions — Mechanics of Faulting, Directivity, Peak Ground Displacements. Earthquake Displacement Loading on Structures: Displacement-controlled Loading — Movement beneath Structures, Maximum Demand on Structures; Desirable Behaviour — Seven Virtues, Preferred Damage Mechanism, Expected Deformability; Design Approaches (Elastic Design, Inelastic Design). Structural Design for Earthquake Displacement Demand: Review of Methods reported in Literature; Design of Moment Frame Buildings — Method, Fundamental Mode and Plastic Rotation Capacity, Step-wise Procedure; Detailing (Members, Joints). Structural Capacity Assessment: Closed Loop Method (Forward Loop, Return Loop); Inelastic Static Analysis — Overstrength Hinge Properties, Pushover Analysis; Inelastic Dynamic Analysis — Cyclic Overstrength Hinge Properties, Response History Analysis.

Course Outcomes

1. Understand earthquake behaviour of structures, with inelastic actions in its members
2. Gain understanding of principles of earthquake resistant design considering displacement hazard as an input

References

- Aschheim, M., Hernandez-Montes, E. and Vamvatsikos, D. (2019). Design of Reinforced Concrete Buildings for Seismic Performance, CRC Press, Boca Raton, USA
- Priestley, M.J.N., Seible, F. and Calvi, G.M. (1996). Seismic Design and Retrofit of Bridges, John Wiley & Sons, Inc., New York, USA
- Sullivan, T.J., Priestley, M.J.N. and Calvi, G.M. (Eds.) (2012). A Model Code for the Displacement-Based Seismic Design of Structures, IUSS Press, EUCENTRE, Pavia, Italy

(x) Earthquake Protection of Nonstructural Elements (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Protection of Nonstructural Elements
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Introduction to Non-Structural Elements (NSEs): Structural and Non-structural Elements; Classification of NSEs; Performance of NSEs during Past Earthquakes (Damages, Importance of Securing NSEs). Conceptual Earthquake Behaviour of NSEs: The Two Challenges; The Protection Strategies — Force-Sensitive NSEs, Displacement-Sensitive NSEs; Interaction between SEs and NSEs. Behaviour of NSEs in Earthquake: Effects of Earthquake Shaking on Buildings (Floor Acceleration Response, Displacement Response); Effects on NSEs (Acceleration Effects, Displacement Effects); Behaviour of Unanchored and Anchored Force-Sensitive NSEs; Behaviour of Displacement-Sensitive NSEs. Performance Expectation from NSEs: Earthquake Design Philosophy (Expected Levels of Performance, Levels of Shaking, Safety from Primary and Secondary Hazards); Protection Strategies — Non-Engineered, Pre-Engineered, Engineered Design Practice. Code Provisions: Basic Provisions for Engineered Strategy; BIS Provisions (IS 1893 Part 1, IS 16700); Earthquake Performance of Code-Designed Connections; Limitations in Current Design Procedure; Importance of Seismic Pre-Qualification of NSEs.

Course Outcomes

1. Understand the importance of nonstructural elements
2. Study physical characteristics that make nonstructural elements vulnerable to earthquakes
3. Gain expertise into several methods of analysis

References

- Murty, C.V.R., Goswami, R., Viajanarayanan, A.R. and Mehta, V.V. (2012). Some Concepts in Earthquake Behaviour of Buildings, Gujarat State Disaster Management Authority, India
- Villaverde, R. (2009). Fundamental Concepts of Earthquake Engineering, CRC Press, Boca Raton, USA
- Gatscher, J.A., McGavin, G.L. and Caldwell, P.J. (2012). Earthquake Protection of Building Equipment and Systems, ASCE Press, Virginia, USA

(xi) Earthquake Analysis of Concrete Dams (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Analysis of Concrete Dams
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Performance of Concrete Dams in Past Earthquakes. Design Earthquake Hazard Assessment: Ground Motions (Uniform and Non-uniform, Amplitude, Attenuation, and Amplification); Return Period (Levels of Earthquake Shaking for Concrete Dams). Methods of Structural Analysis: Seismic Coefficient Method; Simplified Response Spectrum Method; Classical Spectral Method; Sliding Block Method; Finite Element Analysis. Analysis of Concrete Dams: Nonlinear Constitutive Laws of Concrete (Stress-Strain Curve, Damping); Dam-Water and Dam-Foundation-Rock Interactions; Modelling of Dam-Reservoir-Foundation-Rock System — Components (Dam, Reservoir, Foundation, Rock), Canyon Geometry, Boundary Conditions, Convergence.

Course Outcomes

1. Understand dynamic behaviour of Dam-Reservoir-Foundation system
2. Gain expertise in various methods of dynamic analysis of concrete dams
3. Acquire skill sets to conduct dynamic analysis incorporating appropriate modelling schemes
4. Conduct advanced analysis considering the interaction between dam-reservoir-foundation

References

- Chopra, A.K. (2020). Earthquake Engineering for Concrete Dams: Analysis, Design, and Evaluation, Wiley, NJ, USA
- Fell, R., MacGregor, P., Stapledon, D., Bell, G. and Foster, M. (2018). Geotechnical Engineering of Dams, CRC Press, Taylor & Francis Group, Boca Raton, USA
- ICOLD Bulletin 148 (2016). Selecting Seismic Parameters for Large Dams, International Commission on Large Dams, Paris, FR
- ICOLD Bulletin 120 (2001). Design Features of Dams to Effectively Resist Seismic Ground Motion, International Commission on Large Dams, Paris, FR
- ICOLD Bulletin 52 (1986). Earthquake Analysis Procedures for Dams (Linear Analysis), International Commission on Large Dams, Paris, FR

(xii) Earthquake Analysis of Earthen Dams and Embankments (PE)

UG/PG: PG	Department: National Centre for Disaster Mitigation and Management
Course Code:	Course Name: Earthquake Analysis of Earthen Dams and Embankments
Credit: 3	L-T-P: 3-0-0
Version: 2026	Approved on:
Pre-requisite course: None	

Syllabus

Performance of Earth Dams and Embankment Dams in Past Earthquakes. Design Earthquake Hazard Assessment: Ground Motions (Uniform and Non-uniform, Amplitude, Attenuation, and Amplification); Return Period (Levels of Earthquake Shaking for Earth Dams); Nonlinear Behaviour of Soil; Liquefaction. Methods of Structural Analysis: Pseudo-Static Method; Pseudo-Static Method with Non-Uniform Seismic Coefficient; Equivalent Linear Method; Nonlinear Method; Finite Element Analysis. Analysis of Earth Dams: Nonlinear Dynamic Constitutive Laws of Rock and Soil (Stress-Strain Curve, Damping); Dam-Water and Dam-Foundation-Rock Interactions; Modelling of Dam-Reservoir-Foundation-Rock System — Components (Dam, Reservoir, Foundation, Rock), Canyon Geometry, Boundary Conditions, Cavitation, Convergence, Modelling Liquefaction Phenomena using Finite Element Models.

Course Outcomes

1. Understand various modes of failure from past seismic events
2. Explore various constitutive models for dynamic behaviour of soils
3. Select appropriate method for analysis of earth and embankment dams
4. Incorporate the influence of liquefaction in the dynamic analysis of earth and embankment dams
5. Understand analytical and numerical models of dam-reservoir-foundation-rock system of increasing complexity

References

- Chopra, A.K. (2020). Earthquake Engineering for Concrete Dams: Analysis, Design, and Evaluation, Wiley, NJ, USA
- Fell, R., MacGregor, P., Stapledon, D., Bell, G. and Foster, M. (2018). Geotechnical Engineering of Dams, CRC Press, Taylor & Francis Group, Boca Raton, USA
- Kramer, S.L. (1996). Geotechnical Earthquake Engineering, Prentice Hall International, Upper Saddle River, USA
- Towhata, I. (2008). Geotechnical Earthquake Engineering, Springer Series in Geomechanics and Geoengineering, Berlin, Heidelberg, GER

Recommendations of UG curriculum review committee

Senate, in its 59th Meeting held on 16 July 2025, vide Resolution No. Senate-59/2025/22, constituted a Committee to review the scheme and structure of Undergraduate (UG) programmes in accordance with the provisions and recommendations of NEP-2020.

Subsequently, the Senate, in its 61st Meeting, after detailed deliberations, vide Item No. 61-3.6, approved the recommendations of the UG Curriculum Review Committee for ensuring compliance with NEP-2020. The Senate further resolved that the distribution of the overall credit requirements (160–166 credits) among Institute Core, Programme Core, Programme Electives, Open Electives, PLEAS/BS courses, Projects, and other curricular components shall be finalized discipline-wise in consultation with the respective Departments.

Further, while confirming the minutes of the 61st Meeting during its 62nd Meeting, the Senate recommended expansion of the UG Curriculum Review Committee by including at least one faculty representative from each Department.

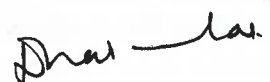
Thereafter, based on requests received from various faculty members and under the directions of the Chairman, Senate, it was decided to organize an Open House discussion to deliberate upon the proposed UG curriculum framework formulated in compliance with NEP-2020.

Accordingly, an Open House was conducted on 08 May 2026 at Neeti Sabhagar, Malaviya National Institute of Technology Jaipur, wherein approximately 100 faculty members and 15 students participated in the deliberations regarding the proposed UG curriculum structure. The suggestions and observations received during the Open House were placed before the UG curriculum review committee, Heads of the Departments and SUGB for further examination and consideration in the process of finalization of the UG curriculum framework under NEP-2020. The UG Curriculum Review Committee held a series of meetings and based on comprehensive consultations, the revised UG curriculum structure has been prepared with due consideration of the recommendations received from all stakeholders while ensuring compliance with the provisions of NEP-2020.

The Committee, having examined the revised UG curriculum structure prepared through the above consultative process, recommends the same for placement before the Senate Under Graduate Board (SUGB) and subsequently before the Senate for consideration and approval.

Table 1 Details of Institute Core Courses

Details of Institute Core Courses				
Course Category		Course Name	Credits Proposed	Remarks
Institute Core (IC)	M a n d a t o r y	Mathematics I	3	1 st Sem
		Mathematics II	3	2 nd Sem
		Makers Lab	6	1 st & 2 nd Sem
		Data Analytics	2	1 st & 2 nd Sem
		Design thinking for Innovation	2	3 rd & 4 th Sem
		Environmental Science	1	1 st & 2 nd Sem
		Soft Skills Foundational Lab	1	1 st & 2 nd Sem
		Soft Skills Advanced Lab	1	3 rd & 4 th Sem
		Human Values and Professional Ethics	1	1 st & 2 nd Sem
	IC Bucket (Minimum 3)	Physics	3	1 st & 2 nd Sem
		Engineering Chemistry	3	1 st & 2 nd Sem
		Programming with Python + Lab	3	1 st & 2 nd Sem
		Principles of Economics	3	3 rd or Higher Sem
	IC Lab Bucket (Minimum 2)	Physics Lab	1	1 st & 2 nd Sem
		Engineering Chemistry Lab	1	1 st & 2 nd Sem
		Engineering Drawing and Sketching Lab	1	1 st & 2 nd Sem
Institute Core (IC) Range			31 – 35	

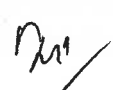



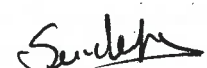














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 Mudit Agrawal - 2023 UME190
Birgh
 Bipul Singh - 2024 UEC15
Arjan
 ARYAN GARG - 2024 UEC15

Table 2: First Year Structure

First Year Structure			Credits		Remarks	Semester					
Course Category	Course Name	Cycle 1	Cycle 2	I		II					
Institute Core	BSC	Mathematics I (For All students in Sem 1)	3		ODD Sem	Modern Physics Group Cycle 1 & Classical Physics Group Cycle 2	Modern Physics Group Cycle 2 & Classical Physics Group Cycle 1				
		Mathematics II (For All students in Sem 2)		3	EVEN Sem						
		Physics (IC Bucket*)	0 / 3		ODD-EVEN						
		Engineering Chemistry (IC Bucket*)		0 / 3	ODD-EVEN						
	ESC	Programming with Python + Lab (IC Bucket*)	0 / 3		ODD-EVEN			Modern Physics Group Cycle 1 & Classical Physics Group Cycle 2	Modern Physics Group Cycle 2 & Classical Physics Group Cycle 1		
		Makers Lab		6	ODD-EVEN						
		Data Analytics		2	ODD-EVEN						
		Environmental Science	1		ODD-EVEN						
	HSSC	Soft Skills Foundational Lab	1		ODD-EVEN	Modern Physics Group Cycle 1 & Classical Physics Group Cycle 2	Modern Physics Group Cycle 2 & Classical Physics Group Cycle 1				
		Human Values and Professional Ethics	1		ODD-EVEN						
	Minimum 2	Physics Lab (IC Lab Bucket*)	0 / 1		ODD-EVEN					Modern Physics Group Cycle 1 & Classical Physics Group Cycle 2	Modern Physics Group Cycle 2 & Classical Physics Group Cycle 1
		Engineering Chemistry Lab (IC Lab Bucket*)		0 / 1	ODD-EVEN						
		Engg. Drawing and Sketching Lab (IC Lab Bucket*)	0 / 1		ODD-EVEN						
	Total Institute Core (IC)		10 – 14	11 – 15							
Program Core (PC) (11 – 14) + 3 in case Principles of Economics		5 – 10	5 – 10								
Total Credits		19 – 21	19 – 21								

Constraints:

- 1) Total number of credits in first year must be exactly 40
- 2) Must select at least 3 courses from the IC bucket
- 3) Principles of Economics selected as IC bucket course, will be offered in 2nd or 3rd Year
- 4) Not more than 2 PC in any semester (except when selected Principles of Economics as IC course)
- 5) Not more than 1 PC Lab in any semester
- 6) Not more than 5 PC (theory + Lab) in first year (except when selected Principles of Economics IC bucket)
- 7) If including any lab it must be preferably experiential learning type
- 8) While choosing the courses from the IC buckets departments to ensure that intended POs, PSOs, and PEOs continue to be satisfactorily attained through the proposed course structure.
- 9) Modern Physics Group: Artificial Intelligence & Data Engineering, Computer Science & Engineering, Electronics & Communication Engineering, Electrical Engineering, and Mathematics and Computing
- 10) Classical Physics Group: Civil Engineering, Chemical Engineering, Mechanical Engineering, Metallurgical & Materials Engineering, and Engineering Physics.

Ram Singh

Dr. Anurag

Prer

Mudit

Mudit Agrawal - 2023 UMEIS

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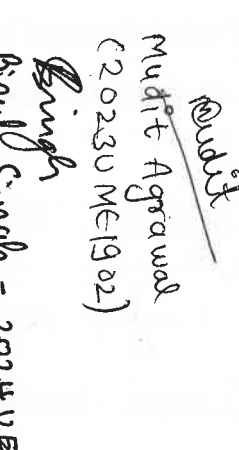
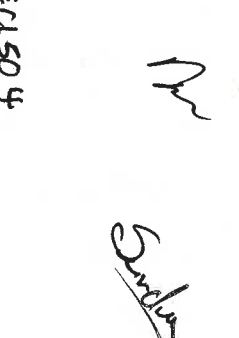
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Table 3: Semester wise credit distribution

Regular B.Tech									
Year	Semester	Course Category							Total
		IC	PC	PL(EAS/BS)	PE	OE	Project	Industrial T/S	
1	I	10-14	5-10	0-3	0	0	0	0	19-21
	II	11-15	5-10	0-3	0	0	0	0	19-21
	III	0-3	15-18	0-3	0-3	0	0	0	18-24
	IV	0-3	15-18	0-3	0-3	0	0	0	18-24
2	V	0-3	15-18	0-3	3-6	0	0	0	22-24
	VI	0-3	15-18	0-3	3-6	3-6	0	0	22-24
	VII		0-6	0	6-9	0-6	3	2-3	15-22
	VIII		0-3	0	3-6	0-3	6	0	9-15
Total		31-35	70-82	6-12	21-30	9	9	2-3	160-166

B.Tech with Minor/Honors (in addition to regular B.Tech courses)									
Year	Semester	Course Category							Total
		IC	PC	PL(EAS/BS)	PE	OE	Project	Industrial T/S	
1	I								
	II								
	III		0-3						0-3
	IV		3						3
2	V								
	VI		3						3
	VII		0-3		0-3				3
	VIII		0-3		0-3				3
Total			9-18		0-6		0-3		15-18

* The students opting for a Minor specialization in another department may be permitted to count upto one (in case of 15 credits Minor specialization) or two (in case of 18 credits Minor specialization) courses from their Minor specialization basket as Open Electives.

 Mudit Agrawal
 (2023UMC1902)
 Bipul Singh
 (2024UEC1504)
 ARYAN GARG - 2024UEC1513


Recommendations regarding Multiple Entry/Exit:

1. A student will be allowed to exit a programme upon meeting the minimum requirements for exit at the respective level.
2. A student will be allowed to re-enter a programme only at the beginning of an odd semester (or academic year).
3. Re-entry at various levels of a programme during an academic year will be permitted based on the credits earned from CFTIs ranked within the top 100 in the "Overall" category of NIRF for that academic year.
4. Upon re-entry into a programme, the student must surrender the previously obtained certificate (UG Certificate/ UG Diploma/ Advanced UG Diploma used for re-entry) to the Institute. This certificate will not be returned if the student earns a higher certificate, diploma, or degree after re-entry.

Gap between Exit and Re-entry:

1. A minimum gap of one year from each exit is required for re-entry into the programme.
2. A maximum gap of five years from the last earned certificate/ diploma/degree is allowed for re-entry into the programme.

Re-entry of Students from Institutions Other than MNIT:

1. A minimum CGPA of 6.5 (on a 10-point scale) is required for re-entry into any programme at MNIT.
2. Students must pass the proficiency test conducted by the respective departments of MNIT to qualify for entry into any programme at MNIT.
3. Students re-entry from institutes other than MNIT shall be permitted provided the candidate has been admitted to the first year of the programme following the same entry requirement as that of MNIT (e.g. JEE mains (for B. Tech/B. Arch))

Course Mapping:

1. The DUGC shall map the credits acquired by the student with the applicable curriculum (at the time of entry) course category-wise when a student re-enters a programme.
2. The student must acquire the deficit courses/credits in each course category as per the applicable curriculum (at the time of entry).

Maximum Number of Students Permitted to Re-enter a Programme per Academic year (only for students from Institutions other than MNIT):

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[Signature] (2023UME1902)
Mudit Agrawal
Bipul Singh - 2024UECIS
ARYAN GARG-2024UECIS

1. The maximum number of students permitted to re-enter a programme run by a department in an academic year will be limited to maximum of (two students or seats vacant for each entry level).
2. For the Architecture stream, the entry would only be applicable as per CoA norms and seat vacancies in that particular year.

Departments shall design the relevant skill development courses to meet the credit requirement for UG Certificate/UG Diploma/Advanced UG Diploma in consultation with academia/industry.

Awarding Institute:

1. Upon entry into a programme (except entry level), the student must surrender the previously obtained certificate (UG Certificate/ UG Diploma/ Advanced UG Diploma used for entry to the Institute. This certificate will not be returned if the student earns a higher certificate, diploma, or degree after entry.
2. Only the students fulfilling the minimum credit requirements of regular degree programme will be conferred degrees in convocation.

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Mudit

Mudit Agrawal

-20230ME1902

Birgh

2024UEC1504 Bipul Singh

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ARYAN GARG-2024UEC15

Table 4: The various entry/exit options proposed for B.Tech programmes

Semester of Study	Entry Requirement	Exit Requirement	Degree/Certificate awarded	NCRF Level
1st Semester begning	Only through JosAA/DASA/ICCR/SII	NA	NA	4
2nd Semester end	NA	Minimum 40 credits earned + 2 credits of department specific skill courses	UG Certificate in the relevent Engg. Stream	4.5
3rd Semester begning	UG Certificate in relevant Engg. Stream + 1 year of gap/work experience post UG certificate	NA	NA	4.5
4th Semester end	NA	Minimum 80 credits earned + 2 credits of department specific skill courses	UG Diploma in the relevent Engg. Stream	5
5th Semester begning	UG Diploma in the relevent Engg. Stream + 1 year of gap/work experience post UG Diploma	NA	NA	5
6th Semester end	NA	Minimum 120 credits earned + 2 credits of department specific skill courses	Advanced UG Diploma in the relevent Engg. Stream	5.5
7th Semester begning	Advanced UG Diploma in the relevent Engg. Stream + 1 year of gap/work experience post Advanced UG Diploma	NA	NA	5.5
8th Semester end	NA	Regular B.Tech requirement as per the curriculum	B.Tech/B.Tech with Honors/Minor	6

Mudit (2023041902)
Mudit Agrawal
Bipul Singh 2024UECL501
ARYAN GARG - 2024UECL

89

Table 5: The various entry/exit options proposed for B.Arch program

Semester of Study	Entry Requirement	Exit Requirement	Degree/ Certificate awarded
1st Semester begning	Only through JosAA/DASA/ICCR/SII	NA	NA
2nd Semester end	NA	Minimum 47 credits earned + 2 credits of department specific skill courses	UG Certificate in Basic Architecture
3rd Semester begning	UG Certificate in Basic Architecture + 1 year of gap/work experience post UG certificate	NA	NA
4th Semester end	NA	Minimum 96 credits earned + 2 credits of department specific skill courses	Certificate of Arch. Assistantship
5th Semester begning	Certificate of Arch. Assistantship + 1 year of gap/work experience post Arch. Assistantship certificate	NA	NA
6th Semester end	NA	Minimum 146 credits earned + 2 credits of department specific skill courses	UG Diploma in Architecture
7th Semester begning	UG Diploma in Architecture/equivalent + 1 year of gap/work experience post UG Diploma	NA	NA
8th Semester end	NA	Minimum 183 credits earned + 2 credits of department specific skill courses	Advanced UG Diploma in Architecture
9th Semester begning	Advanced UG Diploma in Architecture + 1 year of gap/work experience post Advanced UG Diploma (only for	NA	NA

Audit (20230ME1902)

 Mudit Agrawal

 B Singh Bipul Singh

 2024UEC1504

 ARYAN GARG - 2024UEC15

	students opted to exit from MNIT at earlier levels)		
10th Semester end	NA	Regular B.Arch requirement as per the curriculum	B.Arch/B.Arch with Honors/Minor

Handwritten signatures and initials:
 (Large signature) Dhruv
 (Signature) Sr
 (Signature) Singh
 (Signature) Arjun
 (Signature) Sandeep
 (Signature) Moh
 (Signature) Anshu

Audit (20230MG19)
 Mudit Agrawal
 Singh Bipul Singh
 2024UEC1504
 A.
 ARYAN GARG
 2024UEC1513

Annexure-E

MNIT Jaipur Seat Matrix for M.Tech./M.Plus (All Categories)

Annexure- E																		
Departments	Programmes	Admission Category	Group	OPEN	OPEN-PWD	EWS	EWS-PWD	SC	SC-PWD	ST	ST-PWD	OBC	OBC-PWD	Total	Sponsored		DASA	
															Full-Time	Part-Time	CIWG	Other
Department of Architecture & Planning-(AP)	Urban Planning-(UP)	CCMT	Group 1	7	1	2	0	3	0	2	0	4	0	19				
		Self-Financed	Group 2	3	0	0	0	1	0	0	0	3	0	7	5	6	1	1
Department of Civil Engineering-(CE)	Environmental Engineering-(EV)	CCMT	Group 1	6	1	2	0	2	0	1	0	4	0	16				
		Self-Financed		4	0	1	0	2	0	1	0	2	0	10	5	6	0	0
	Structural Engineering-(SU)	CCMT	Group 1	6	0	2	1	2	0	1	0	4	0	16				
		Self-Financed		4	0	1	0	2	0	0	0	2	1	10	5	6	1	1
	Transportation Engineering-(TE)	CCMT	Group 1	6	0	2	0	2	1	1	0	4	0	16				
		Self-Financed		4	0	1	0	1	0	1	0	3	0	10	5	6	0	0
Department of Computer Science & Engineering-(CT)	Water Resources Engineering-(WR)	CCMT	Group 1	6	0	1	0	2	0	2	0	4	1	26				
		Self-Financed		4	0	1	0	1	1	1	0	2	0	10	5	6	0	0
	Computer Science & Information Security-(CQ)	CCMT	Group 1	10	0	2	0	4	1	2	0	7	0	26				
		Self-Financed		4	0	1	0	1	0	1	0	3	0	10	0	0	0	0
	Computer Science & Engineering-(XG)	CCMT	Group 1	10	0	2	0	4	0	2	0	7	1	26				
		Self-Financed		3	1	1	0	2	0	1	0	2	0	10	5	6	3	5
Centre for Energy & Environment-(CY)	Renewable Energy-(RE)	CCMT	Group 1	9	1	3	0	4	0	2	0	7	0	26				
		Self-Financed		4	0	1	0	1	0	1	0	3	0	10	5	6	0	0
Department of Electronics & Communication Engineering-(EC)	Embedded Systems-(EB)	CCMT	Group 1	7	1	2	0	3	0	2	0	4	0	19				
		Self-Financed	Group 2	3	0	0	0	1	1	0	0	3	0	8	0	0	0	0
	Electronics & Communication Engineering-(EF)	CCMT	Group 1	8	0	2	0	3	0	2	1	5	0	21				
		Self-Financed		4	0	1	0	2	0	1	0	1	1	10	5	6	1	1
	VLSI Design-(VN)	CCMT	Group 1	8	1	2	0	3	0	1	0	5	0	20				
		Self-Financed	Group 2	2	0	1	0	1	0	0	0	2	0	6	5	6	1	1
Department of Electrical Engineering-(EL)	Power Electronics & Drives-(PD)	CCMT	Group 1	10	1	2	0	4	0	2	0	7	0	26				
		Self-Financed		3	1	1	0	2	0	0	0	3	0	10	0	0	0	0
	Power Systems Management-(PN)	CCMT	Group 1	6	0	2	0	2	0	1	0	4	1	16				
		Self-Financed		4	0	1	0	1	0	1	0	3	0	10	5	6	0	0

Department of Mechanical Engineering (ME)	Power Systems (PO)	CCMT	Group 1	8	0	2	0	3	0	2	1	5	0	21	5	6	1	1
		Self-Financed		4	0	1	0	1	0	1	0	2	1	10				
		CCMT	Group 1	8	0	2	0	3	0	1	0	6	1	21	0	0	0	0
	Design Engineering (DG)	Self-Financed		4	0	1	0	1	0	1	0	3	0	10				
				4	0	1	0	1	0	1	0	3	0	10				
			Group 1	4	1	1	0	1	0	1	0	3	0	11				
		CCMT	Group 2	2	0	1	0	1	0	0	0	1	0	5	5	6	1	1
	Industrial Engineering (IG)	Self-Financed		3	1	1	0	2	0	0	0	3	0	10				
				9	0	1	0	3	0	2	0	4	1	20	0	0	1	1
	Thermal Engineering (TI)	CCMT	Group 1	4	0	1	0	2	0	1	0	2	0	10				
National Centre for Disaster Mitigation and Management (DM)		Self-Financed		6	0	2	1	2	0	1	0	4	0	16	5	6	0	0
	Earthquake Engineering (EE)	CCMT	Group 1	4	0	0	1	2	0	0	0	3	0	10				
		Self-Financed		6	0	2	0	2	0	1	0	4	0	15				
		CCMT	Group 1	4	0	2	0	2	0	1	0	4	0	15	5	6	0	0
Department of Metallurgical and Materials Engineering (MT)	Materials Engineering	Self-Financed		4	0	1	0	1	0	0	1	3	0	10				
		CCMT	Group 1	6	1	1	0	2	0	1	0	4	0	15	5	6	0	0
Department of Chemical Engineering	Chemical Engineering and Sustainability (CE&S)	Self-Financed		4	0	1	0	1	0	1	0	3	0	10				
		CCMT	Group 1	5	1	1	0	2	0	1	0	5	0	15	5	6	0	0
Materials Research Centre (MRC)	Semiconductor Material & Devices (SM)	Self-Financed		5	0	1	0	2	0	1	0	2	0	10				
		CCMT	Group 1	5	1	1	0	2	0	1	0	2	0	10	5	6	0	0
Total Seats				242	13	60	3	89	5	46	3	164	8	633	80	96	11	13

Tanish
16/04/2026

मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर
MALVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

पंजिका संख्या / File No.

कार्यालय टिप्पणी

Note Sheet

Academic Section

Dated:-16-04-2026

Sub:- Regarding approval of seat matrix of Ph.D. Admission Odd Semester 2026-27 on Institute Assistantship and Self Financed (without any Assistantship).

Reservation matrix for Institute Assistantship & Self Financed seats (without any Assistantship) for Ph.D. admission odd semester 2026-27								
S.N o.	Departments	Type of slots	Total Slots	Gene ral	EWS (10%)	OBC (27%)	SC (15%)	ST (7.5%)
1	ARCHITECTURE AND PLANNING	Institute Assistantship	9	4	1	2	1	1
		Self Financed (wihtout any Assistantship)	8	3	1	2	1	1
2	ARTIFICIAL INTELLIGENCE & DATA ENGINEERING	Institute Assistantship	3	1	0	1	1	0
		Self Financed (wihtout any Assistantship)	3	2	0	1	0	0
3	CENTRE FOR ENERGY AND ENVIRONMENT	Institute Assistantship	5	3	0	1	1	0
		Self Financed (wihtout any Assistantship)	4	2	0	1	1	0
4	CHEMICAL ENGINEERING	Institute Assistantship	19	8	2	5	3	1
		Self Financed (wihtout any Assistantship)	13	5	1	4	2	1
5	CHEMISTRY	Institute Assistantship	7	2	1	2	1	1
		Self Financed (wihtout any Assistantship)	0	0	0	0	0	0
6	CIVIL ENGINEERING	Institute Assistantship	21	8	2	6	3	2
		Self Financed (wihtout any Assistantship)	13	5	1	4	2	1
7	COMPUTER SCIENCE AND ENGINEERING	Institute Assistantship	20	8	2	5	3	2
		Self Financed (wihtout any Assistantship)	16	7	2	4	2	1
8	ELECTRICAL ENGINEERING	Institute Assistantship	18	7	2	5	3	1
		Self Financed (wihtout any Assistantship)	13	5	1	4	2	1
9	ELECTRONICS AND COMMUNICATION ENGINEERING	Institute Assistantship	21	9	2	6	3	1
		Self Financed (wihtout any Assistantship)	15	6	2	4	2	1
10	HUMANITIES AND SOCIAL SCIENCE	Institute Assistantship	1	1	0	0	0	0
		Self Financed (wihtout any Assistantship)	0	0	0	0	0	0
11	MANAGEMENT STUDIES	Institute Assistantship	9	4	1	2	1	1
		Self Financed (wihtout any Assistantship)	12	5	1	3	2	1
12	MATERIAL RESEARCH CENTER	Institute Assistantship	3	1	0	1	1	0
		Self Financed (wihtout any Assistantship)	2	2	0	0	0	0
13	MATHEMATICS	Institute Assistantship	8	3	1	2	1	1
		Self Financed (wihtout any Assistantship)	0	0	0	0	0	0



दैनन्दिनी
संख्या
MNIT
Diary
NO.

मालवीय राष्ट्रीय प्राध्यागका संस्थान जयपुर MALVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

पंजिका संख्या / File No.....

कार्यालय टिप्पणी Note Sheet

14	MECHANICAL ENGINEERING	Institute Assistantship	21	9	2	6	3	1
		Self Financed (wihtout any Assistantship)	16	6	2	4	3	1
15	METALLURGICAL AND MATERIALS ENGINEERING	Institute Assistantship	14	6	1	4	2	1
		Self Financed (wihtout any Assistantship)	9	4	1	2	1	1
16	NATIONAL CENTRE FOR DISASTER MITIGATION AND MANAGEMENT	Institute Assistantship	2	1	0	1	0	0
		Self Financed (wihtout any Assistantship)	0	0	0	0	0	0
17	PHYSICS	Institute Assistantship	8	3	1	2	1	1
		Self Financed (wihtout any Assistantship)	2	1	0	1	0	0
	Total :	Institute Assistantship	189	78	18	51	28	14
		Self Financed (wihtout any Assistantship)	126	53	12	34	18	9

Note :- The reservation of physically handicapped (PWD) is 5% overall.

3/N

There are 189 Institutional Assistantship and 126 Self-Financed seats in the Odd Semester 2026-27. The seat matrix after SC, ST, OBC and EWS reservation as per rules is shown above. The seat matrix is submitted for approval.

Admic
16/04/26
Dealing Assistant

Deepak S.

Admic
16/04/26

AR (PB)

Reman
16/04/2026

AD (RC)

Categorywise seat matrix is submitted for kind approval for Institute Assistantship seats and self financed seats.

Verma
16/4/26

Dean Academic

मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर
MALVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

पंजिका संख्या / File No.

कार्यालय टिप्पणी

Note Sheet

Category wise break up of Ph.D. seats
in various departments/centres is submitted
for approval for the forthcoming selection
process of odd semester 2026-27

Dhanraj
16/04/2026

Chairman, Senate.

2521
16/04/26

G. V. Rao
16/04/26

4134-L
16/04/26

DEAN (AA)

Dhanraj
16/04/2026

PhD (A conf.)

मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

14 जुलाई 2026 को आयोजित सीनेट स्नातकोत्तर बोर्ड (एसपीजीबी) की 76वीं बैठक के कार्यवृत्त MINUTES OF THE 76th MEETING OF THE SPGB HELD ON 14th JULY 2026

सीनेट स्नातकोत्तर बोर्ड (एसपीजीबी) की 76वीं बैठक 14 जुलाई 2026 को सांय: 03:00 बजे सभा कक्ष संख्या-3, प्रभा भवन, मा.रा.प्रौ.सं. जयपुर में आयोजित की गई थी।

The 76th meeting of the SPGB was held on 14th July 2026 at 03:00 PM in the meeting room no.3, Prabha Bhawan, MNIT Jaipur.

निम्नलिखित एजेंडा बिन्दुओं पर चर्चा की गई, और सिफारिशें इस प्रकार हैं:

The following agenda items were discussed, and the recommendations are as follows:

Item No. 76-1.0	To confirm the minutes of the 75th meeting of the SPGB held on 18.03.2026.		
	The minutes of the 75 th meeting of the SPGB held on 18.03.2026 were confirmed.		
Item No. 76-2.0	To note the "Action Taken" on the decisions taken in the 75th meeting of the SPGB.		
	The SPGB noted the action taken report on the decisions taken in the 75 th meeting.		
Item No. 76-3.0	Items for Consideration.		
Item No. 76-3.1	To consider the request of the former Ph.D. student Mr. Vikas Sangwan (ID: 2018RME9100) for grant of mercy for revival of his terminated Ph.D. registration.		
	S. No.	Name & ID	Recommendation & Justification of DPGC, if any
	1.	Mr. Vikas Sangwan (ID:2018RME9100)	The DPGC in its meeting dated 27-05-2026 recommended the following:- 1. Sympathetic consideration regarding grant of mercy attempt and revival of his Ph.D. registration. 2. Prof. Makkhan Lal Meena shall act as Main Supervisor 3. Dr. Surendra Singh Godara shall act as Co-supervisor. 4. Prof. Kuldeep Singh Sangwan, Department of Mechanical Engineering, BITS Pilani as the External Joint Supervisor.
			Recommendation & Justification of SPGB
			Since the student was enrolled in the Ph.D. program eight years ago, the SPGB, considering his severe and unavoidable family-related circumstances and the recommendations of the DPGC, recommended to the senate that Mr. Vikas Sangwan (ID: 2018RME9100) may be permitted to register afresh and complete the coursework requirements again. His eligibility for promotion to the subsequent semester shall be evaluated based on his academic performance after re-registration under the supervision of proposed supervisors.

Item No. 76-3.2	To consider the mercy requests of M.Sc. I semester students Ms. Madhu Saini (2025PPH5259) (CGPA-3.8) and Ms. Neelam Lora (2025PPH5294) (CGPA-2.0) against termination due to CGPA less than 5.5 in AY 2025-26.			
	S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
	1.	Ms. Madhu Saini (2025PPH5259) (CGPA-3.8)	The DPGC has recommended sympathetic consideration of her requests for the grant of a mercy attempt to continue/re-register in the program as per Institute norms.	The SPGB, considering their inadequate proficiency in the English language and the recommendations of the DPGC, recommended that Ms. Madhu Saini (ID: 2025PPH5259) and Ms. Neelam Lora (ID: 2025PPH5294) be permitted to re-register in the programme and repeat all the first-semester courses. Their eligibility for promotion to the subsequent semester shall be evaluated based on their academic performance after re-registration.
	2.	Ms. Neelam Lora (2025PPH5294) (CGPA-2.0)	The DPGC has recommended sympathetic consideration of her requests for the grant of a mercy attempt to continue/re-register in the program as per Institute norms.	
Item No. 76-3.3	To consider the mercy application of Ms. Ritu Ankodiya (2025PPD5360) for Continuation of M.Tech (Power Electronics and drives) programme.			
	S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
	1.	Ms Ritu Ankodiya (2025PPD5360)	The DPGC recommended that her mercy appeal be accepted and that she be permitted to continue her registration in the III Semester (Odd Semester 2026–27) as a special case.	The SPGB, considering her health issues, adverse family circumstances, and the recommendations of the DPGC, recommended that Ms. Ritu Ankodiya (ID: 2025PPD5360) be permitted to re-register in the programme and repeat all the first-semester courses. Her eligibility for promotion to the subsequent semester shall be evaluated based on her academic performance after re-registration.
Item No. 76-3.4	To consider the mercy application of Mr. Jayesh Singh Sagar (2023PES5426) for continuation of M.Tech. (Power Systems) programme.			
	S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
	1.	Mr. Jayesh Singh Sagar (2023PES5426)	The DPGC recommended that the matter to be forwarded to Academic Section for the necessary action.	The SPGB, after due deliberation, did not recommend the mercy application of Mr. Jayesh Singh Sagar (ID: 2023PES5426) to the Senate, as he had already been granted a one-time mercy opportunity for re-registration in the Odd Semester of the Academic Session 2024–25.
Item No. 76-3.5	To consider the inclusion of the "Decision Analytics (with Python)" (21BMT883) course, a PG Open Elective to be offered as Program Elective in Business Analytics specialization of MBA program.			
	The SPGB, after due deliberation, decided to revert back the proposal regarding inclusion of the "Decision Analytics (with Python)" (21BMT883) course, a PG Open Elective to be offered as Program Elective in Business Analytics specialization of MBA program for revision.			

Item No. 76-3.6	To consider the mercy application of Mr. Vishal Kumar Naveen (2024PPD5131) for Continuation in the M. Tech (Power Electronics and Drives) Programme.								
	<table><tr><th>S. No.</th><th>Name & ID</th><th>Recommendation & Justification of DPGC, if any</th><th>Recommendation & Justification of SPGB</th></tr><tr><td>1.</td><td>Mr. Vishal Kumar Naveen (2024PPD5131)</td><td>The DPGC recommended the mercy appeal of Mr. Vishal Kumar Naveen (2024PPD5131) be considered to allow him to continue in the M.Tech. programme.</td><td>The SPGB, after due deliberation, recommended to the Senate that the mercy appeal of the candidate be accepted and that the candidate be permitted to continue in the M.Tech. (Power Electronics and Drives) programme. The Committee noted that the candidate had successfully completed all the coursework requirements of the programme and that only the Seminar and Dissertation components remained. It was further observed that the candidate's CGPA had fallen below 5.50 solely due to the award of FP grades in the Seminar and Dissertation courses. In view of these circumstances, the SPGB recommended that the candidate be allowed to continue in the programme.</td></tr></table>	S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB	1.	Mr. Vishal Kumar Naveen (2024PPD5131)	The DPGC recommended the mercy appeal of Mr. Vishal Kumar Naveen (2024PPD5131) be considered to allow him to continue in the M.Tech. programme.	The SPGB, after due deliberation, recommended to the Senate that the mercy appeal of the candidate be accepted and that the candidate be permitted to continue in the M.Tech. (Power Electronics and Drives) programme. The Committee noted that the candidate had successfully completed all the coursework requirements of the programme and that only the Seminar and Dissertation components remained. It was further observed that the candidate's CGPA had fallen below 5.50 solely due to the award of FP grades in the Seminar and Dissertation courses. In view of these circumstances, the SPGB recommended that the candidate be allowed to continue in the programme.
S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB						
1.	Mr. Vishal Kumar Naveen (2024PPD5131)	The DPGC recommended the mercy appeal of Mr. Vishal Kumar Naveen (2024PPD5131) be considered to allow him to continue in the M.Tech. programme.	The SPGB, after due deliberation, recommended to the Senate that the mercy appeal of the candidate be accepted and that the candidate be permitted to continue in the M.Tech. (Power Electronics and Drives) programme. The Committee noted that the candidate had successfully completed all the coursework requirements of the programme and that only the Seminar and Dissertation components remained. It was further observed that the candidate's CGPA had fallen below 5.50 solely due to the award of FP grades in the Seminar and Dissertation courses. In view of these circumstances, the SPGB recommended that the candidate be allowed to continue in the programme.						
Item No. 76-3.7	To consider the revised curriculum and syllabus of the Program M.Tech. in Structural Engineering.								
	The SPGB, after due deliberation, directed the Department to clearly highlight the proposed changes in the curriculum and circulate the revised curriculum among all SPGB members for their comments. The SPGB further authorized the Chairman SPGB to recommend the revised curriculum to the Senate after incorporating the comments received from the members.								
Item No. 76-3.8	To consider the revised curriculum and syllabus of the M.Tech. Programme in Earthquake Engineering.								
	The SPGB, after due deliberation, directed the center to clearly highlight the proposed changes in the curriculum and circulate the revised curriculum among all SPGB members for their comments. The SPGB further authorized the Chairman SPGB to recommend the revised curriculum and syllabus to the Senate after incorporating the comments received from the members.								
Item No. 76-3.9	To consider the revised curriculum and syllabus of the M.Sc. (Physics).								
	The SPGB, after due deliberation, advised the Department to circulate the detailed syllabi of the Programme Elective courses, Open Elective courses, and all newly introduced courses among all faculty members for their review and comments.								
Item No. 76-3.10	To consider the revision of Ph.D. Admission Eligibility Criteria for the Centre for Energy and Environment (CEE).								
	The SPGB, after due deliberation, recommended revising the Ph.D. admission eligibility criteria by aligning the qualifying M.Sc. disciplines with the research areas of the Centre.								

Item No.
76-3.11

To consider the list of Ph.D. students proposed for termination from the Ph.D. program.

The SPGB, after due deliberation, recommended the termination of the following four students:

S. No.	Student Id	Student Name	Supervisor Name	Fees/ registration status	Remarks
1	2025REC9566	Sandesh Singh Shekhawat	Dr. Sarthak Singhal Prof. M.M. Sharma	1 st semester fees submitted in January 2026	CGPA below 07 (0) DPGC recommendation not required. Termination as per PG RR 14.7 (i) (Minimum Academic Performance for Semester Promotion in PhD Program)
2	2025RMA9073	Ajay Kumar	Dr. Om P. Suthar Dr. Manjinder Singh	1 st semester fees submitted in June 2025	CGPA below 7 (6.9), DPGC recommendation not required. Termination as per PG RR 14.7 (i) (Minimum Academic Performance for Semester Promotion in PhD Program)
3	2025RME9074	Pradhuman Chahar	Dr. Naresh Kumar Raghuvanshi Dr. Preeti Gulia	Last fees submitted in January 2026 for second semester	CGPA below 7 (4.4), DPGC recommendation not required. Termination as per PG RR 14.7 (i) (Minimum Academic Performance for Semester Promotion in PhD Program)
4	2024REE9502	Neeraj Verma	Dr. Dipti Saxena Dr. Surender Hans	Fees submitted till the 3rd Semester in January 2026	Failed the comprehensive examination twice. As per PG RR 14.3 (G-II,III). If the student fails to clear the comprehensive exam in two attempts, the student shall be deemed terminated from the program. (The information has already been received through the Supervisor and the DPGC convenor)

Item No.
76-3.12

To consider the proposal submitted by the Department of Electrical Engineering regarding the transfer/conversion of vacant seats between Full-Time (Sponsored) and Part-Time (Sponsored) categories for M.Tech. admissions (Academic Session 2026–27).

The SPGB, after due deliberation, recommended the proposal submitted by the Department of Electrical Engineering for the interconversion of vacant M.Tech. seats between the Full-Time (Sponsored) and Part-Time (Sponsored) categories.

Item No.
76-3.13

To consider the request of Ms. Ruchika Arora, Ph.D. Scholar (ID: 2026RHS9091), to carry forward of PhD coursework credits completed under her previous registration (ID:2025RHS9055).

Ms. Ruchika Arora was admitted to the Ph.D. programme in the Department of Humanities and Social Sciences (HSS), MNIT Jaipur, during the 2025 admission cycle under the supervision of Dr. Preeti Bhatt and was allotted Scholar ID 2025RHS9055.

Subsequently, on 9 April 2026, Dr. Preeti Bhatt forwarded the scholar's request for a change of research supervisor. Prof. Vibhuti Singh Shekhawat expressed his willingness to supervise the scholar as the sole supervisor. After due deliberation, the Departmental Postgraduate Committee (DPGC) recommended the change of supervision from Dr. Preeti Bhatt to Prof. Vibhuti Singh Shekhawat and forwarded the recommendation for further administrative consideration.

As per the Institute regulations, a change of Ph.D. supervisor is permissible only under exceptional circumstances. Subsequently, Ms. Ruchika Arora applied afresh for admission to the Ph.D. programme under the supervision of Prof. Vibhuti Singh Shekhawat during the Odd Semester 2026–27 admission cycle. She appeared before the Departmental Selection Committee (DSC), was selected through the prescribed admission process, accepted the fresh admission, withdrew her earlier Ph.D. registration (Scholar ID 2025RHS9055), and was allotted a new Scholar ID 2026RHS9091.

The scholar had registered her Ph.D. research in the area of “Gender” under her previous registration and continues to pursue research in the same area under the fresh registration. The coursework completed under the earlier registration is fully aligned with her current research programme.

Accordingly, following her fresh registration, Ms. Ruchika Arora requested that the Ph.D. coursework credits earned under her previous registration (Scholar ID 2025RHS9055) be carried forward to her current registration (Scholar ID 2026RHS9091). The Departmental Postgraduate Committee examined the request and strongly recommended the transfer of the coursework credits. The Committee observed that the coursework completed under the previous registration is fully aligned with the scholar's current research programme and that requiring her to repeat the same coursework would result in unnecessary duplication of academic effort and institutional resources. The Committee further noted that permitting the transfer of credits would ensure continuity of research and avoid unnecessary delay in the scholar's academic progress.

After detailed deliberation, the SPGB recommended to the Senate that the Ph.D. coursework credits earned by Ms. Ruchika Arora under her previous registration (Scholar ID 2025RHS9055) be considered towards the fulfilment of the coursework requirements under her current registration (Scholar ID 2026RHS9091), as she is continuing her research in the same research area and the coursework completed under her previous registration remains fully relevant to her present Ph.D. programme.

Item No. 76-4.0	Items for reporting
Item No. 76-4.1	To note the list of the Ph.D. students of change of supervisor. Noted.
Item No. 76-4.2	To note the list of Ph.D. students permitted for comprehensive exam extension. Noted.
Item No. 76-4.3	To note the list of MNIT Faculty permitted to supervise Ph.D. students of other institutes. Noted.
Item No. 76-4.4	To note the list of Ph.D. students converted from Full-time to Part-time. Noted.
Item No. 76-4.5	To note the list of Ph.D. students permitted for research work in other institutes. Noted.
Item No. 76-4.6	To note the list of the Ph.D. students permitted for Semester Withdrawal.

	Noted.	
Item No. 76-4.7	To note list of Ph.D. students whose supervisors (Internal/External) are added.	
	Noted.	
Item No. 76-4.8	To note the list of the Ph.D. students of change of supervisor.	
	Noted.	
Item No. 76-5.0	Table Agenda.	
Item No. 76-5.1	To consider the mercy request for extension of Ph.D. registration period beyond 7 years.	
	Name	Recommendation of DPGC
	Ms. Aruna Chouhan (2019REC9037)	The DPGC noted that the scholar has completed her research work, submitted her research paper to a journal, and is awaiting the publisher's decision. She has also completed the compilation of her thesis. Accordingly, the DPGC recommended forwarding her application for a six-month mercy extension, as recommended by the supervisors and the DREC, for further consideration.
	Mr. Rajkumar (2019REC9161)	The DPGC noted that the scholar has completed his research work, submitted his research paper to a journal, and is awaiting the publisher's decision. He has also completed the compilation of his thesis. Accordingly, the DPGC recommended forwarding his application for a six-month mercy extension, as recommended by the supervisors and the DREC, for further consideration.
	Mr. Subhash Chand Pal (2019RME9089)	The DPGC noted that the scholar has published one conference paper and has two SCI-indexed journal manuscripts under review. Considering the progress made in the research work, the DPGC strongly recommended that his request for a one-semester extension be considered favourably.
	Mr. Puneet Sharma (2019RME9163)	The DPGC noted that the scholar has published one conference paper and submitted one SCI-indexed journal paper, for which the revised manuscript has already been
		The SPGB, after due deliberation, noted that the scholar has completed her research work, submitted her research paper to a journal, and compiled her thesis. Accordingly, the SPGB recommended forwarding her application for a six-month mercy extension to the Senate for consideration, as recommended by the supervisors, the DREC, and the DPGC.
		The SPGB, after due deliberation, noted that the scholar has completed his research work, submitted his research paper to a journal, and compiled his thesis. Accordingly, the SPGB recommended forwarding his application for a six-month mercy extension to the Senate for consideration, as recommended by the supervisors, the DREC, and the DPGC.
		The SPGB, after due deliberation, considered the progress made by the scholar and recommended forwarding his request to the Senate for granting a one-semester mercy extension to enable him to complete the remaining requirements of his Ph.D. programme.
		The SPGB, after due deliberation, considered the substantial progress made by the scholar, the advanced stage of his research work, and the strong recommendation of the DPGC.

		submitted after the second round of review. Considering the substantial progress made, the advanced stage of the research work, and the likelihood of thesis submission within the requested period, the DPGC recommended granting a one-semester extension to enable him to complete the remaining requirements of his Ph.D. programme.	Accordingly, the SPGB recommended forwarding the mercy application of Mr. Puneet Sharma (2019RME9163) to the Senate with its recommendation for granting a one-semester mercy extension to complete the remaining requirements of his Ph.D. programme.
76-5.2	To consider the proposal for establishment of "Centre of Excellence in Intelligent and Sustainable Power Management" at MNIT Jaipur. The proposal was discussed briefly, and it was decided to circulate the proposal to all the SPGB members for their comments. SPGB constituted a committee of the following members: 1. Prof. Lava Bhargava – Convener 2. Prof. Amar Patnaik – Member The Committee shall examine the proposal along with the comments received from the SPGB members and submit its recommendations to the Chairperson, SPGB at the earliest. The SPGB further authorized the Chairperson, SPGB to recommend the proposal to the Senate after receiving the recommendations of the proposed committee.		

The meeting ended with a vote of thanks to the Chair.


 सभापति, सीनेट स्नातकोत्तर बोर्ड
 Chairperson SPGB


 सहअधिष्ठाता (स्नातकोत्तर)
 Associate Dean (PG)

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14.07.2026 को आयोजित 76वीं एसपीजीबी बैठक में निम्न सदस्यों ने भाग लिया:
The following members attended the 76th SPGB Meeting held on 14.07.2026:

S. No.	Name of Faculty	Designation
1.	Prof. Suja George	Chairperson, SPGB
2.	Prof. D. Boolchandani	Dean Academic
3.	Prof. Lava Bhargava	Chairperson, SUGB
4.	Dr. Yogesh Meena	Associate Dean, PG
5.	Dr. Ram Dayal	Associate Dean, UG
6.	Dr. Gireendra Kumar	Convener DPGC, Architecture and Planning
7.	Dr. Amartya Chowdhury	Convener DPGC, Centre For Energy and Environment
8.	Prof. Kailash Singh	Convener DPGC, Chemical Engineering
9.	Dr. Pradeep Kumar	Convener DPGC, Chemistry
10.	Dr. Rajesh Gupta	Convener DPGC, Civil Engineering
11.	Prof. Vijay Laxmi	Convener DPGC, Computer Science and Engineering
12.	Prof. Purna Jain	Representative, Convener DPGC, Electrical Engineering
13.	Dr. Ravi Kumar Maddila	Convener DPGC, Electronics and Communication Engineering
14.	Prof. Manju Singh	Convener DPGC, Humanities and Social Science
15.	Dr. Reeta Singh	Convener DPGC, Management Studies
16.	Dr. Nisha Verma	Convener DPGC, Material Research Center
17.	Prof. Amar Patnaik	Convener DPGC, Mechanical Engineering
18.	Dr. Swati Sharma	Convener DPGC, Metallurgical and Materials Engineering
19.	Prof. S. D. Bharti	Convener DPGC, National Centre For Disaster Mitigation and Management
20.	Dr. Debasish Sarkar	Convener DPGC, Physics
21.	Dr. Manoj Kumar	Head of Department, Physics

निम्न सदस्य बैठक में शामिल नहीं हो सके:

The following members could not attend the meeting:

1.	Prof. Dilip Sharma	Ex-Chairperson, SPGB
2.	Prof. R. K. Vyas	Nominee, Chairperson Senate
3.	Dr. Satyendra Singh Chouhan	Convener DPGC, Artificial Intelligence and Data Engineering
4.	Dr. Makkhan Lal Meena	Convener DPGC, Centre For Rural Development
5.	Dr. Om P. Suthar	Convener DPGC, Mathematics
6.	Manisha Prajapat (2022REC9501)	Student Nominee

मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

MINUTES OF THE 55th MEETING OF SUGB HELD ON 09 July 2026

55th Meeting of SUGB held on 09th July 2026 at 10:30 AM in the Meeting Room No. 3 (Old Senate Room), First Floor, Prabha Bhawan, MNIT Jaipur.

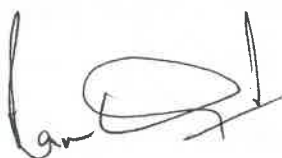
The following agenda items were discussed, and the recommendations are as follows:

Item No. 55-1.0	To confirm the minutes of the 54th meeting of SUGB. The minutes were confirmed.
Item No. 55-2.0	To note the "Action Taken" on the decisions taken in the 54th meeting of SUGB. Action taken on the decision made was noted.
Item No. 55-3.0	Items for Consideration.
Item No. 55-3.1	To consider the recommendations of the UG Curriculum Review Committee for approval by the Senate. The recommendations of the UG Curriculum Review Committee were discussed in detail. The SUGB deliberated upon the proposed curriculum revisions, implementation strategy, and the modalities for ensuring uniform adoption across all Departments. After detailed discussions, the SUGB appreciated the recommendations of the Committee and forwarded the same for consideration by the Senate. The SUGB advised all Departments to circulate the syllabus of all newly introduced and revised courses, wherever applicable, for comments and feedback as per the regulations.
Item No. 55-3.2	To consider the Syllabus of Data Science/Analytics/Visualization course proposed as Institute core in the revised UG Scheme. The Department of Chemical Engineering presented the syllabus of the proposed Institute Core course to be titled Data Analytics, and agreed to undertake the academic ownership of the course. The Board appreciated the initiative and suggested that the syllabus be circulated among all Departments for obtaining comments and feedback in accordance with the prescribed procedure before its implementation. The SUGB recommended the proposed syllabus of the Institute Core course on Data Analytics for consideration by the Senate after incorporation of feedback, if any.

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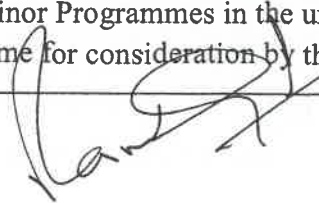

Item No. 55-3.3	To consider the Syllabus of Makers Lab course proposed in the revised UG Scheme. The Convener of the Makers Lab Committee presented the syllabus of the newly introduced Institute Core course Makers Lab. The SUGB appreciated the activity-based and interdisciplinary nature of the course and discussed various aspects of its implementation. The SUGB advised the Convener to circulate the proposed syllabus among all Departments for comments and feedback as per the Institute regulations before its final adoption. The SUGB recommended the proposed syllabus of the Makers Lab course for consideration by the Senate after due circulation and incorporation of suggestions, if any.
Item No. 55-3.4	To consider the New UG Schemes & Syllabus for UG programmes. The SUGB considered the undergraduate schemes submitted by various Departments, including the newly introduced programmes B.Tech. in Mathematics and Computing and B.Tech. in Engineering Physics. After detailed deliberations, the Board observed that the proposed schemes should be aligned with the revised Institute framework for the first-year curriculum. It was agreed that the undergraduate programmes be grouped as follows: • Modern Physics Group: Artificial Intelligence & Data Engineering, Computer Science & Engineering, Electronics & Communication Engineering, Electrical Engineering, and Mathematics and Computing. • Classical Physics Group: Civil Engineering, Chemical Engineering, Mechanical Engineering, Metallurgical & Materials Engineering, and Engineering Physics. The SUGB advised that the respective Departments consult the concerned stakeholders while finalizing the proposed PLEAS courses and their syllabi so as to maintain uniformity and academic coherence across the Institute. The SUGB recommended that all the newly proposed/revised syllabi for consideration by the Senate after due circulation and incorporation of suggestions, if any.
Item No. 55-3.5	To consider the recommendations for one credit industry connect course. The SUGB considered the proposal for introducing a one-credit Industry Connect Course to strengthen industry-academia interaction and provide students with exposure to contemporary industrial practices and emerging technologies. The proposed course shall be offered as a one-credit audit course by Departments/Centres through industry experts, entrepreneurs, alumni, or



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	professionals from reputed organisations. The SUGB deliberated on the approval mechanism and observed that, as the availability of industry experts may often arise at short notice, a simplified approval process is necessary to facilitate the timely offering of such courses. The SUGB also emphasized that Departments/Centres should, as far as possible, recommend such courses, preferably before the last date of the course add/drop window of the concerned semester. The SUGB recommended the policy for offering the Industry Connect Course. It was further recommended that, upon the recommendations of the concerned Department Faculty Board (DFB) and the SUGB, the proposal for offering such courses is recommended to Chairman Senate for approval.
Item No. 55-3.6	To consider the recommendations for provision of institute minor programs. The SUGB considered the recommendations of the Committee constituted pursuant to the decision of the 54th SUGB for developing a framework for Institutional Minor Programmes jointly offered by multiple Departments, Centres, and Virtual Centres. The SUGB agreed that such programmes would facilitate multidisciplinary learning by enabling students to pursue structured specializations in emerging areas requiring expertise from multiple academic units. After deliberations, the SUGB accepted the following recommendations: 1. Each Institutional Minor Programme shall consist of a basket of six courses jointly offered by participating Departments/Centres/Virtual Centres. 2. Each participating Department/Centre shall ordinarily contribute not more than two courses. 3. The basket of courses for each Institutional Minor Programme shall be notified at the end of the even semester along with the Minor courses offered by individual Departments. 4. Each participating Department/Centre/Virtual Centre shall include not more than one programme core course in the Institutional Minor basket. 5. Undergraduate students shall be eligible to register for Institutional Minor courses after completion of the first year. 6. A student shall complete at least four courses from Departments/Centres/Virtual Centres other than the parent Department to earn an Institutional Minor. 7. Students fulfilling the prescribed requirements shall be awarded the corresponding Institutional Minor specialization as per the prevailing regulations. The SUGB recommended the above framework for introducing Institutional Minor Programmes in the undergraduate curriculum and recommended the same for consideration by the Senate.



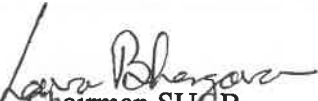
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Item No. 55-3.7	To consider the revision of the existing UG open elective courses of Economics (as approved in the Curriculum Development Workshop held on 13th March 2026). The SUGB advised the DUGC to circulate the revised syllabus among all faculty members for comments and feedback as per the Institute regulations before its final adoption.
Item No. 55-3.8	To consider a new proposed UG open elective course 'Behavioural Economics'. SUGB after reviewing the proposed elective course 'Behavioural Economics', recommended the course for consideration by the senate.
Item No. 55-3.9	To consider the request of Mr. Anmol Bhandari (2019UCH1562) for continuation of B.Tech. SUGB after detailed deliberation while considering that student has only one course of 3 credits remaining to fulfill the requirements for the award of B.Tech degree. Accordingly, SUGB recommended that the student may be allowed to register, as the mercy request had been approved by senate in August 2025 vide senate order No. 59-3.2, considering his absence in last last semester as gap semester and applicable regulations thereof.
Item No. 55-3.10	To consider the matter of Mr. Rahul (2018UCH1663) regarding termination after completing the maximum permissible duration. SUGB after deliberation recommended the termination of Mr. Rahul for consideration in the senate.
Item No. 55-3.11	To consider the mercy request of Mr. Ambuj Singh (ID: 2019UME1291) regarding withdrawal from previous (XIII) semester and registration in the upcoming semester. The SUGB after detailed deliberation and considering the recommendations of DUGC, recommended the Mercy request of Mr. Ambuj Singh to allow two semester withdrawals (beyond the permissible limit) and thus extension of two semesters to complete his B.Tech.
Item No. 55-3.12	To consider the matter of Mr. Harsh Meena (2022UMT1882) regarding promotion to the next semester/year. SUGB after detailed deliberation and observing hardly any improvement even after availing re-registration on Mercy grounds earlier, SUGB recommended termination of Mr. Harsh Meena for consideration in Senate.

Item No. 55-4.0	Item for Reporting
Item No. 55-4.1	To report the list of UG students (2022 batch) permitted for internship during the year 2026 (Academic Year 2025-26). Noted.

The meeting ended with a vote of thanks to the Chair.


Chairman SUGB


Associate Dean (UG)

The 55th SUGB meeting was attended by the following members:

S. No.	Name of Faculty	Designation
1.	Prof. Lava Bhargava	Chairman SUGB
2.	Prof. D. Boolchandani	Dean Academic
3.	Dr. Yogesh Meena	Associate Dean PG
4.	Dr. Ram Dayal	Associate Dean UG
5.	Dr. Niruti Gupta	Representative Convener DUGC, Department of Architecture and Planning
6.	Dr. Arya Prakash Padhi	Convener DUGC, Department of Artificial Intelligence and Data Engineering
7.	Dr. Subbaramaiah V.	Convener DUGC, Department of Chemical Engineering
8.	Dr. Manviri Rani	Convener DUGC, Department of Chemistry
9.	Dr. Neha Shrivastava	Convener DUGC, Department of Civil Engineering
10.	Dr. Dinesh Kumar Tyagi	Convener DUGC, Department of Computer Science and Engineering
11.	Dr. Vinay Pratap Singh	Convener DUGC, Department of Electrical Engineering
12.	Dr. Amit Mahesh Joshi	Convener DUGC, Department of Electronics and Communication Engineering
13.	Dr. Dipti Sharma	Convener DUGC, Department of Humanities and Social Science
14.	Dr. Shridev Devji	Representative Convener DUGC, Department of Management Studies
15.	Dr. Sanjay Bhatte	Convener DUGC, Department of Mathematics
16.	Dr. Gunjan Soni	Convener DUGC, Department of Mechanical Engineering
17.	Dr. Rajesh Kumar Rai	Convener DUGC, Department of Metallurgical and Materials Engineering
18.	Dr. Rajnish Dhiman	Convener DUGC, Department of Physics
19.	Dr. Kuldeep Singh	Associate Professor ECE Dept.

The following members couldn't attend the meeting:

S. No.	Name of Faculty	Designation
1.	Prof. Suja George	Chairman SPGB
2.	Prof. Rajeev Shringi	Ex-Chairman, SUGB
3.	Dr. Nivedita Kaul	Nominee Chairman Senate
4.	Dr. Sunanda Sinha	Convener DUGC, Department of Centre for Energy and Environment
5.	Dr. Vikas Sharma	Convener DUGC, Department of Materials Research Centre

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Items for reporting

Item No. 63-5.4: To note the minutes of the 52nd, 53rd, 54th and 55th meetings of the Academic Affairs Committee.

The minutes of the 52nd, 53rd, 54th and 55th meetings of Academic Affairs Committee (AAC) meetings held on 05-06-2026, 25-06-2026, 02-07-2026 and 13.07.2026, is placed for information to the Senate (**Annexure-H Page 111 to 117**).

Item is placed for information.

Item No. 63-5.5 To note the minutes of the meetings of the Unfair Means Committee.

The minutes of the meetings of the Unfair Means Committee held on 14th May 2026 are placed for information to the Senate (**Annexure-I, Page-118 to 123**).

Item is placed for information.

Table Agenda

Item No. 63-6.1 To consider the mercy application of Mr. Nimit Gupta (2022PCS5312), M.Tech. (Structural Engineering), Department of Civil Engineering, for permission to rejoin the M.Tech. programme in Part-Time mode.

A mercy request of Mr. Nimit Gupta (2022PCS5312) has been submitted by the Department of Civil Engineering seeking permission for him to rejoin the M.Tech. Programme in Part-Time mode.

Mr. Nimit Gupta was admitted to the M.Tech. Programme in Structural Engineering (Full-Time) during the Academic Session 2022–23. He successfully completed the coursework prescribed for the first two semesters, securing a CGPA of 8.44. Subsequently, after joining Hindustan Petroleum Corporation Limited (HPCL), he requested conversion of his programme from Full-Time to Part-Time mode. However, the request could not be processed at that time due to the non-submission of the requisite No Objection Certificate (NOC) from his employer.

The applicant has now submitted a fresh representation along with a No Objection Certificate issued by HPCL, requesting permission to rejoin the M.Tech. Programme in Part-Time mode and complete the remaining academic requirements.

The matter was considered by the DPGC in its meeting held on 20th July 2026 and was subsequently circulated online among the members of the SPGB for their consideration.

The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Mr. Nimit Gupta (2022PCS5312)	Considering the student's satisfactory academic performance during the first two semesters and the submission of the employer's NOC, the DPGC recommended the mercy application of Mr. Nimit Gupta (2022PCS5312).	The SPGB recommended the mercy request of Mr. Nimit Gupta to the Senate for consideration, in view of the student's satisfactory academic performance during the first two semesters and the recommendations of the DPGC.

Item is placed for consideration and approval.

Item No. 63-6.2 To consider the Credit Based Fee Policy for registration of backlog courses by Undergraduate Students Exceeding the Minimum Prescribed Duration of Degree Programmes.

The Board of Governors (BoG), MNIT Jaipur, at its 60th meeting held on 09-04-2026, under Agenda Item No. 60-5.15, considered the credit-based fee system for students who have exceeded the minimum prescribed duration of their respective degree programmes.

The Board considered the proposal of the credit based fee for students who have exceeded the minimum prescribed duration of their degree at ₹4,000 per credit, while Institute and other common fee shall be charged as per existing norms.

The Board further resolved that detailed operational guidelines for implementation be framed by the Academic Section and place before the Senate.

In this regard, the existing and proposed fee provisions are placed below:

Existing Applicable Fee

For undergraduate students registering in the IX semester (XI semester in case of B.Arch.) and beyond, i.e., after completion of the regular VIII semester (X semester for B.Arch.), the same fee structure as applicable during the regular semesters is presently charged. No concession in tuition fee is provided for such extended-semester registrations, irrespective of the number of credits registered by the student.

Proposed Fee

It is proposed that, with effect from the Academic Session 2026–27, the following fee structure be adopted for undergraduate students registering in extended semesters:

The undergraduate students registering in the IX semester (XI semester in case of B.Arch.) and beyond, shall be charged tuition fee on a credit basis, while the Institute Fee and other common fees shall continue to be charged as per the applicable fee structure.

Semester	Institute Fee	Proposed Tuition Fee for Backlog Courses
IX semester (XI semester of B.Arch.) and beyond	As per the applicable Institute Fee structure	₹4,000 × Number of registered credits

To maintain parity with the regular semester fee structure, it is proposed that:

- For students registering for up to 15 credits, the tuition fee shall be calculated on a credit basis at the rate of ₹4,000 per credit.
- For students registering for more than 15 credits, the tuition fee payable shall be the same as the tuition fee applicable during a regular semester, with no concession.

For undergraduate students admitted through JoSAA/CSAB centralized counselling under the General, OBC, and EWS categories, with annual family income above ₹5 lakh, the tuition fee shall be charged as per the credit-based structure proposed above.

For undergraduate students admitted through JoSAA/CSAB centralized counselling under the General, OBC, and EWS categories, with annual family income between ₹1 lakh and ₹5 lakh, availing the benefits of Fee Remission, it is proposed that:

- For registration of up to 5 credits, tuition fee shall be calculated on a credit basis at the rate prescribed above.
- For registration of more than 5 credits, the tuition fee payable shall be the same as that applicable during a regular semester, with no concession.

Any student registering for any graded course for first time even beyond minimum prescribed program duration, the provisions under this policy are not applicable.

The proposed tuition fee structure shall not apply to undergraduate students admitted through JoSAA/CSAB under the following categories, as they are already exempted from payment of tuition fee under the existing rules:

- Scheduled Caste (SC)
- Scheduled Tribe (ST)
- Persons with Disabilities (PwD)
- Students belonging to the family income category of up to ₹1 lakh per annum, availing the benefits of Fee Remission

The proposed tuition fee structure shall also not apply to undergraduate students admitted under special admission categories such as:

- DASA
- ICCR
- MEA
- Study in India
- Any other similar admission category

The proposed fee structure is intended to align the tuition fee liability of students in extended semesters with their actual academic registration load, while ensuring recovery of institutional and common service charges as per existing norms.

As per the Gazette Notification Statutes dated 23 April 2009, Statute No. 37 (Fees), Sub-clause (i) provides that the tuition fee shall be determined by the NIT Council and shall be uniform across all National Institutes of Technology (NITs), which is presently Rs.62500/- per semester. Further, if any changes made by NIT Council w.r.t. Tuition Fee then this proposed policy i.e. Rs.4000/- per credit for backlog courses, shall proportionality may be changed in future.

Submitted for consideration and approval of above fee policy and authorization for implementation from the academic year 2026-27.

Item No. 63-6.3 To consider the mercy application of Mr. Utkarsh Yadav (2024PCP5307), M.Tech. (Computer Science and Engineering), Department of Computer Science and Engineering, for continuation of M. Tech. programme and conversion from Full Time to Part-Time.

Mr. Utkarsh Yadav was admitted to the M.Tech. (Computer Science & Engineering) programme as a Full-Time student in the Academic Session 2024–25. He successfully completed all the prescribed coursework requirements during the first two semesters of the programme. After completion of the first two semesters, Mr. Utkarsh Yadav joined the Cabinet Secretariat on 24 May 2025. He subsequently obtained the required No Objection Certificate (NoC) from his employer on 5 August 2025 for pursuing the M.Tech. programme as a Part-Time student.

Due to his joining service, Mr. Utkarsh Yadav could not register for the third and fourth semesters of the programme. He has now submitted a mercy application requesting permission to continue his M.Tech. programme along with a request for conversion of his registration status from Full-Time to Part-Time in the prescribed format. The NoC issued by his employer and other relevant documents are enclosed for consideration.

The matter was considered by the DPGC and was subsequently circulated online among the members of the SPGB for their consideration.

The recommendations of the DPGC and the SPGB are as follows:

S. No.	Name & ID	Recommendation & Justification of DPGC, if any	Recommendation & Justification of SPGB
1.	Mr. Utkarsh Yadav (2024PCP5307)	The DPGC considered the mercy application of Mr Utkarsh Yadav and his request for conversion from full-time to part-time. The DPGC recommended that, since Mr. Utkarsh Yadav has successfully completed all the coursework during the first two semesters of the M.Tech. (Computer Science and Engineering) programme, his mercy application may be favourably considered. He may be permitted to continue the programme as a Part-Time student from the current semester.	The SPGB recommended that Mr. Utkarsh Yadav has successfully completed all the coursework during the first two semesters of the M.Tech. (Computer Science and Engineering) programme, his mercy application may be favourably considered. He may be permitted to continue the programme as a Part-Time student from the current semester, subject to the Institute rules.

Item is placed for consideration and approval.

Mathematics – I

COURSE OBJECTIVE(s)

This course aims to familiarize and equip the students with fundamental knowledge of Calculus. The learned knowledge would enable the students to tackle standard engineering problems.

COURSE OUTCOMES

CO1	Learn the concepts related to differential calculus of functions of several variables and analyze multivariable functions to evaluate partial derivatives, approximate local errors.
CO2	Learn the concept and methods of evaluating multiple integrals and their applications to various problems
CO3	Understand vector fields and apply differential and integral vector theorems to solve real-world physical and engineering problems

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S.No.	Component	Weightage
(a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
(b)	Mid-term examination	30%
(c)	End Semester Examination	50%

Mathematics-I					
Prerequisite: None		L	T	P	C
Total hours: 28		2	1	0	3
Course Content					Hrs.
Unit 1	Differential Calculus: Review of calculus of one variable and ϵ - δ definition, functions of several variables, Limit, Continuity, Partial derivatives, Euler's theorem on homogeneous functions, Chain rule, Jacobians, Taylor's theorem for two variables (Statement only), Error approximations.				10
Unit 2	Integral Calculus: Double and Triple integrals, Change of order of integration. Change of variables. Improper Integrals(Gamma and Beta functions).				8
Unit 3	Vector Calculus: Differentiation of vectors, gradient, directional derivative, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl, Line and surface integrals, Green's, Gauss and Stokes' theorem (Statement only) and their applications				10

Text Books	
1.	Kreyszig E., Advanced Engineering Mathematics, 10th Edition, Wiley, 2011.
2.	Hass J., Heil C. and Weir M. D., Thomas' Calculus, 14th Edition, Pearson Education, 2018.
Reference books	
1.	Jain R. K. and Iyengar S. R. K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House, 2016.
2.	Zill D. G. and Wright W. S., Advanced Engineering Mathematics, 4th Edition, Viva, 2011.
3.	O'Neil P. V., Advanced Engineering Mathematics, 8th Edition, Cengage Learning, 2017.
4.	Grewal B.S., Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2021.

Mathematics II

COURSE OBJECTIVE(s)

This course aims to familiarize and equip the students with fundamental knowledge of Matrix, Differential Equations, Laplace Transforms and Fourier Series. The learned knowledge would enable the students to tackle standard engineering problems.

COURSE OUTCOMES

CO1	Develop skills in solving systems of linear equations and diagonalization techniques to engineering problems.
CO2	Gain proficiency in analyzing and solving various first- and higher-order ordinary differential equations and systems of ODEs.
CO3	Master the various concepts of Laplace Transform and their applications to differential equations.
CO4	Learn the various concepts of Fourier Series and Fourier analysis to represent periodic functions.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S.No.	Component	Weightage
(a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
(b)	Mid-term examination	30%
(c)	End Semester Examination	50%

Mathematics-II					
Prerequisite: None		L	T	P	C
Total hours: 28		2	1	0	3
Course Content					Hrs.
Unit 1	Matrix Algebra: Row echelon form, Rank of a matrix, Solution of linear simultaneous equations, Eigenvalues and Eigenvectors of a matrix, Cayley- Hamilton theorem (Statement only), Diagonalization of a matrix.				8
Unit 2	Ordinary Differential Equations: Exact differential equations, Solution of second and higher order linear differential equations with constant coefficients using operator method, Cauchy-Euler equations. Reduction of order, Method of variation of parameters, Matrix method for system of linear differential equations.				8
Unit 3	Fourier Series: Fourier series and its convergence, Fourier series of even and odd functions, Fourier half-range series.				4
Unit 4	Laplace Transform: Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of				8

	derivatives and integrals, Convolution theorem, Heaviside unit step function and Dirac delta function, Applications of Laplace transform.	
Text Books		
1.	Kreyszig E., Advanced Engineering Mathematics, 10th Edition, Wiley, 2011.	
2.	Zill D. G. and Wright W. S., Advanced Engineering Mathematics, 4th Edition, Viva, 2011.	
Reference books		
1.	Jain R. K. and Iyengar S. R. K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House, 2016.	
2.	Strang G., Linear Algebra and its Applications, 4 th edition, Cengage Learning, 2006.	
3.	O'Neil P. V., Advanced Engineering Mathematics, 8th Edition, Cengage Learning, 2017.	
4.	Grewal B.S., Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2021.	

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Scheme/Specialization: B.Tech. (I Year)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
26xxxx	Makers lab	6	0	3	6	0

PREREQUISITE

NIL

COURSE OBJECTIVE(s)

To equip students with hands-on skills in mechanical, electrical, electronics, digital fabrication, and embedded systems through project-based learning. The course enables students to integrate multidisciplinary engineering concepts to design, build, and test functional engineering prototypes while fostering creativity, problem-solving, and teamwork.

COURSE OUTCOMES:

CO1	Understand the fundamental concepts of engineering drawing, fabrication, electronic components, and embedded programming.
CO2	Design, fabricate, and assemble components of standard engineering mechanisms by integrating multidisciplinary engineering concepts and tools.
CO3	Analyze, troubleshoot, and optimize engineering systems through systematic testing, and iterative prototyping.
CO4	Demonstrate the practical application of multidisciplinary engineering knowledge through a functional engineering prototype.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage (%)
a)	PRS (Practical Sessional)	50
b)	PRM (Practical Mid-term)	20
c)	PRE (Practical End-term)	30

COURSE CONTENTS

Mechanical Engineering Module

Engineering drawing and CAD-based modelling of engineering components; preparation of orthographic drawings with dimensioning and scaling; precision measurement and marking using vernier caliper, micrometer, height gauge, depth micrometer, center/ dot punching, scribe, soap-stone, dividers; fabrication of engineering components using conventional workshop tools, FDM 3D printing, and laser cutting; design, fabrication, and assembly of mechanical parts and standard mechanisms following design-for-manufacturing and design-for-assembly principles; robot chassis fabrication, wheel coupling, shaft alignment, and mechanical integration of engineering subsystems.

Electrical Engineering Module

Measurement of electrical parameters using digital multimeters and bench power supplies, circuit prototyping using breadboard, switches, and connectors; construction and testing of circuits using diodes, LEDs, Zener diodes, BJTs, rectifiers, voltage dividers, and operational amplifiers, assembly and testing of transformer-based rectifier, power supplies, voltage regulators, and transistor switching circuits; interfacing and control of DC, BLDC, servo, and stepper motors using motor drivers and; implementation of Astable and monostable circuits using the 555 timer; PID-based motor control, electrical measurements, circuit debugging, fault isolation, testing, and troubleshooting of electrical systems.

Electronics Engineering Module

Generation and analysis of electrical test signals using function generator and digital storage oscilloscope; identification and testing of electronic components using datasheets; Arduino Nano; development of embedded applications using Arduino IDE, including LED blinking, motor control, and speed control, interfacing of ESP32 microcontrollers with sensors and peripheral devices using I²C and SPI communication protocols; PCB schematic design, PCB layout and routing, firmware development, sensor interfacing, wiring and electronic system integration, testing, reliability assessment, and validation of electronic subsystems for functional prototype development.

TEXT BOOKS/ REFERENCE BOOKS :-

1. Millman, J., & Halkias, C. C. **Integrated Electronics: Analog and Digital Circuits and Systems**. Tata McGraw-Hill Education, Latest Edition.
2. Boylestad, R. L., & Nashelsky, L. **Electronic Devices and Circuit Theory**. Pearson Education, Latest Edition.
3. Van Valkenburg, M. E. **Network Analysis** (3rd ed.). Prentice Hall of India, 1974.
4. Nise, N. S. **Control Systems Engineering** (8th ed.). John Wiley & Sons, 2019.

5. Mazidi, M. A., Mazidi, J. G., & McKinlay, R. D. **The 8051 Microcontroller and Embedded Systems: Using Assembly and C** (2nd ed.). Pearson Education, Latest Edition.
6. Bahga, A., & Madiseti, V. K. **Internet of Things: A Hands-on Approach**. Universities Press, 2014.
7. Hajra Choudhury, S. K., Hajra Choudhury, A. K., & Roy, N. **The Elements of Workshop Technology, Volumes I & II**. Media Promoters and Publishers Pvt. Ltd., Latest Edition.
8. Awari, G. K., Thorat, C. S., Ambade, V., & Kothari, D. P. **Additive Manufacturing and 3D Printing Technology: Principles and Applications**. CRC Press, 2021.

Syllabus of Introduction to Data Science

1. Subject Code: (To be assigned), **Subject Title:** Introduction to Data Science

2. Contact Hours: L-T-P: 2-0-0

3. Credits: 2, **Semester:** I / II

4. Pre-requisite: None

5. Course Objectives: Upon successful completion of the course, students will be able to:

- i. Understand the importance of statistics in engineering and data science.
- ii. Organize, summarize, and visualize engineering data.
- iii. Apply probability concepts for uncertainty analysis.
- iv. Interpret probability distributions commonly encountered in engineering.
- v. Perform elementary statistical inference.
- vi. Use statistical tools for data-driven decision making.

Course Outcomes (COs): Upon completion of this course, students will be able to:

CO1: Summarize and visualize engineering datasets using descriptive statistics.

CO2: Apply probability concepts to analyze uncertain engineering systems.

CO3: Perform basic statistical inference including confidence intervals and hypothesis testing.

CO4: Apply tools in Python/R/Excel for data analysis.

Details of course:

Unit No.	Contents	Contact Hours
1	Introduction to Statistics and Data: Statistics in engineering and data science, Types of data, Population and sample, Variables and measurement scales, Data collection methods, Sampling techniques, Sources of bias, Data quality. Dataframe in Python/R.	7
2	Descriptive Statistics and Data Visualization: Frequency distributions, Scatter plot, Histograms, Bar charts, Pie charts, Box plots, Stem-and-leaf plots. Measures of central tendency: mean, median, Mode. Measures of dispersion: Range, Variance, Standard deviation, Interquartile range, Outlier detection. Application in Python/R.	7

3	Probability Fundamentals: Random experiments, Events, Sample space, Probability axioms, Conditional probability, Bayes' theorem, Independence, Random variables, Expectation, Variance, Discrete and continuous random variables. Probability Distribution: Binomial distribution, Poisson distribution, Normal distribution, Central Limit Theorem. Use cases in Python/R/Excel.	7
4	Statistical Inference and Applications: Sampling distribution, Confidence interval, Hypothesis testing, p-value, Errors in hypothesis testing. Case studies such as air quality parameters, detection of defective products, energy consumption in buildings, climate data analysis, healthcare data analysis, etc.)	7
	Total Contact hours	28

Books:

1. Montgomery, D.C., Runger, G.C., Hubele, N.F., Engineering Statistics, 5th edition, Wiley, 2011.
2. Navidi, W., Statistics for Engineers and Scientists, 6th edition, McGraw Hill, 2024.
3. Bruce, P., Bruce, A., Gedeck, P., Practical Statistics for Data Scientists, 2nd edition, O'Reilly, 2020.

DEPARTMENT OF CIVIL ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
Scheme/Specialization: B.Tech. (All Engineering Branches)

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
26CEXX X	Environmental Science	1	1	0	0	0

PREREQUISITE

None

COURSE OBJECTIVE

To introduce engineering students to modern environmental challenges and sustainable technological solutions through environmental monitoring, data-driven decision making, artificial intelligence, renewable technologies, and circular economy concepts for sustainable development.

COURSE OUTCOMES

CO1	Explain emerging environmental challenges and sustainable development principles from an engineering perspective.
CO2	Interpret environmental quality indicators using modern monitoring technologies, environmental data, and sustainability metrics.
CO3	Evaluate engineering solutions for environmental protection, resource efficiency, climate resilience, and circular economy.
CO4	Apply digital technologies including IoT, GIS, Artificial Intelligence and data analytics for solving environmental problems.

COURSE ASSESSMENT

Course Assessment (culminating to the final grade), will be made up of the following:

S. No.	Component	Weightage
a)	Assignments / Scrap Book / Activities	40%
b)	End Semester Examination	60%

COURSE CONTENTS

Module 1: Environmental Challenges (No. of Lectures – 3)

Current environmental issues, Selected National and International Environmental Case Studies

Module 2: Environmental Monitoring (No. of Lectures – 4)

Air pollution and Air Quality Index (AQI), Indoor Environmental Quality, Environmental Sensors, CPCB Continuous Monitoring Systems: Air, water and soil, Climate change and its impacts.

Module 3: Engineering Solutions for Sustainable Development (No. of Lectures – 6)

Sustainable Development Goals (SDGs), Introduction to Environmental Impact Assessment (EIA), Sustainable Buildings, Renewable Energy Technologies, Electric Vehicles and Sustainable Transportation, Water Reuse and Rainwater Harvesting, Waste Management including Plastic Waste and E-waste Management, Circular Resource Recovery, Introduction to Net Zero and Carbon Neutrality, India's LiFE Mission.

TEXT BOOKS/ REFERENCE BOOKS (Authors, Title, Publisher)

1. Bala Krishnamoorthy, "Environmental Management" PHI Pvt. Ltd., 2005
2. R. Rowe and H. S. Peavy, "Environmental Engineering", McGraw Hill Education, 2017.
3. R. Rajagopalan, "Environmental Studies", Oxford university press, 2015.
4. Standards and Manuals of Central Pollution Control Board. WHO, USEPA reading materials.
5. Municipal Solid Waste Management Manual, Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, 2024
6. Daniel Vallero, Environmental Engineering, CRC Press, Latest Edition.
7. G. Tyler Miller & Scott Spoolman, Environmental Science, Cengage Learning, Latest Edition.
8. IPCC Sixth Assessment Report (Selected Chapters).
9. National Clean Air Programme (NCAP), Ministry of Environment, Forest and Climate Change.
10. UNEP Global Environment Outlook Reports.
12. NITI Aayog Sustainable Development Goals India Index.

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Scheme/Specialization: B.Tech. (I / II Semester)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
—	Soft Skills: Foundational Lab	1	0	0	2	0

PREREQUISITE

None

COURSE TYPE

Core Course

COURSE OBJECTIVE

The course aims to foster soft skills and communication in professional and interpersonal communications and facilitate an all-round development of personality. It also envisions to expose students to right attitudinal and behavioural aspects and to build the same through activities.

COURSE OUTCOMES

CO1	Demonstrate knowledge of personal beliefs and values and a commitment to continuing personal reflection and reassessment.
CO2	Develop self-esteem and self-confidence to effectively manage personal and professional relationships.
CO3	Gain a functional understanding of basic English grammar and eliminate errors in language usage.
CO4	Be a better communicator in written and spoken form of communication.

COURSE ASSESSMENT

Course Assessment (culminating to the final grade), will be made up of the following:

S. No.	Component	Weightage
a)	Continuous Assessment (Participation, involvement in activities)	30%
b)	Mid-term Examination	30%
c)	End Semester Examination	40%

COURSE CONTENTS

Module I

Self-awareness and SWOT analysis, Social Awareness, Developing Self-Esteem and Building Self-Confidence

Activities: Self-introduction, SWOT analysis, Group discussion, Extempore, Role Plays, Picture Perception

Assessment: Through Viva-voce/ Group Discussion/ Role Play/Extempore

Module II

Seven Elements of Effective communication, Verbal and Non-Verbal Communication, English Language Skills: Vocabulary Building, Reading Comprehension, Usage of Tense, Subject-Verb Agreement, Passive Voice, Conditionals, Common Errors

Activities: Practice on Language Lab Software, Worksheets on Grammar

Assessment: End-Term Examination (Oral and Written)

TEXT BOOKS/ REFERENCE BOOKS

1. Language Lab Software: Study Skills Success, Clarity English Success, Active Reading, and Tense Buster.
2. Green, David. *Contemporary English Grammar –Structures and Composition*. MacMillan India. 2014.
3. Stephen R. Covey, *The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change*.
4. Carol S. Dweck “Mindset: The New Psychology of Success”.
5. Kerry Patterson, Joseph Grenny, Ron McMillan, and Al Switzler, *Crucial Conversations: Tools for Talking When Stakes Are High*.
6. Dorch, Patricia. *What Are Soft Skills?* New York: Executive Dress Publisher, 2013.
7. Kamin, Maxine. *Soft Skills Revolution: A Guide for Connecting with Compassion for Trainers, Teams, and Leaders*. Washington, DC: Pfeiffer & Company, 2013.
8. Klaus, Peggy, Jane Rohman & Molly Hamaker. *The Hard Truth about Soft Skills*. London: HarperCollins E-books, 2008.
9. Petes S. J., Francis. *Soft Skills and Professional Communication*. New Delhi: Tata McGraw-Hill Education, 2011.
10. Gopalaswamy, Ramesh. *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success*. India: Pearson Publication ,2010.

DEPARTMENT OF HUMANITIES AND SOCIAL SCIENCES
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Scheme/Specialization: B.Tech. (III / IV Semester)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
—	Soft Skills: Advanced Lab	1	0	0	2	0

PREREQUISITE

Soft Skills: Foundational Training Course

COURSE TYPE

Core Course

COURSE OBJECTIVE

The course aims to enhance soft skills and communication in professional and interpersonal communications and facilitate an all-round development of personality. It also envisions to foster better employability skills of the students.

COURSE OUTCOMES

CO1	Apply time management techniques to prioritize and complete tasks efficiently and effectively.
CO2	Make an effective presentation and perform well in teams.
CO3	Demonstrate leadership and teamwork skills by effectively communicating, collaborating, and resolving conflicts in group settings.
CO4	Create a personal brand and perform effectively in Personal Interviews.

COURSE ASSESSMENT

Course Assessment (culminating to the final grade), will be made up of the following:

S. No.	Component	Weightage
a)	Continuous Assessment (Participation, involvement in activities)	30%
b)	Mid-term Examination	30%
c)	End Semester Examination	40%

COURSE CONTENTS

Module I

SWOT Review, Soft Skills: Time Management, Team Building and Leadership, Presentation skills on Language Lab software

Activities: Team Building, Time management, Practice on software

Assessment: Presentation of Team project

Module II

Employability Skills: Personality Grooming, Goal Setting, Drafting Cover letter and Resume using Language Lab software, Creating a personal brand online/LinkedIn, E-mail Etiquette, Elevator Pitch, Interview Skills

Activities: Elevator Pitch and Mock Interviews

Assessment: End-Term Examination (Oral and Written)

TEXT BOOKS/ REFERENCE BOOKS

1. Language Lab Software: Business Writing, It's Your Job, Study Skills Success
2. Cuddy, Amy. *Presence: Bringing Your Boldest Self to Your Biggest Challenges*. United States: Back Bay Books ,2018.
3. Tulgan, Bruce. *Bridging the Soft Skills Gap: How to Teach the Missing Basics to Today's Young Talent*, United States: Jossey Bass, 2018.
4. Willett, Alan. *Leading the Unleadable: How to Manage Mavericks, Cynics, Divas, and Other Difficult People*. United States: Amacom Publisher ,2016.
5. Higgins, Jessica. *10 Skills for Effective Business Communication: Practical Strategies from the World's Greatest Leaders*. United States: Tycho Press,2018.
6. Wentz, Frederick H. *Soft Skills Training: A Workbook to Develop Skills for Employment*. United States: Create Space Independent Publisher ,2012.
7. Mitra, Barun. *Personality Development and Soft Skills*. India: Oxford University Press ,2016.
8. Norman Vincent Peale, *The Power of Positive Thinking*.
9. Olivia Fox Cabane, *The Charisma Myth: How Anyone Can Master the Art and Science of Personal Magnetism*.
10. Andrew Leigh & Michael Maynard: *The Perfect Presentation*, Random House.

Human Values and Professional Ethics

Course Credit: 1 (1-0-0)

Core Course

Course Coordinator: Dr Preeti Bhatt, Department of Humanities and Social Sciences

Course Objectives:

- To introduce fundamental human values and their significance in professional conduct.
- To explore the concept of professional ethics and its application in real-world scenarios.
- To understand the role of traditional knowledge systems in ethical decision-making.
- To navigate emerging ethical challenges posed by new technologies & AI.
- To develop critical thinking and problem-solving skills in ethical dilemmas.

Learning Outcomes:

At the end of this course, the students should be able to:

- articulate the importance of human values and professional conduct
- identify and analyze ethical issues in professional decisions
- appreciate the contributions of traditional knowledge systems to professional practices
- critically evaluate the ethical implications of emerging technologies

Assessment:

Class participation and presentations : 30%

Mid-term exam : 30%

Final exam : 40%

Course Contents:

Unit 1: Human Values & Professional Ethics	
1	Introduction to Human Values and Professional Ethics
2	Harnessing Traditional Knowledge with a Focus on Indian Knowledge Systems (IKS)
3	Spirituality, Values and Professional Ethics
Unit 2: Social Responsibility	
4	Social Welfare, Responsibility and Professional Decision-making
5	Ethical Dilemmas: Types and Resolution Frameworks
Unit 3: Ethics in Research & Communication	
6	Research Ethics
7	Ethics & Integrity in Communication & Publications
Unit 4: Ethics and New Age Technology	
8	Ethical Use of New Age Technology
9	Professional Conduct and Responsible Use of Technology and AI
Unit 5: Ethics and Environment	
10	Environmental Ethics & Practices
11	Tools and Frameworks for Sustainable Development
Unit 6: Ethics & Human Interactions	
12	Navigating Ethical Interactions, Group Dynamics & Competing Interests
13	Issues related to Diversity, Equity, and Inclusion
14	Reporting Professional Misconduct & Whistleblowing

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Recommended Readings

- A.C. Bhaktivedanta Swami., The Science of Self-realization. The Bhaktivedanta Book Trust International, Inc., P.O. Box 1437, Alachua, FL 32616, USA; Bhaktivedanta Book Trust, Hare Krishna Land, Juhu, Mumbai.
- Andrew Light & Holmes Rolston III, Environmental Ethics, (Wiley Blackwell, 2002)
- Clancy, R. F., & Zhu, Q. (2021). Global Engineering Ethics: What? Why? How? And When? *ASEE Annual Conference and Exposition*. available at <https://peer.asee.org/3722>
- D. K. Chaturvedi, Professional Ethics Values and Consciousness, Ane Books Pvt. Ltd., 2023.
- Dale Jamieson, Ethics and the Environment, (Cambridge, 2008)
- Davis, M. (1991). Thinking like an engineer: The place of a code of ethics in the practice of a profession, *Philosophy & Public Affairs*, 20(2), 150-167 available at <https://www.jstor.org/stable/2265293>
- Edmund G Seebauer and Robert L Berry, "Fundamental of Ethics for Scientists and Engineers", Oxford University Press, 2001.
- Elegbe, J. A. (2015). Emotional intelligence: Missing priority in engineering programs. *Journal of Business Studies Quarterly*, 7(2), 196-207. available at: <https://www.proquest.com/docview/1755024715?pq-origsite=gscholar&fromopenview=true&sourcetype=Scholarly%20Journals>
- Fernández Aller, C., & Miñano Rubio, R. (2015). Social & ethical issues in engineering. (Case Study) available at: https://upcommons.upc.edu/bitstream/handle/2117/89178/CS_21.pdf
- Goleman, D. (2020). *Emotional intelligence: Why it can matter more than IQ* (25th Anniversary Ed.). Bloomsbury
- Govindarajan M, Natarajan S, Senthil Kumar V. S, Engineering Ethics, Prentice Hall of India, New Delhi, 2004.
- Harris, C. E. (2008). The good engineer: Giving virtue its due in engineering ethics. *Science and Engineering Ethics*, 14, 153-164. available at: https://scholar.google.com/scholar?output=instlink&q=info:pjPxiVrHTEJ:scholar.google.com/&hl=en&as_sdt=0.5&scillfp=15712639047527848662&oi=lle
- Harris, Charles E. (2018). *Engineering ethics: Concepts and cases*. Cengage
- Hughes, Claretha (2016). *Diversity intelligence: Integrating diversity intelligence alongside intellectual, emotional and cultural intelligence for leadership and career development*. Palgrave Macmillan
- Louis P. Pojman. "The moral life: An introductory reader in ethics and literature". New York, Oxford University Press, 2017.
- Marebane, S., Hans, R., & Kgaphola, P. (2023, September). Mapping of Studies on Ethical Responsibilities of Software Engineers. In *2023 IEEE AFRICON* (pp. 1-6). IEEE. available at: <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10293734>
- Mike W. Martin and Roland Schinzinger, Ethics in Engineering, Tata McGraw Hill, New Delhi, 2003.
- Pojman & Pojman, Environmental Ethics, 5th Edition (Thomson-Wadsworth, 2008)
- Prem, E. (2023). From ethical AI frameworks to tools: a review of approaches. *AI and Ethics*, 3(3), 699-716. available at: <https://link.springer.com/content/pdf/10.1007/s43681-023-00258-9.pdf>

- R R Gaur, R Sangal, G P Bagaria, A foundation course in human values and Professional Ethics, 2010.
- R.S. Naagarazan, "A Textbook on Professional Ethics and Human Values", New Age International Publishers, 2006.
- Robert Elliot, Environmental Ethics, (Oxford, 1995)
- Sanderson, C., Douglas, D., Lu, Q., Schleiger, E., Whittle, J., Lacey, J., ... & Hansen, D. (2023). AI ethics principles in practice: Perspectives of designers and developers. *IEEE Transactions on Technology and Society*.
available at: <https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=10071542>
- Schinzinger, R. (2000). Introduction to engineering ethics.
available at: <https://philarchive.org/archive/SCHITE-2>
- Singh, D. (2006). *Emotional intelligence at work: A professional guide*. Sage.
- Whitbeck, C. (2011). *Ethics in engineering practice and research*. Cambridge University Press.
- Zhu, Q., & Jesiek, B. K. (2017, June). Engineering ethics in global context: Four fundamental approaches. In *2017 ASEE Annual Conference & Exposition*.
available at <https://peer.asee.org/engineering-ethics-in-global-context-four-fundamental-approaches>
- Zhu, Q., & Jesiek, B. K. (2020). Practicing engineering ethics in global context: A comparative study of expert and novice approaches to cross-cultural ethical situations. *Science and Engineering Ethics*, 26(4), 2097-2120.
available at: <https://link.springer.com/content/pdf/10.1007/s11948-019-00154-8.pdf>

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
IC	To be assigned	Classical Physics	3	2	1	0	0

PREREQUISITE: None

COURSE OBJECTIVE(s)

To equip students with basic concepts and techniques related to Newtonian Mechanics of point particles and extended objects. The learned knowledge would enable the students to tackle standard engineering problems.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Kinematics and dynamics: polar coordinates, velocity and acceleration in polar coordinates, Review of Newton's Laws, inertial frames, frames of reference, pseudo forces, work energy theorem, conservative and non-conservative forces, work done by non-conservative forces, variable mass system: motion of rocket. Engineering Applications in Aerospace, Robotics, Mechanical, and Automotive **(No. of lectures- 8)**

Oscillations: Review of SHM. damped harmonic oscillator, overdamping, underdamping, critical damping, energy, Q-value, forced oscillations without damping, forced damped harmonic oscillations, transient and steady state behavior, resonance, resonance curve and quality factor **(No. of lectures- 5)**

Rotational motion and Elasticity: rotations about fixed axis, angular momentum along the axis and moment of inertia, angular momentum vector and inertia tensor, rotations about translating axis, rotations about translating axis, gyroscope **(No. of lectures- 8)**

Fluid Mechanics: definition of fluid, density and pressure of a fluid and hydrostatic equilibrium, pressure force on a moving fluid, Eulerian and Lagrangian description, flow patterns, volume and mass rate of flow, Equation of continuity, Euler equation, Bernoulli's equation using Euler equation, Euler equation and pressure accelerating fluid, Navier-Stokes' Equation (without derivation), viscosity, Aerofoil design considerations **(No. of lectures- 5)**

TEXT BOOKS

1. *An Introduction to Mechanics* by Kleppner and Kolenkow, McGraw Hill Education
2. *Mechanics* by D. S. Mathur, S. Chand

REFERENCE BOOKS

1. *Engineering Mechanics: Statics and Dynamics* by J. L. Meriam and L. G. Kraige, Wiley
2. *Engineering Physics* by D. R. Joshi, McGraw Hill Education

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
IC	To be assigned	Classical Physics Lab	1	0	0	2	0

COURSE OBJECTIVE

To equip students with basic knowledge of standard experimental concepts, techniques, and apparatus in undergraduate Physics.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1)	Internal assessment (based upon practical lab records, viva, and attendance) (PRS)	50%
2)	Mid-term examination (PRM)	20%
3)	End Semester Examination (PRE)	30%

COURSE CONTENTS

The course will consist of the following experiments:

S. No.	List of Experiments
1.	To learn about various types of basic measurement tools and devices, error propagation and curve fitting using least squares method (Basic measurements, error analysis and curve fitting).
2.	To determine the value of Planck's constant by measuring the stopping potential of different color filters.
3.	To plot I-H curve for an iron rod.
4.	To determine the wavelength of sodium light by Newton's ring.
5.	To determine the wavelength of any three lines of mercury light by diffraction grating in 1st order spectrum.
6.	To determine the specific rotation of glucose by Polarimeter using three different concentrations.
7.	To verify the equation of motion of a torsional pendulum, and the limits of its applicability.
8.	To verify parallel and perpendicular axis theorems for rotating rigid bodies.
9.	To determine the Poisson's ratio (σ) for rubber.

Text Books / Reference Books

1. *Concepts of Modern Physics*, Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury (Mc Graw Hill), 2017
2. *Introduction to Electrodynamics* (4th edition), Griffiths (Pearson), 2015
3. *Essentials of Engineering Physics*, A. S. Vasudeva (S. Chand), 2010
4. *Optics* (8th edition), Ajoy Ghatak (Tata McGraw Hill), 2024

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
IC	To be assigned	Modern Physics	3	2	1	0	0

PREREQUISITE: None

COURSE OBJECTIVE(s)

This course aims to familiarize and equip the students with fundamental knowledge of quantum mechanics and electrodynamics. The learned knowledge would enable the students to tackle standard engineering problems.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Electrodynamics - Introduction to vector analysis, Gradient, Divergence and Curl, Gauss divergence theorem and applications, Stokes theorem and applications, Laws of electromagnetism, Boundary conditions of electric and magnetic field, Maxwell's equations (differential and integral forms) and their physical significance, Displacement current and continuity equation, Vector potential, Electromagnetic wave equation and its solution in free space, Transverse nature of electromagnetic waves, Energy and momentum in electromagnetic waves, Poynting theorem and power flow, engineering applications of electrodynamics
(No. of lectures- 13)

Quantum Mechanics – Basics of quantum mechanics, Wave-particle duality, Concept of phase and group velocity, Heisenberg's uncertainty principle and its applications, Wave function and its properties, Orthogonality of wave function and expectation values, Energy and momentum operators, Schrodinger equation (time dependent and time independent), Probability current density, Solution of Schrodinger equation for 1D and 3D infinite potential well, Concepts of quantum mechanical tunneling, technological applications of quantum mechanics
(No. of lectures- 13)

TEXT BOOKS: -

1. *Introduction to Electrodynamics*, David J. Griffiths, Prentice Hall
2. *Concepts of Modern Physics*, Arthur Beiser, McGraw Hill Education

REFERENCE BOOKS: -

1. *Quantum Mechanics*, Nouredine Zettili, Wiley
2. *Engineering Physics*, Hitendra K. Malik and A. K. Singh, McGraw Hill Education

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
IC	To be assigned	Modern Physics Lab	1	0	0	2	0

COURSE OBJECTIVE

To equip students with basic knowledge of standard experimental concepts, techniques, and apparatus in undergraduate Modern Physics.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1)	Internal assessment (based upon practical lab records, viva, and attendance) (PRS)	50%
2)	Mid-term examination (PRM)	20%
3)	End Semester Examination (PRE)	30%

COURSE CONTENTS

The course will consist of the following experiments:

S. No.	List of Experiments
1.	To learn about various types of basic measurement tools and devices, error propagation and curve fitting using least squares method (Basic measurements, error analysis and curve fitting).
2.	To determine the value of Planck's constant by measuring the stopping potential of different color filters.
3.	To plot I-H curve for an iron rod.
4.	To determine the wavelength of sodium light by Newton's ring.
5.	To determine the wavelength of any three lines of mercury light by diffraction grating in 1st order spectrum.
6.	To determine the specific rotation of glucose by Polarimeter using three different concentrations.
7.	To determine the energy band gap of Germanium crystal by Four Probe Method.
8.	To determine the Hall coefficient of a given sample.
9.	To determine the dielectric constant of a given solid.

Text Books / Reference Books

1. *Concepts of Modern Physics*, Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury (Mc Graw Hill), 2017
2. *Introduction to Semiconductor Materials and Devices*, M.S Thyagi (John Wiley & Sons), 1991
3. *Introduction to Electrodynamics* (4th edition), Griffiths (Pearson), 2015
4. *Essentials of Engineering Physics*, A. S. Vasudeva (S. Chand), 2010
5. *Optics* (8th edition), Ajoy Ghatak (Tata McGraw Hill), 2024

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF CHEMISTRY

Engineering Chemistry

All branches I/II Semester B.Tech (Core course)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CYT101	Engineering Chemistry	3	2	1	0	0

Course Description:

- Students will learn the basic and advanced knowledge of chemistry concerning the applications of the basics of chemistry in different fields and branches of engineering.
- To function very efficiently and know how to build connections over the exploration/use of a modern work environment to run or lead those as professionals.

COURSE CONTENTS

Lecture Plan (Hrs.)	Course Content
Unit 1 (8 L)	Water and its treatment: Hardness, types of hardness, Units of hardness, and methods of estimation of hardness. Removal of Hardness (Softening Methods): Lime Soda process, Permutit or Zeolite process and Deionization or Demineralization process. Municipal Water Supply: Purification of water by various methods, Detailed study of methods of Disinfection, Removal of heavy metals from industrial wastewater.
Unit 2 (2 L)	Lubricants: Introduction of lubricants and lubrication. Types of the mechanism of lubrication, Uses, and properties of lubricants viz. Viscosity & Viscosity index.
Unit 3 (4 L)	Fuels and Combustion: Classification and Properties of fuels, Calorific value, Petroleum: refining and fractional distillation of crude petroleum, Cracking, Synthetic petrol, Knocking, Anti-knocking Agents, octane and cetane numbers. Gaseous fuels and hydrogen fuels.

Unit 4 (3 L)	New Engineering Materials: Organic/hybrid photovoltaic materials, Conducting Polymers, Introduction to nanotechnology and nanomaterials (fullerenes and quantum dots).
Unit 5 (4 L)	Corrosion: Introduction, theory, and mechanism of Corrosion, galvanic and differential aeration corrosion, various preventive measures to control Corrosion.
Unit 6 (3 L)	Advanced electrochemical systems: Introduction to Energy Storage devices, Li-ion batteries, redox flow batteries, Fuel cells, H ₂ -O ₂ fuel cells.
Unit 7 (4 L)	Spectroscopy: Introduction, Classification, and Applications. Ultraviolet-Visible, Infra-Red, and Nuclear Magnetic Resonance Spectroscopy.
Recommended Text Books	1. Engineering chemistry: A Text book by P.C. Jain, Dhanpat Rai & Sons. 2. A Text book of Engineering chemistry by Shashi Chawla, Dhanpat Rai and Sons. 3. Engineering chemistry: A Text book by S.S. Dara, S. Chand & Co. 4. Solid State Chemistry and its Applications by Anthony R. West, Wiley 2014 5. Modern Batteries by C.A. Vincent and B. Scrosati, Elsevier 1997. 6. P. S. Kalsi, Spectroscopy of Organic Compounds, New Age International (P) Ltd. Publishers 7. Fundamentals of molecular spectroscopy by Colin Banwell and Elaine McCash, Tata McGraw Hill Education Pvt. Ltd.

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CYP102	B.Tech. Engineering Chemistry Laboratory	2	0	0	2	0

PREREQUISITE

Basic knowledge about inorganic salts and chemical analysis

Course Description:

- To impart the knowledge of the processes of chemical analysis.
- Identification of product purities/impurities

S. No.	Name of the Experiment
1.	To determine the percentage of available chlorine in given sample of bleaching powder.
2.	To determine hardness of Water by EDTA method.
3.	To determine the total alkalinity of water.
4.	To determine the amount of various oxidizing agents iodometrically.
5.	Analysis of ores and alloys a) Estimation of copper in brass, b) Estimation of iron in plain carbon steel, c) Estimation of iron in hematite ore.
6.	Preparation of bakelite polymer.
7.	Synthesis of Nylon-6,6.
8.	Synthesis of Urea-Formaldehyde Resin.
9.	Determination of viscosity of oil by Redwood viscometer.
10.	To carry out conductometric titration.
11.	To estimate the iodine in iodized common salt using iodometry.
12.	Synthesize of Thiocol rubber.
13.	To determine the dissolved oxygen content of given water sample by Winkler's method.
14.	To determine total moisture content, volatile matter, ash content and fixed carbon in a given coal sample by proximate analysis.
15.	To determine the flash point and fire point of given oil by Penskey-Marten's apparatus.
16.	Extraction of caffeine from tea leaves.
17.	Determination of coefficient of viscosity of unknown liquid by Ostwald viscometer.
Reference Books	1. Laboratory Manual on engineering chemistry by S.K. Bhasin & Sudha Rani, Dhanpat Rai Publishing Company, New Delhi. 2. A text book of Practical chemistry by K. D. Gupta & K.K. Saxena University Press, Jaipur.

Semester-wise Scheme and Syllabus

Scheme and Syllabus of 1st Year Institute Core Subjects

Programming with Python						
Prerequisite: Nil			L	T	P	C
Total hours: 28			2	0	0	2
Course Content						Hrs.
Unit 1	Introduction to computer system and binary number systems – addition, subtraction (2’s complement), multiplication, left shifting and right shifting.					4
Unit 2	Introduction to Python: Python variables, Python basic Operators, Understanding python blocks. Python Data Types, Declaring and using Numeric data types: int, float etc. Python Program Flow Control Conditional blocks: if, else and else if, Simple for loops in python, for loop using ranges, string, list and dictionaries. Use of while loops in python, Loop manipulation using pass, continue, break and else. Programming using Python conditional and loop blocks.					6
Unit 3	Python Complex data types: Using string data type and string operations, Defining list and list slicing, Use of Tuple data type. String, List and Dictionary.					6
Unit 4	Building blocks of python programs: string manipulation methods, List manipulation, Dictionary manipulation, Programming using string, list and dictionary in-built functions. Python Functions, Organizing python codes using functions, Introduction to classes.					6
Unit 5	Python File Operations: Reading files, Writing files in python, Case study: development of mini projects using libraries like matplotlib, numpy, etc.					6
References						
1.	Wesley J. Chun, “Core Python Applications Programming”, 3rd Edition , Pearson Education, 2016.					
2.	Charles Dierbach, “Introduction to Computer Science using Python”, Wiley, 2015.					
3.	Jeeva Jose & P. Sojan Lal, “Introduction to Computing and Problem Solving with PYTHON”, Khanna Publishers, New Delhi, 2016.					
4.	Downey, A. et al., “How to think like a Computer Scientist: Learning with Python”, John Wiley, 2015.					
5.	Mark Lutz, “Learning Python”, 5th edition, Orelly Publication, 2013, ISBN 978- 1449355739					
6.	John Zelle, “Python Programming: An Introduction to Computer Science”, Second edition, Course Technology Cengage Learning Publications, 2013, ISBN 978- 1590282410					
7.	Michel Dawson, “Python Programming for Absolute Beginners” , Third Edition, Course Technology Cengage Learning Publications, 2013, ISBN 978-1435455009					
8.	David Beazley, Brian Jones., “Python Cookbook”, Third Edition, Orelly Publication, 2013, ISBN 978-1449340377					

Programming with Python Lab					
Prerequisite:		L	T	P	C
Total hours: 28		0	0	2	1
Course Content					Hrs.
	The following proposed coverage are broad guiding areas lab. The programs mentioned here just sample programs and they are just for reference purpose. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with concerned theory course. 1. Installation of Python Tool, Introduction to Python programming, and python datatypes [1 Lab] 2. Data types, Input/Output and library imports [1 Lab] 3. Python strings operations, Doc strings [1 Lab] 4. Objects - List, Tuples and Dictionaries [3 Lab] 5. Control flow, functions working and some advanced functions [2 Lab] 6. Python File Operations: Reading files, Writing files in python [1 Lab] 7. Introduction to classes [1 Lab] 8. Numpy, Matplotlib utility functions [2 Lab]				
References:					
1.	Core Python Applications Programming: Wesley J. Chun, Pearson Education, 2016.				
2.	Introduction to Computer Science using Python: Charles Dierbach, Wiley, 2015				
3.	Python for Programmers: Paul J. Deitel, Harvey Deitel , Pearson, 2020 .				
4.	Learning Python: Mark Lutz, Orelly Publication, 2013				
5.	Python Programming: An Introduction to Computer Science: John Zelle, Course Technology Cengage Learning Publications, 2013.				

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY

Department: Civil Engineering

Course name: Engineering Drawing and Sketching Lab

Course Code: 26CEPxxx

Syllabus:

Unit 1: Basics of Engineering Drawing and Sketching [6 Hours]

- Introduction to AutoCAD software
- Introduction to Engineering Drawing, Types of Projections
- Orthographic Projection and Views

Unit 2: Projection of 1-D Objects [6 Hours]

- Projection of Points
- Projection of Lines
- Traces of Lines

Unit 3: Projection of 2-D Objects [4 Hours]

- Projection of Planes
- Concept of Auxiliary Planes and their application in orthographic projections.

Unit 4: Projection of 3-D Objects [6 Hours]

- Projection of Solids

Unit 5: Other projection systems [4 Hours]

- Isometric projection

Proposed Distribution

Department of Architecture & Planning												
Course category	Credits approved by the Senate (Old for B.Tech Program)	I Sem	II Sem	III Sem	IV Sem	V Sem	VI Sem	VII Sem	VIII Sem	IX Sem	X Sem	Total Credits
Basic Sciences	16	1	-	-	-	-	-	-	-	-	-	1
Fundamental Engg. (EAS)	15	-	-	-	-	-	-	-	-	-	-	0
Humanities & Social Science	5	-	-	-	-	-	-	-	-	-	-	0
Institute core	36	1	-	-	-	-	-	-	-	-	-	1
Programme core		14	15	18	16	19	16	15	-	9	3	125
Programme elective	109 – 136	-	-	-	-	3	3	6	-	6	6	24
Advance elective		-	-	-	-	-	-	-	-	-	-	0
Project	3 – 12	-	-	-	-	-	-	-	-	4	9	13
Management	3	-	-	-	-	-	-	-	-	-	-	0
Industrial Training and Seminar	-	-	-	-	-	-	-	-	9	-	-	9 [#]
Discipline-specific courses	121 – 139	14	15	18	16	22	19	21	9	19	18	171
Open electives	6						3				3	6
Programme linked EAS/BS	3 – 15	3	6	3	6							18
Other courses	9-21											24
Total Credits	178 – 184											196*

*Note: The total credits distribution of B.Arch is higher than the 4-Year B.Tech Program, as B.Arch is a 5-Year course.

[#]Proposed Industrial Training and Seminar as a separate and Mandatory Course category as per CoA rules.

Dr. Kalpana Pandit
(DUGC Convener)

Prof. Tarush Chandra
(Head of Department)

16/06/2026

16/06/2026
Dr. Kalpana Pandit
Dr. Tarush Chandra
Dr. [Signature]
Dr. [Signature]
Dr. [Signature]
Dr. [Signature]
Dr. [Signature]
Dr. [Signature]

Comparison with IITs and SPA

Course Category (MNIT senate approved)	MNIT Jaipur (Old Credit Distribution)	MNIT Jaipur (Revised/Reduced)	SPA Bhopal* (July 2024)	IIT Kharagpur* (After 2024)	IIT Roorkee* (2024 onwards)
Institute Core (IC)	2	1	-	-	52
Program Core	156	125	169	205	98
Program Linked PL (EAS/BS)	18	18	14		-
Program Elective (PE)	24	24	18	21	18
Open Electives (OE)	6	6	-	-	9-12
Project (Min + Major)	11	13	24	12	-
Industrial training/ seminar	12	9	25	4 (Placed in Depth Core)	12
Total	229	196	250	242	189-192

*Note: The credit categorisation is different from the MNIT course category. The distribution shown for other institutes belongs to different categories. For example, for SPA Bhopal, 228 credits are for compulsory core courses (here, Program Core) and 18 for elective courses (here, program electives). At IIT Kharagpur, 209 (including training) credits fall under Depth Core (here, Program Core). At IIT Roorkee, credits are mainly distributed across the Institute Core Course and the Program Core Course.

Dr. Kalpana Pandit
(DUGC Convener)

Prof. Tarush Chandra
(Head of Department)

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16/06/26

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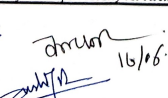
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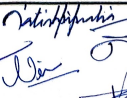
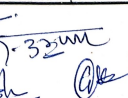
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MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING I/V							
B.Arch. Teaching Scheme							
Semester I							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours/Week
1	22CET102	Environmental Science and Ecology	Institute Core	Theory	1	1-0-0-0	1
2	22CET109	Architectural Structures (Statics)-I	Program Linked	Theory	3	2-1-0-0	3
3	22ARP109	Architectural Presentation Technique & Model Making-I	Program Core	Practical	2	0-0-4-0	4
4	22ARP110	Architectural Drawing	Program Core	Studio	4	1-0-0-3	4
5	22ARP111	Building Construction & Materials-I	Program Core	Studio	4	1-0-0-3	4
6	22ARP104	Introduction to Architecture and Basic Design	Program Core	Studio	4	1-0-0-3	4
Total Credits & Teaching hours/semester					18		20
Note: • Educational Tour to be part of Design Studio in either even or odd semester • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20 students per examiner • External examiner should be a practicing architect of repute or a faculty member from academia having Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA							
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING I/V							
B.Arch. Teaching Scheme							
Semester II							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours/Week
1	22ART151	History of Architecture - I	Program Core	Theory	3	2-1-0-0	3
2	22CET193	Architectural Structure - II	Linked	Theory	3	2-1-0-0	3
3	22CET191	Surveying and Introduction to GIS	Linked	Theory	2	2-0-0-0	2
	22CEP192	Surveying and Introduction to GIS Lab	Linked	Practical	1	0-0-2-0	2
4	22ARP152	Architectural Presentation Technique & Model Making- II	Program Core	Practical	2	0-0-4-0	4
5	22ARP153	Architectural Design - I	Program Core	Studio	6	0-0-0-6	6
6	22ARP154	Building Construction & Materials - II	Program Core	Studio	4	1-0-0-3	4
7	22BM1201	Introduction to Standardization	Institute Core	Audit Course	0	1-0-0-0	
Total Credits & Teaching hours/semester					21		24
Note: • Educational Tour to be part of Design Studio in either even or odd semester • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20 students per examiner • External examiner should be a practicing architect of repute or a faculty member from academia having Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA							


MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING II/V							
B.Arch. Teaching Scheme							
Semester III							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours/Week
1	22ART201	Building Science - I	Program Core	Theory	3	2-1-0-0	3
2	22ART202	History of Architecture - II	Program Core	Theory	3	2-1-0-0	3
3	22CET241	Architectural Structures -III	Linked	Theory	2	2-0-0-0	2
4	22CEP242	Architectural Structures - III Lab.	Linked	Practical	1	0-0-2-0	2
5	22ARP203	Comp. Application for Architects	Program Core	Practical	2	0-0-4-0	4
6	22ARP204	Architectural Design - II	Program Core	Studio	6	0-0-0-6	6
7	22ARP205	Building Construction & Materials -III	Program Core	Studio	4	1-0-0-3	4
Total Credits & Teaching hours/semester					21		24
Note: • Educational Tour to be part of Design Studio in either even or odd semester • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20 students per examiner • External examiner should be a practicing architect of repute or a faculty member from academia having • Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA							

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING II/V							
B.Arch. Teaching Scheme							
Semester IV							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours /Week
1	22ART251	Building Services - I	Program Core	Theory	3	2-1-0-0	3
2	22ART252	History of Architecture - III	Program Core	Theory	3	2-1-0-0	3
3	22CET291	Architectural Structures -IV	Linked	Theory	3	2-1-0-0	3
4	22HST291	Technical Communication & Writing	Linked	Theory	3	1-2-0-0	3
5	22ARP253	Architectural Design - III	Program Core	Studio	6	0-0-0-6	6
6	22ARP254	Building Construction & Materials -IV	Program Core	Studio	4	1-0-0-3	4
Total Credits & Teaching hours/semester					22		22
Note: • Educational Tour to be part of Design Studio in either even or odd semester • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20 students per examiner • External examiner should be a practicing architect of repute or a faculty member from academia having • Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA							

16/06/26
 R. Sharma
 J. S. Choudhary
 0732m
 D. S. Choudhary
 T. S. Choudhary
 A. S. Choudhary
 S. S. Choudhary
 M. S. Choudhary
 K. S. Choudhary
 N. S. Choudhary
 H. S. Choudhary
 P. S. Choudhary
 Q. S. Choudhary
 R. S. Choudhary
 S. S. Choudhary
 T. S. Choudhary
 U. S. Choudhary
 V. S. Choudhary
 W. S. Choudhary
 X. S. Choudhary
 Y. S. Choudhary
 Z. S. Choudhary

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING III/V							
B.Arch. Teaching Scheme							
Semester V							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours / Week
1	22ART301	Building Services - II	Program Core	Theory	3	2-1-0-0	3
2	22ART302	Quantity Survey and Specification	Program Core	Theory	3	1-2-0-0	3
3	22ART303	Theory of Design and Architectural Appreciation	Program Core	Theory	3	2-1-0-0	3
4	22ARP304	Architectural Design -IV	Program Core	Theory	6	0-0-0-6	6
5	22ARP305	Building Construction & Materials - V	Program Core	Studio	4	1-0-0-3	4
6		Program Elective - I	PE	Theory	3	1-2-0-0	3
7		Honours Elective -I / International Internship (assessment after VI semester summer vacation)	B.Arch. (H)		0/3	2-1-0-0	0/3
Total Credits & Teaching hours/semester					22		22

Note: • Educational Tour to be part of Design Studio in either even or odd semester
 • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20 students per examiner
 • External examiner should be a practicing architect of repute or a faculty member from academia having
 • Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA

1	22ART922	Universal Design In Built Environment	PE	Theory	3	1-2-0-0	3
2	22ART921	Product Design	PE	Theory	3	1-2-0-0	3
3	22ART923	Vernacular Architecture	PE	Theory	3	1-2-0-0	3

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING III/V							
B.Arch. Teaching Scheme							
Semester VI							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours / Week

1	22ART351	Building Science - II	Program Core	Theory	3	2-1-0-0	3
2	22ARP352	Architectural Design - V	Program	Studio	6	0-0-0-6	6
3	22ARP353	Building Construction &	Program	Studio	4	1-0-0-3	4
4	22ARP354	Site Planning & Landscape	Program	Studio	3	1-0-0-2	3
5		Program Elective - II	PE	Theory	3	1-2-0-0/ 1-0-0-2	3
6		Open Elective - I	OE	Theory	3	3-0-0-0	3
7		Honours Elective -II / International Internship (assessment after VI semester summer vacation)	B.Arch. (H)	Theory	0/3	2-1-0-0	0/3
Total Credits & Teaching hours/semester					22		22

Note: • Educational Tour to be part of Design Studio in either even or odd semester
 • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20 students per examiner
 • External examiner should be a practicing architect of repute or a faculty member from academia having

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 16/06/2024
[Signatures: R. Sharma, Anil Kumar, etc.]

• Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA						
List of Program Elective II in Sem. VI						
1		Interior Design	PE	Theory	3	1-2-0-0 3
2		Human – Computer Interaction	PE	Theory	3	1-2-0-0 3
3		Design for healthcare Facilities	PE	Theory	3	1-2-0-0 3

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING IV/V							
B.Arch. Teaching Scheme							
Semester VII							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours /Week
1	22ART401	Building Services - III	Program Core	Theory	3	2-1-0-0	3
2	22ART402	Introduction to Planning	Program Core	Theory	3	2-1-0-0	3
3	22ARP403	Architectural Design - VI	Program Core	Studio	6	0-0-0-6	6
4	22ARP404	Working Drawings	PC	Studio	3	0-0-0-3	3
5		Program Elective - III	PE	Theory	3	1-2-0-0	3
6		Program Elective - IV		Theory	3	3-0-0-0	3
7		Honours Elective -III / International Internship (assessment after VI semester summer vacation)	B.Arch. (H)	Theory	0/3/6	2-1-0-1	0/3/6
8		Honours Elective -IV / International Internship (assessment after VI)	B.Arch. (H)	Theory	0/3/6	2-1-0-0	0/3/6
Total Credits & Teaching hours/semester					21		21
Note: • The ETE of Arch.Design will include evaluation of sessional works by external examiners @15-20							
• External examiner should be a practicing architect of repute or a faculty member from academia having more than 5 Years of experience							
• Adjunct/Expert faculty for Arch.Design and Building Construction Studio to be included as per CoA							
List of Program Elective- III in Sem. VII							
1	22ART928	Earthquake Resistant Architecture	PE	Theory	3	1-2-0-0	3
2	22ART929	Energy Efficient Architecture	PE	Theory	3	1-2-0-0	3
List of Program Elective- IV / Honours Electives in Sem. VII							
1	22ART927	Building Information Modelling (BIM) application for Built Environment	PE	Theory	3	1-2-0-0	3
2		Parametric Design and Computational Geometry	PE	Theory	3	1-2-0-0	3
3	22ART930	Illustration and Painting	PE	Theory	3	1-2-0-0	3

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 RSharma
 13/2/26
 Tamm
 (Other illegible signatures)

3 | Architectural Journalism | PE | Theory | 3 | 1-2-0-0 | 3

Interviewee
Tanya
Jomon
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MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING						I/V	
B.Arch. Teaching Scheme							
Semester I							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours/Week
1	22CET102	Environmental Science and Ecology	Institute Core	Theory	1	1-0-0-0	1
2	22CET109	Architectural Structures (Statics)-I	Program Linked	Theory	3	2-1-0-0	3
3	22ARP109	Architectural Presentation Technique & Model Making-I	Program Core	Practical	2	0-0-4-0	4
4	22ARP110	Architectural Drawing	Program Core	Studio	4	1-0-0-3	4
5	22ARP111	Building Construction & Materials-I	Program Core	Studio	4	1-0-0-3	4
6	22ARP104	Introduction to Architecture and Basic Design	Program Core	Studio	4	1-0-0-3	4
		Total Credits & Teaching hours/semester			18		20

Scheme/Specialization: B.Arch.
Semester 1

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CET109	Architectural Structures (Statics)-I	3	2	1	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To instruct students with principles of structural mechanics and Strength of Materials

COURSE OUTCOMES

1. To introduce the basic concepts of structural mechanics and Strength of Materials.
2. Conceptual understanding of Compressive and tensile forces, and bending moments.
3. Equilibrium of forces.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	30%
b)	MTE	30%
c)	ETE	40%

COURSE CONTENTS

MODULE I- Centroid of an area, moment of inertia, radius of gyration, polar moment of inertia, parallel and perpendicular axes theorems.

MODULE II- Concept of stress and strain, stress-strain curve, modulus of elasticity, Poisson's ratio. Theory of simple bending, distribution of bending stresses.

MODULE III- Shear stress distribution in beams. Shear force and bending moment diagrams for simply supported and continuous beams, and cantilevers.

MODULE IV- Analysis of pin, roller, and fixed joints. Long and short columns, slenderness ratio, buckling load for various end conditions of column

REFERENCES: -

1. B.C.Punmia, Strength of Materials & mechanic of Structure
2. V.S.Prasad, Structural Mechanics & Analysis
3. C.S.Reddy, Basic Structural Analysis

B.Arch

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP110	Architectural Drawing	4	1	0	0	3

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To develop drawing skills as tools for thinking, visualization, and representation of the design.

COURSE OUTCOMES

- To understand drafting procedures and graphic codes.
- To understand interpenetration of solids.
- To understand Three-Dimensional Graphic Representation.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE I- Drafting Procedures-Familiarizing with drawing materials and equipment. Introduction to drafting procedures, graphic codes, symbols, and architectural lettering, Practice of line-types, line weight, dimension lines, extension lines, center lines, section lines, etc. and Introduction to architectural and construction symbols. Understanding architectural scales and their application to real objects and drawings (plain scale, graphic scale, diagonal scale, and isometric scale), Construction of basic and complex geometrical shapes, platonic shapes and their surface developments.

MODULE II- Projections in Drawings- Orthographic projections of simple regular two-dimensional shapes, i.e. Projection of lines – True length, Projection of planes and solids, Complex solids and hollow objects and sections i.e cube, prism, pyramid, cylinder, cone and sphere. Study of the interpenetration of solids.

MODULE III- Introduction to Three-Dimensional Graphic Representation-Isometric, axonometric and oblique projections. Perspective- One-point and two-point Perspectives. Exercises in Perspective drawing of simple geometrical forms leading to the perspective of Buildings. Sciography of simple geometric forms leading to sciography of Architectural forms.

EXERCISES:

Drawing/drafting exercises based upon above modules

REFERENCES:-

1. Engineering Drawing: N.D. Bhatt ,Venugopal
2. Engineering Drawing: P.S. Gill.
3. Perspective and Sciography : Mulik
4. Rendering with Pen & Ink : Robert W. Gill.

B.Arch

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP109	Architectural Presentation Techniques & Model Making- I	2	0	0	4	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To instruct students for free-hand sketching, drawing and graphics with colour rendering and its applications.

COURSE OUTCOMES

- Learning and practicing various mediums for free-hand sketching, drawing and graphics.
- Exploring various materials for making three-dimensional models.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

Module I (Using various mediums pencils, crayons, colours, charcoal and ink etc.): Free hand sketching of objects of daily use, vegetation, human figures, automobiles, etc. Silhouettes drawings, Line drawings, cross-hatching, stippling, doodling etc. Understanding the depiction of forms in a minimal way through abstraction. Indoor and outdoor sketching. Exploring various innovative techniques of presentation.

Module II- (Colour Rendering and its Application): Understanding the colour wheel and study of primary, secondary, tertiary, complementary, monochromatic, analogous, and triadic colours. Study of shades, tints and tones. Rendering techniques via using various colouring mediums such as water/acrylic/crayons/pastel/pencil colours and sketch pens.

Module III- (Model Making and Sculpting): Understanding proportions and scale through models in various mediums. Exploring forms through subtraction, addition and intersection of various forms using Plaster of Paris (POP) and clay modeling.

REFERENCES:

1. Rendering with Pen & Ink: Robert W. Gill
2. The Color Source Book for Graphic Designers: Sadao Nakamiva

B.Arch

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP111	Building Construction and Materials - I	4	1	0	0	3

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- The understanding and application of basic building materials and techniques in conventional construction practices. Emphasis to be laid on Load bearing construction.

COURSE OUTCOMES

- To understand Construction principles of Masonry work and bond details.
- To understand Flooring in brick and stone.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE I- Study of manufacturing process, structural, visual and textural properties, varieties and application of Masonry building Materials.

MODULE II- Construction principles of Masonry work and bond details in brick and stone in walls, wall junctions and piers. Foundations - simple wall and pier footings.

MODULE III- Openings – Construction details of lintels, arches, sill and jambs, jalis, and cornices in brick and stone. Flooring in brick and stone.

MODULE IV- Introduction to Roof Construction such as Flat roof, Jack arch roof, domes, vaults etc. in brick and stone. Exterior and interior wall sections.

EXERCISES:

Exercises based upon above modules

REFERENCES:-

- Francis D.K. Ching, Building Construction.
- Barry / Chudley / Times Savers Building Materials
- P N Khanna
- W.B.McKay, Mehta, M. Scarborough, Armpriest, Diane, "Building Construction : Principles, Materials and Systems", Pearson Prentice Hall.

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP104	Introduction to Architecture and Basic Design	4	1	0	0	3

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To understand elements and principles of design and their application in spatial design.

COURSE OUTCOMES

- Learning elements of design.
- Understanding anthropological activities in designing space.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE I- (Perception of Architecture): Learning elements of design: point, line, plane, solid, curve etc. Understanding principles of design like harmony, rhythm, contrast, balance and proportions etc., and their application. Composition of forms/ shapes using concepts of symmetry, array, translation, mirroring concentric & grid arrangements etc. and transformation through intersection, addition, subtraction. Exploring kinaesthetic and sensory qualities of architectural space: size, proportion, scale, degree of enclosure, light and relationship with other spaces. Introduction to architectural vocabulary and architectural appreciation through studying the works of Indian and Foreign architects and understanding their design concepts and realization of the same.

MODULE II- (Human factors in Architecture): Understanding anthropological activities, anthropometrics, ergonomics etc., involved in the design of spaces and human responses to them. Typical drawings to study furniture layouts and its relation to human functions & activities. Form based design of a shelter for a certain activity such as: Kiosk design, food vendor's stall, guard house, Bus Stop, Gazebo etc.,

Note: Local study tour will be part of the subject.

EXERCISES:

Exercises based upon above modules.

REFERENCES:-

1. Francis D.K. Ching, Form, Space & Order
2. Jatin Das, Elements of space making
3. James Scott, Elements of Design
4. Victor Papanek, Design for the real World
5. Debkumar Chakrabarti, Indian Anthropometric Dimensions, National Institute of Design 1997

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CET102	Environmental Science and Ecology	1	1	0	0	0

Ecosystems: Concept of an ecosystem. Structure and function of an ecosystem.

Producers, consumers and decomposers.

Energy flow in the ecosystem, Ecological succession, Food chains, food webs and ecological pyramids.

Environmental Pollution: Definition, Causes, effects and control measures of:

1. Air Pollution (Ambient and Indoor)

2. Water Pollution

3. Soil Pollution

4. Marine Pollution

Noise Pollution, Solid Waste Management: cases, effects and control measures of urban and industrial wastes. Role of an individual in preventing pollution, Pollution case studies.

Social issues and environment: From unsustainable to sustainable development.

Urban problems related to energy, Water conservation, rainwater harvesting, and watershed management. Resettlement and rehabilitation of people: its problem and concerns case studies. Climate change, global warming, acid rain, ozone layer depletion. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Introduction to ISO 14000, Green Building Concept, Introduction to biodiversity.

Important Text Books/References

1. P. Meenakshi, "Elements of Environmental Science and Engineering", Prentice-Hall of India Pvt. Ltd. New Delhi, 2008.
2. P. D. Sharma, "Ecology and Environment" Rastogi Publication, 2009.
3. J.Glynn Henry, Gary W. Heinke, "Environmental Science and Engineering" Prentice-Hall of India Pvt. Ltd. New Delhi, 2004
4. Bala Krishnamoorthy, "Environmental Management" Prentice-Hall of India Pvt. Ltd. New Delhi, 2005.

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DEPARTMENT OF ARCHITECTURE AND PLANNING						I/V	
B.Arch. Teaching Scheme							
Semester II							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours/Week
1	22ART151	History of Architecture - I	Program Core	Theory	3	2-1-0-0	3
2	22CET193	Architectural Structure - II	Linked	Theory	3	2-1-0-0	3
3	22CET191	Surveying and Introduction to GIS	Linked	Theory	2	2-0-0-0	2
	22CEP192	Surveying and Introduction to GIS Lab	Linked	Practical	1	0-0-2-0	2
4	22ARP152	Architectural Presentation Technique & Model Making- II	Program Core	Practical	2	0-0-4-0	4
5	22ARP153	Architectural Design - I	Program Core	Studio	6	0-0-0-6	6
6	22ARP154	Building Construction & Materials - II	Program Core	Studio	4	1-0-0-3	4
7	22BMI201	Introduction to Standardization	Institute Core	Audit Course	0	1-0-0-0	
		Total Credits & Teaching hours/semester			21		24

Semester 2

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ART151	History of Architecture-I	3	2	1	0	0

PREREQUISITE

None

COURSE OBJECTIVE(s)

- To understand the genesis and characteristic features of Indian “Architectural styles” with reference to causative forces such as climate, society, technology, available materials, geo-natural factors and the underlying socio-cultural & religious aspects translating to design theories in the context of Indian architecture.

COURSE OUTCOMES

- To describe and analyze the major stylistic and theoretical developments in Indian architecture from ancient to medieval times.
- To develop the knowledge, skills, and perspectives gained through the study of Indian architecture.
- To develop a nuanced understanding of the relationships between Indian architecture and other forms of artistic expression, such as sculpture, painting, and literature, and to explore the broader cultural and historical contexts in which Indian architecture is situated.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	20%
b)	MTE	30%
c)	ETE	50%

COURSE CONTENTS

MODULE I- Buddhist Architecture: Origin and sources of the Style. Rock-cut architecture of the Early Buddhist period, Stupas: concept, types and construction, the great stupa at Sanchi, Sarnath, and Amrawati. Stupas in other south Asian countries, Architecture of Chaityas and Viharas.

MODULE II- Early Hindu Architecture: Concept and origin of Hindu Temple Architecture, typology, and regional styles. Introduction to Nagara, Dravida and Vesara temples, Kutina, Latina, Bhumiya and Shekhari modes. Introduction to the concept and basic principles of Vastushastra. **Early Temples:** Rock-cut temples of Pallavas and Rashtrakutas. Early North

Indian temples of Guptas. A brief introduction to Proto Nagara Shrines of South Kosala, maitrakas and Gopadri style. Early Chalukyan Temples at Badami and Aihole. Genesis of Temple architecture. **Nagara Temples:** Pratihara and Solanki Temples of western India, Kalinga style of temples, Temples of Central India, Major temple groups in Malwa, Bundelkhand, and Orissa, (Khajuraho, Bhuvaneshwar, Jagannath puri, Konark, Osian, Baroli etc.)

Dravida Temples: Built-up temples of Pallavas, Cholas, Nayakas, and Pandyas, representative examples of each style and period. Temples of Kerala.

Vesara Temples: Mishraka Vimanas of Chalukyan style. Introduction to Hoysala Temples, Kalyani Chalukyan architecture, Vijay Nagar style, Maru Gurjara temples of Solankis.

Jain Architecture: Jain Temples, concept and select examples, comparison with Hindu temples.

MODULE III- Indo-Islamic Architecture in India: Spatial, Structural and aesthetic concepts of Islamic Culture. Islamic building typologies. **Imperial Architecture at Delhi:** Slave, Khalaji, Tughlaq, and Sayyid/Lodhi tombs and Mosques. **Provincial/Regional Architecture:** Styles of Bengal, Gujarat, Jaunpur, Deccan, Malwa, and Bijapur. **Mughal Architecture of Delhi and Agra:** Mosques, Forts, tombs, and Gardens of Mughals. **Post Mughal Buildings in India:** Genesis of a hybrid architectural style of Hindu and Islamic traditions in 18th and 19th-century. Introduction to, Rajput, Bengal, and Maratha architecture

REFERENCES:-

1. Temples in India - origin & development stages, S.P Gupta & S. Vijayakumar, Centre for research & training in history, Archaeology & Paleo-Environment & D.K Printworld Ltd.
2. History of Indian and Eastern Architecture, J. H Ferguson, DODD Mead and Co. 1891, John Murray, Albemarle Street, W 1910
3. History of Architecture, Fletcher, S. B., London: Batsford & 1924.
4. NPTEL: Architecture - NOC: Introduction to History of Architecture in India. (n.d.). <https://archive.nptel.ac.in/courses/124/106/124106009/>

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CET193	Architecture Structures-II	3	2	1	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To introduce the understanding of statically determinate and indeterminate structures.

COURSE OUTCOMES

- To make students aware about slopes and deflections in structures.
- To gain knowledge about various method of analysis for structural loads.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	30%
b)	MTE	30%
c)	ETE	40%

COURSE CONTENTS

MODULE I- Slopes and deflections in statically determinate beams using double integrations method, moment area method and conjugate beam method.

MODULE II- Equilibrium and stability of structures, static and kinematic indeterminacies of beams and plane frames.

MODULE III- Analysis of continuous beams and simple portal frame using slope deflection method and M.D. method.

MODULE IV- Approximate method of analysis for lateral loads- portal and cantilever method.

MODULE V- Arches: Geometrical properties, basic mechanics, arch action; three hinged arch, and two hinged arches.

REFERENCES:-

- B.C.Punmia, Strength of Materials & mechanic of Structure
- V.S.Prasad, Structural Mechanics & Analysis
- C.S.Reddy, Basic Structural Analysis , IS Codes

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CET191	Surveying & Introduction to GIS	1	0	0	2	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To equip students with survey procedures and measurement tools for systematic study of topographic features in reference to planning and design of architecture projects.

COURSE OUTCOMES

- To introduce students about Survey of Sloping Landforms.
- To make students aware about Advanced Survey methods and GIS software.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS/PRS	30%
b)	MTE/PRM	30%
c)	ETE/PRE	40%

COURSE CONTENTS

MODULE I - Introduction: Understanding of Principles, definitions, symbols and instruments used in Surveying, Reading of Survey maps, understanding of topographic features: contours, slope analysis, grading process, graphic representations of landforms, Identification of common errors in surveying and their corrections.

MODULE II- Elementary survey methods: Horizontal plane measurements, Type of linear survey- chain survey, tape survey, compass survey, system of entries and record of measurement, setting field boundaries and area estimations.

MODULE III - Survey of Sloping Landforms: Characteristics of landform, Contouring methods & level instruments, contour intervals, methods of contouring, contour surveys, development of cross sections, and L-section, gradients, plotting contours & profiles, estimating areas & volumes. Measurements along sloping landforms, methods of simple & differential leveling.

MODULE IV - Advanced Survey methods and GIS: Limitations of traditional survey techniques, Theodolite surveying, Introduction to Remote sensing & GIS- concept and

definition, Applications of GIS in surveying, automated & digital surveying, Total station, G.P.S, Aerial Photography, digital levels, auto-levels, drone survey.

REFERENCES:-

1. Surveying & Levelling, :S.K. Duggal
2. Surveying: Dr. B.C. Punmia
3. Introduction to Remote Sensing and GIS : P K Garg

B.Arch

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP152	Architectural Presentation Technique & Model Making- II	2	0	0	4	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- Advance learning and practicing of different mediums for sketching, drawing and rendering for presenting architectural plans, sections, elevations and 3D views.

COURSE OUTCOMES

1. To make student aware about various different Rendering methods and mediums.
2. To introduce various types of architectural models and their application.
3. To gain knowledge about Architectural photography and digital processing for documentation and presentation.

COURSE ASSESSMENT The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE I- (Architectural Rendering): Rendering of architectural drawings and applying methods such as hatching, cross hatching, stippling, doodling in black & white or colour. Rendering of architectural drawings using different mediums such as water, acrylic, crayons, pastel, pencil colours and sketch pens.

MODULE II (Architectural Model Making): Types of architectural models and their application at various stages of design development. Volumetric translation of architectural concepts through models making. Application of laser cutting and 3D printing for rapid prototyping.

MODULE III (Architectural Photography): Learning photographic composition, frames and viewing angles. Digital processing of photographs using graphic softwares.

REFERENCES: -

1. Rendering with Pen & Ink: Robert W. Gill
2. The Color Source Book for Graphic Designers: Sadao Nakamiva
3. Landscape graphics: plan, section and perspective drawing of landscape spaces: Grant Reid
4. Model Making: Megan Werner, Princeton Architectural Press, New York
5. Architectural Modelmaking: Architectural Modelmaking, Laurence King Publishing LTD, London, 2014

B.Arch

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP154	Building Construction and Materials – II	4	1	0	0	3

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- The understanding and application of Timber and its products in building. Emphasis to be laid on timber joinery details in various applications.

COURSE OUTCOMES

- To introduce students about Varieties and application of paints and varnishes.
- To gain knowledge about Timber joinery, details, and their applications.
- To understand Conceptual and structural applications various materials.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE I- Study of conversion and preservation process, structural, visual and textural properties, varieties and application of timber, and its different derivatives. Varieties and application of paints and varnishes.

MODULE II- Timber joinery, details, and their applications.

MODULE III- Conceptual and structural applications of timber for floors, walls/partitions, roofs, staircases etc.

MODULE IV- Derivatives of timber such as ply-board, particle boards, MDF, HDF, HPCL, veneers, and laminates.

MODULE V- Flooring and finishes: timber flooring and timber panelling. **MODULE VI-** Openings: different types of doors and windows in timber. **NOTE: Professional expert may be called from time to time.**

REFERENCES:-

1. Francis D.K. Ching, Building Construction.
2. Barry / Chudley / Times Savers Building Materials
3. P N Khanna
4. W.B.McKay, Mehta, M. Scarborough, Armpriest, Diane, "Building Construction : Principles, Materials and Systems", Pearson Prentice Hall

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP153	Architectural Design-I	6	0	0	0	6

PREREQUISITE

Introduction to Architecture and Basic Design

COURSE OBJECTIVE(s)

- To understand the process of evolution of architectural form through analysis of simple activities and geometry.

COURSE OUTCOMES

- To make students familiar with Architectural form with respect to site, context and aesthetics.
- To gain knowledge about space, form, function and anthropometrics.
- To Introduce students basic design methodologies.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE I- Introduction to determinants of Architectural form with respect to site, context and aesthetics.

MODULE II- Interdependence of space, form, function and anthropometrics.

MODULE III- Introduction to basic design methodologies involving a relevant case study with due emphasis on development of form, study of mass, void and materials used.

NOTE:

- 1 practicing Architect has to be part of the design studio as visiting faculty for each section.***

REFERENCES:-

- Joseph De Chiara & John Hancock, Neufert Architects' Data
- Callender, Time Saver Standards for Building Types

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING						II/V	
B.Arch. Teaching Scheme							
Semester III							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours/Week
1	22ART201	Building Science - I	Program Core	Theory	3	2-1-0-0	3
2	22ART202	History of Architecture - II	Program Core	Theory	3	2-1-0-0	3
3	22CET241	Architectural Structures -III	Linked	Theory	2	2-0-0-0	2
4	22CEP242	Architectural Structures - III Lab	Linked	Practical	1	0-0-2-0	2
5	22ARP203	Comp. Application for Architects	Program Core	Practical	2	0-0-4-0	4
6	22ARP204	Architectural Design - II	Program Core	Studio	6	0-0-0-6	6
7	22ARP205	Building Construction & Materials -III	Program Core	Studio	4	1-0-0-3	4
		Total Credits & Teaching hours/semester				21	24

Scheme/Specialization: B.Arch.
Semester 3

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ART202	History of Architecture-II	3	2	1	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- The objective of studying this syllabus is to provide a comprehensive understanding of the evolution of architecture from prehistoric times to the Byzantine era, highlighting the significant architectural styles, structures, and town planning principles of each period.

COURSE OUTCOMES:

1. Understanding of the evolution and development of architecture from prehistoric times to the Byzantine era.
2. Knowledge of the architectural styles, techniques, and materials used in different cultures and civilizations.
3. Ability to analyze and interpret the architectural features and design principles of various ancient buildings and structures.
4. Awareness of the significance and influence of ancient architecture.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	20%
b)	MTE	30%
c)	ETE	50%

COURSE CONTENTS

MODULE I- Prehistoric Architecture: An introduction to pre- historic Architecture: Stone henge, Qatal Hugok, Cyclopean walls, Sepulchral Structures. Architecture and Town Planning of the Indus Valley.

MODULE II: Ancient Architecture:
Egyptian Architecture: Mastbas of Memphis Age. Pyramids – Stepped pyramid of King Zosers, Pure pyramids of Khufu, Khafreand, Mankure
Middle Kingdom temples, tombs, New kingdom temple of Amon, Khons, Minoan and Mycaenian Architecture.
West Asiatic architecture: Assyrian, Sumerian and Babylonian buildings; Ziggurats, palaces, houses and temples, select examples of city planning.

MODULE III: Classical Architecture:Greek Architecture: The Greek Orders- Doric, Ionic & Corinthian. Optical Corrections in Greek Architecture, Acropolis at Athens, Greek Temples: Temple of Athena Nike: Temple of Artemis, Erectheum, and the Parthenon at Athens. Theatres: Theatre at Epidaurus Assembly Hall at Priene. City planning & Civic spaces of the Greeks: Acropolis, Athens & city of Miletus, Priene; Hippodamus - Planning Principles. **Roman Architecture:** Evolution of Arches and Domes with special emphasis on understanding structural systems and materials. Aqua ducts & bridges: Pont du Guard to Nimes & Aqua Claudia, Rome. Temples: Pantheon, Rome; Temple of Trojan, Rome; Temple of Jupiter, Balbek. Circus & Amphitheatres: Circus of Maximus at Rome and Pompei. Theatres: Theatre of Marcelli, Colosseum at Rome; Theatre of Pompei. Bath Houses: Bath of Carcalla & Dicoletian, Leptis Magna. Fora: Basilicas of Constantine, Rome; Forum of Augustus; Forum & Basilica of Trajan. Triumphal Arches: Arch of Titus, Rome. Villas & Palaces: Domus Aurea (Golden House) Rome, Hadrian's Villa, Trivoli. City Planning of Rome.

MODULE IV: Early Christian & Byzantine Architecture:Early Christian Architecture: Laterano Basilica Rome, Old Basilica of S. Peter. Rome S. Clement, Rome & S. Lorenzo, Rome.

Byzantine Architecture: Planning & Structural system of St. Hagia Sophia, Constantipole, St. Marks Basilica, Venice.

REFERENCES: -

1. A history of architecture, Sir Banister Fletcher's, 20th ed. / Oxford ; Boston, Architectural Press.,1996
2. The World Atlas of Architecture, Christine Flon ; Chambers, James, Mitchell Beazley, 1984
3. The master builders: a history of structural and environmental design from ancient Egypt to the nineteenth century, Henry J. Cowan, New York: Wiley, c1977.
4. Architecture Gothic and Renaissance, Roger T. Smith, Forgotten Books, 2018
5. A World History of Architecture, Moffet, M., Fazio, M. &Wodehouse, McGraw- Hill, Boston, 2004
6. A History of Western Architecture, David Watkin, Laurence King Publishing, London, Great Britain, 2011.
7. *Architecture - NOC: introduction to history of architecture in India*. NPTEL. (n.d.). Retrieved April 28, 2023, from <https://archive.nptel.ac.in/courses/124/106/124106009/>

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CET241	Architecture Structures-III	2	2	0	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To develop an understanding of the design of concrete structures in buildings.

COURSE OUTCOMES

- To develop understanding related to concrete and its preparation.
- To be able to understand the basic concept of design theories.
- To be able to calculate the various loads acting on the concrete structures
- To be able to calculate the reinforcement of column beam and slab.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS/PRS	40%
b)	MTE	20%
c)	ETE/PRE	40%

COURSE CONTENTS

MODULE I - Properties of cement, coarse aggregate and fine aggregates, properties of concrete in fresh and hardened state. The durability of concrete and introduction to concrete mix design procedures.

MODULE II- Introduction to working stress method of design. Limit State method of Design, the difference between limit state and working stress method.

MODULE III- Design of beams, singly and doubly reinforced rectangular beams and T- Beams subjected to flexure, shear and torsion. Design of slabs, one-way slab, and two-way slab, flat slab with corners condition using B.I.S. codes; Design of doglegged staircase.

MODULE IV- Design of Column; short columns and long columns with lateral ties and helical reinforcement. Design of footing. Isolated column footings, the concept of combined footing, raft and pile foundation.

MODULE V-Introduction to Pre-cast Pre-stressed & Steel concrete composite structures

REFERENCES:-

- Dayaratnam, Design of RCC Structure (Limit State)
- Dr. A.K. Jain, Design of RCC Structure (Limit State)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ART201	Building Science -I	3	2	1	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To instruct students with fundamental understanding of climate sensitive design including passive design techniques.

COURSE OUTCOMES

- To understand the elements of climate and its impact on built form.
- To understand concepts of climate responsive building design.
- To understand the passive design strategies for light and ventilation in buildings.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	20%
b)	MTE	30%
c)	ETE	50%

COURSE CONTENTS

MODULE I- Climatic zones, macro and micro-climate, elements of climate; solar radiation, Temperature, Humidity, Wind, Cloud, Precipitation. Interpretation of weather data and its application in design of buildings.

MODULE II- Effect of climate on building envelope such as heat flow, heat transfer, heat storage and time lag of various building materials and elements.

MODULE III- Effect of climate on humans: thermal indices (temperature and humidity measurement), thermal comfort, psychometric chart and its application in site planning and design evolution.

MODULE IV- Orientation of building with respect to sun, wind and view, study of indigenous shelter and urban form as a response to climate. Sun path diagram, shading devices and fenestration design.

MODULE V- Natural ventilation in and around building, evaporative cooling, earth air tunnel, stack and venturi effect.

REFERENCES

1. Bansal, N.K., "Passive Building Design: A Handbook of Natural Climate Control", Elsevier Science.
2. Koenisberger, "Manual of Tropical Housing and Building- Part I: Climatic Design", Universities Press.
3. Majumdar, M. "Energy Efficient Buildings in India", the Energy and Resources Institute, TERI.
4. Hausladen, G., "Climatic Design: Solutions for Buildings that can do more with less Technology", Birkhauser.
5. Szolokay S V., "Introduction to Sustainable Architectural Science", Elsevier
6. Civil Engineering - NOC:principles and applications of Building Science. NPTEL. (n.d.). Retrieved April 28, 2023, from <https://archive.nptel.ac.in/courses/105/107/105107156/>

B.Arch

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP203	Computer Application for Architects	2	0	0	4	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s).

- Basic computer skills to enhance and present idea in a better and professional manner

COURSE OUTCOMES

1. Become familiar with digital media as means for Architectural presentation.
2. Learn and grasp architectural layout drafting techniques and to transform hand-drafted architectural drawings into digitally drafted drawings.
3. Visualize building / transform sketches and 2-dimensional CAD drawings to 3D building models and walkthrough.
4. Demonstrate ability to prepare presentation drawings with the help of various rendering and graphic software.
5. Basic computer skills to enhance and present idea in a better and professional manner.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

Module-I (Preparing 2D CAD Drawings): Introduction to computer-aided 2-D drafting. To develop and understand basic set up and menu bars for computer-aided drafting. (Utility commands). Setting units and scale. Preparation of architectural design drawings using AutoCAD

Module-II (Evolving 3D models from 2D Architectural Drawings): Understanding and converting plan, elevation and section of drawing to 3D building model using 3D software such as Autodesk Revit/ SketchUp Creating building models using building elements and then converting model to orthographic projections.

Module-III (Post Processing & Presentation): Generating architectural rendered drawings (photo realistic, montages or theme based). Understanding of graphics editing software such as

Adobe Photoshop for architectural presentation stages. Making of presentations through MS PowerPoint (or similar software). Printing of architectural presentation drawings.

Exercises:

Module-I (Preparing 2D CAD Drawings)

- Developing basic geometric figures and patterns, their addition & subtraction to practising the basic 2D CAD commands
- Preparation of two-dimensional architectural drawings (including plans, elevations and sections) incorporating layers, line weights, texts, scale, dimensioning and formatting of drawings for taking prints and plots.
- Incorporating human figures, plants, car etc. incorporating grid, column, dimensioning, legend and architectural elements.

Module-II (Evolving 3D models from 2D Architectural Drawings)

- Development of basic 3D forms and figures and practicing extrusion-based commands.
- Building 3D models with the help of 2D architectural design drawings, incorporating blocks & components, layers and architectural components.

Module-III (Post Processing & Presentation)

- Generating architectural presentation drawings and renders depicting materials, lighting & shadows, textures, natural environment, scale, furniture, humans etc.
- Performing rapid postproduction processes to generate photo realistic renders.
- Presenting design concepts and architectural drawings with the help of presentations / walkthrough etc.

REFERENCES

1. Microsoft Office 2019 Step by Step, First Edition: Curtis Frye, Joan Lambert..
2. Adobe Photoshop CC Classroom in a Book: Faulkner Andrew and Chavez Conrad.
3. Autodesk user manual for CAD.
4. <https://www.udemy.com/> : Complete course in AutoCAD : 2D and 3D

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP205	Building Construction and Materials –III	4	1	0	0	3

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To familiarize and equip the students with basic knowledge of engineering drawing and develop skills for visualization of geometric forms

COURSE OUTCOMES

- Understand the manufacturing process and properties of construction materials such as Lime, Cement, and Cement concrete, and their application in construction projects.
- Apply knowledge of the different types of foundations, building elements, and finishing techniques, and be able to prepare and evaluate construction details and techniques for R.C.C. structures.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE	30%

COURSE CONTENTS

MODULE 1: Cement & Concrete: Study of manufacturing process, structural visual and textural properties of construction materials like Lime, Cement and Cement concrete and their application. Preparation, tests and application techniques of lime and cement mortar and concrete, concrete admixtures, varieties of concrete, concreting under special conditions.

MODULE 2: Foundations: Different types of R.C.C. foundations: strip, isolated and combined footings, raft, pile etc, along with details of reinforcement in foundation, plinth beam, etc.

MODULE 3: Super-structure: Construction details, position of reinforcement, material composition, interconnection, etc. of different building elements using R.C.C., viz., columns, shear walls, lintels, sills, overhangs, beams and different types of RCC slab like flat slab, coffered slab, etc. and complex forms like vaults, domes, shell roof, pitch roof, etc. Flooring and

finishing: IPS flooring, mosaic flooring and cement tile flooring interlocking paving blocks etc. Staircases: Construction details and position of reinforcement in stringer beams, waist slab, treads, etc. used in different types of R.C.C. staircases.

Exercises:

Identification and study of relevant I.S. codes, field trips. Preparation of study reports and presentation of seminars, preparation of detailed drawings on above topics.

NOTE: Professional expert may be called from time to time.

REFERENCES:-

1. Francis Building construction: W.B. McKay
2. Building construction: R. Barry
3. Building construction: Roy Chudley
4. Building construction: Francis D.K. Ching
5. National Building Code 2016, BIS Codes
6. Rangwala, S. (2004). Building Construction. 22nd Ed. Anand : Charotar Publishing.
7. Rangwala, S. C. (1963). Building Construction: Materials and types of Construction, 3rd Ed. New York : John Wiley and Sons, Inc.
8. Sushil-Kumar, T. B. (2003). Building Construction. 19th Ed. Delhi : Standard Publications
9. <https://www.bis.gov.in/standards/technical-department/national-building-code/>

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP204	Architectural Design-II	6	0	0	0	6

PREREQUISITE

Architectural Design-I

COURSE OBJECTIVE(s)

- To understand the relationship between a building and architectural drawings
- To understand the vernacular characteristic, climatic context and traditional wisdom through architectural design

COURSE OUTCOMES

1. To develop understanding to identify user needs and translate them into a program.
2. To use the program to manifest them in a design in terms of space, materials and construction methodology that is appropriate in a particular context.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE& viva voce	30%

COURSE CONTENTS

MODULE I: To understand various elements of a building such as wall, floor, roofs, openings, staircase and its application in design. Architectural vocabulary, different materials and their application in design. Methods and techniques to measure and document existing building/settlement and understand the relationship between different spaces.

MODULE II: Basic Concepts: - Various elements of a building such as wall, floor, roofs, openings, staircase and its application in design.

Vocabulary and Materials: - Architectural vocabulary, different materials and their application in design.

Measure drawing: - Methods and techniques to measure and document existing building/settlement and understand the relationship between different spaces.

Note:

- *1 practicing Architect has to be part of the design studio as visiting faculty for each section.*
- *Study tour will be part of the subject.*

REFERENCES:-

1. Joseph De Chiara & John Hancock Callender Time Saver Standards for Building Types.
2. Neufert Architects' Data.
3. <https://www.bloomsburyarchitecturelibrary.com/>
4. <https://architectureandeducation.org/category/spaces-for-learning/>
5. <https://prezi.com/73spztjnv47/qualities-of-architectural-space/>

B.Arch

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR							
DEPARTMENT OF ARCHITECTURE AND PLANNING						II/V	
B.Arch. Teaching Scheme							
Semester IV							
S. No.	Course Code	Course Title	Category	Type	Credits	L-T-P-S	Hours / Week
1	22ART251	Building Services - I	Program Core	Theory	3	2-1-0-0	3
2	22ART252	History of Architecture - III	Program Core	Theory	3	2-1-0-0	3
3	22CET291	Architectural Structures -IV	Linked	Theory	3	2-1-0-0	3
4	22HST291	Technical Communication & Writing	Linked	Theory	3	1-2-0-0	3
5	22ARP253	Architectural Design - III	Program Core	Studio	6	0-0-0-6	6
6	22ARP254	Building Construction & Materials -IV	Program Core	Studio	4	1-0-0-3	4
		Total Credits & Teaching hours/semester			22		22

Scheme/Specialization: B.Arch.

Semester 4

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ART252	History of Architecture-III	3	2	1	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- The course objective is to explore the evolution of Western architecture from Renaissance architecture, Gothic Architecture and Baroque Architecture, examining the social, cultural, and technological influences that have shaped its development.

COURSE OUTCOMES

1. To understand the evolution of spatial and structural systems in the architecture of medieval Europe and near east with reference to societal, technological, political factors and external influences.
2. To develop a comprehensive understanding of the major styles and movements in Western architecture from the Renaissance
3. To analyze and critique key works of architecture in their historical and cultural context.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	20%
b)	MTE	30%
c)	ETE	50%

COURSE CONTENTS

MODULE I- Carolingian & Romanesque Architecture: Romanesque Architecture in Italy and around Pisa Cathedral, Pisa: The Campanile, The Baptistery Abbey of St. Denis in France. Central Europe: Church of Apostles, Cologne, Worm's Cathedral, Military Buildings/forts, general Chateau de mer. Sidon etc.

MODULE II- Western Islamic & Gothic Architecture: Gothic Architecture: Structural System & play of lights France: Loan Cathedral: Chartes Cathedral: Reims & Amiens Cathedral British Isles: Canterbury: King's College Chapel, Cambridge: Westminster Abbey Wells Cathedral. Italy: Milan Cathedral: S. Maria Del Florence: S. Maria Novella, Florence etc.

MODULE III- Renaissance Architecture: Renaissance Architecture (upto 1800 A.D.): Forces governing and character of Early Renaissance. Filippo Brunelleschi. Dome of Florence Cathedral Foundling Hospital. S. Lorenzo. Florence Michelozzo: Medici Palace (Palazzo Riccardi) Florence; Palazzo Pitti Florence Leon Battista Alberti; S. Francesco, Rimini. Palazzo Rucellai, St. Andrea at Mantua, St. Maria Novella etc. High Renaissance & Mannerism Bramante: Tempietto, Rome: S. Peter, Rome: Palazzo Farnese, Rome House of Raphael, Andrea Palladio: Basilica, Vicenza, Rotunda (Villa Capra), S. Giorgio Maggiore, Venice: Palladian motifs Michelangelo: Laurentian Library, Florence: Capitoline Palaces, Rome: S. Peter, Rome: Palazzo Farnese, Rome Vitruvius's- IL- Gesù, Rome Raphael: Villa Madama, Rome etc.

MODULE IV- Baroque & Rococo Architecture: Baroque And Rococo- Bernini: St. Andrea at Quirinale, Rome; St. Susanna Piazza of S. Peter, Rome Francesco Borromini: S. Carlo alle Quattro Fontane, Rome S. Giovanni in Laterano Rome Guarino Guarini: S. Lorenzo Turin, Capelladella; S. Sindona, Turin France: Chateau de Chambord, Pierre LeNôtre Fontainebleau Palais de Versailles: Church of Invalides etc. Architecture in British Isles: Tudor, Elizabethan Jacobean Town Houses & streets & restoration St. Paul's Cathedral, London Sir Christopher Wren St. Martin in the Fields, London: Castle Howard Palladianism: Houghton Hall, Norfolk etc.

REFERENCES:-

1. History of Architecture, Fletcher, S. B., London: Batsford & 1924.
2. A history of architecture: settings and rituals, Kostof, S., New York: Oxford & 1995.
3. Encyclopedia of Architecture & Architects, Sharp, D., Watson-Guptill; 1st edition & 1991.
4. Introduction to the History of Architecture. (n.d.). Udemy.
<https://www.udemy.com/course/introduction-to-the-history-of-architecture-for-children/>

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ART251	Building Services- I	3	2	1	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To familiarize and equip the students with basic knowledge of :
- Fundamentals of water supply, drainage, sewerage system and solid waste disposal.
- Water distribution systems and their requirements at different scales, such as buildings, site, neighbourhoods, etc.
- Sanitation and its layout requirements at different scales, such as building, colony and neighborhood.
- Calculations and disposal of rainwater and solid waste disposal

COURSE OUTCOMES

1. To give a basic overview and understanding of water supply and distribution at building and neighbourhood level.
2. To understand drainage and sewage removal at building and neighbourhood level.
3. Design efficient water supply layouts with detailed calculations.
4. To understand & design house Connection & Plumbing Appurtenances.
5. Design rain water disposal and rain water disposal drawings.
6. To equip students to make detail drawings for water supply and sanitation at building level.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	20%
b)	MTE	30%
c)	ETE	50%

COURSE CONTENTS

MODULE I - Water Supply: Terminology, sources of water, fundamentals of treatment of water and types of water distribution system at neighbourhood/city level. Requirements and calculations of water consumption for various building types and occupancies, storage and distribution of water within low rise building premises. Hot water and solar water heating installations and supply, study of fittings, appliances and their layout within the building.

MODULE II - Drainage and Sanitation: Terminology and concepts: Surface run-off, Storm water drainage and rainwater harvesting. Design considerations for wastewater, sewage and solid waste management for buildings.

REFERENCES BOOKS :-

1. Renewable Energy Sources: Twidell& Weir, CRC Press.
2. R. Barry, Building Construction Volume 1 to 5
3. Francis Ching D.K., Building Construction Illustrated
4. S.K. Sharma, Civil Engineering Construction Materials
5. Sushil Kumar, Building Construction
6. Building Construction : W.B. McKay
7. National Building Code.
8. Udemy.com : Design of Plumbing Systems in a Building for Water Supply by Rishabh Srivastava

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22CET291	Architectural Structures- IV	3	2	1	0	0

PREREQUISITE

COURSE OBJECTIVE(s)

- To study the design of steel structures in buildings.

COURSE OUTCOMES

- To develop understanding related to steel and its manufacturing with properties.
- To be able to understand the basic properties of steel and its behavior under loading.
- To be able to design the various joints of steel under different loading conditions.
- To be able to understand the roof trusses, arrangements and various sections.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	30%
b)	MTE	30%
c)	ETE	40%

COURSE CONTENTS

MODULE I - Connection: riveted and bolted joints; design of fillet, butt, plug and slot welds; design of riveted, bolted and welded joints for axially loaded member, eccentric connection

MODULE II- Design of tension member

MODULE III- Design of compression member; built-up column, design of lacing and battening. **MODULE IV**- Column base and introduction to grillage foundation. Design of laterally restrained beams; simple and built up sections.

MODULE V- Roof trusses; generally, arrangement of trusses, spacing of trusses, design loads, design of purlin and simple roof trusses. Introduction to the concept of earthquake-resistant design in buildings

REFERENCES

- S. K. Duggal, Design of steel Structure
- R. Chandra, Design of steel Structure

DETAILS OF THE COURSE

Course Code	Course Title	Credit s	Lecture	Tutorial	Practical	Studio
22HST291	Technical Communication and Writing	3	1	2	0	0

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- The student will have good knowledge of the basic principles of technical communication.
- the student will have detailed knowledge of construction of paragraphs, summarizing skills, and writing, designing and formatting technical reports and proposals.
- The student will be able to make and deliver effective presentations

COURSE Outcome

1. Understand the basic principles of technical communication, develop writing & presentation skills.

COURSE ASSESSMENT

The assessment will be based on Term Examinations as well as internal summation keeping in mind the students' performance in the class as well.

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	CWS	20%
b)	MTE	30%
c)	ETE	50%

COURSE CONTENTS

MODULE 1: TECHNICAL COMMUNICATION: Basic Principles: Audience Analysis, The Objective of Communication, Written Vs Spoken Language.

MODULE 2: WRITING SKILLS: Technical Writing: Basic Principles, Structure & Organization, Features of Good Writing, Process of Writing, Readability: Formatting/Designing the Document, Types of Technical Writing. Technical description: Summary, Technical Report/Proposal, Salient Features, Types & Structure, Data Collection, Use of Graphic Aids and Visuals Drafting, Writing, Editing.

MODULE 3: PRESENTATION SKILLS: Speaking Skills: Accuracy vs. Fluency, The Audience, Pronunciation Guidelines, Effective Non-Verbal Communication, Professional

Presentations, Planning, Preparing, Presentation Strategies, Overcoming Communication Barriers, Using Technology.

References:

1. Kumar, Sanjay & Pushp Lata, "Communication Skills", Oxford University Press, 2011
2. Quirk & Randolph, "A University Grammar of English", Pearson, 2006
3. Rutherford, Andrea J., "Basic Communication Skills for Technology", Pearson, 2007
4. Rizvi, M Ashraf, "Effective Technical Communication", McGraw Hill, 2009
5. Leigh, Andrew & Maynard, Michael, "The Perfect Presentation", Random House
6. Barker, Larry L., "Communication", Prentice-Hall
7. Lesikar & Flatley, "Basic Business Communication-Skills For Empowering the Internet Generation", Tata McGraw-Hill

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP254	Building Construction and Materials – IV	4	1	0	0	3

PREREQUISITE

NONE

COURSE OBJECTIVE(s)

- To make students aware about use and application of metals & its alloys in building construction

COURSE OUTCOMES

1. The course covers the study of structural, visual, and textural properties of steel, metals, and alloys, and their applications.
2. Students will be able to examine and evaluate the planning and execution of different foundation systems, superstructures, roofing materials, and openings utilizing steel, metals, and alloys.
3. Students will also gain knowledge of the materials and finishes for industrial flooring, metal cladding, and metal staircases, in addition to the construction details of these structures.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
d)	PRS	50%
e)	PRM	20%
f)	PRE	30%

COURSE CONTENTS

MODULE I: Study of structural, visual and textural properties of steel, metals and alloys and their applications. Introduction to protective coatings on metals.

MODULE II: Foundation: Grillage foundation.

MODULE III: Super structure: Steel columns, Frames and space structure, Steel portals and steel trusses. Roofing: North light roof truss, patent glazing, etc. Materials and construction details for roof covering using different types of profile sheets. Flooring and finishes: Industrial

flooring and metal cladding.

B.Arch

MODULE III: Openings: Doors, section windows in MS & aluminum and their fixing details. Staircases: Metal staircases of different types.

Exercises

- Identification of materials and study of relevant I.S. codes, market survey, field trips.
- Preparation of study reports and presentation of seminars, preparation of detailed drawings on above topics.

NOTE: *Professional expert may be called from time to time.*

REFERENCES:-

1. Francis Building construction: W.B. McKay
2. Building construction: R. Barry
3. Building construction: Roy Chudley
4. Building construction: Francis D.K. Ching
5. National Building Code 2016, BIS Codes
6. Rangwala, S. (2004). Building Construction. 22nd Ed. Anand : Charotar Publishing.
7. Rangwala, S. C. (1963). Building Construction: Materials and types of Construction, 3rd Ed. New York : John Wiley and Sons, Inc.
8. Sushil-Kumar, T. B. (2003). Building Construction. 19th Ed. Delhi : Standard Publications.
9. <https://www.bis.gov.in/standards/technical-department/national-building-code/>

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22ARP253	Architectural Design-III	6	0	0	0	6

PREREQUISITE:

Architectural Design-II

COURSE OBJECTIVE(s)

- To understand the concepts of barrier free design in built spaces
- To design simple buildings involving multiple functions
- To understand the relationship between site and building

COURSE OUTCOME

1. To develop understanding related to concepts of barrier free design in built spaces
2. To be able to design simple buildings with multiple functions
3. To develop understanding of program development and design methodology, with articulation of a multi-use and multi-user program focusing on site and the context as a moderator of urban space.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	PRS	50%
b)	PRM	20%
c)	PRE+Viva	30%

COURSE CONTENTS

Basic concepts: - Designing simple building/group of buildings involving multiple functions.

Design of building: - Design of small scale community buildings, institutional, public buildings or recreational buildings involving principles of site planning and barrier free design.

Design Exercise:

Designing simple building/group of buildings involving multiple functions.

Design of small-scale community buildings, institutional, public buildings or recreational buildings involving principles of site planning and barrier free design.

Note:

- *1 practicing Architect has to be part of the design studio as visiting faculty for each section.*

REFERENCES:-

1. V. S. Pramer, Design Fundamentals in Architecture.
2. Time Savers Standards of Architects' Design Data
3. CPWD Manual for Barrier Free Design
4. Landscape Graphics- Grant W. Reid
5. Time Savers Standards of Building Types
6. <https://www.bloomsburyarchitecturelibrary.com/>
7. <https://www.re-thinkingthefuture.com/2023/02/09/a9308-how-to-plan-a-multifunctional-room/>
8. <https://www.arch2o.com/multifunctional-spaces-are-fundamental-for-a-better-quality-of-life/>

Tentative UG Scheme for B.Tech AIDE

First Semester					
S. No	Code	Subject	L-T-P	Credit	Type
1		Mathematics I	3-0-0	3	IC
2		Physics	3-0-0	3	IC
3		Python Programming + Lab	2-0-2	3	IC
4		Environmental Science	1-0-0	1	IC
5		Soft Skill Foundational Lab	0-0-2	1	IC
6		Ethics and Human values	1-0-0	1	IC
7		Engg. Drawing and Sketching Lab	0-0-2	1	IC
8		Physics Lab	0-0-2	1	IC
9		Data Structure using C	3-0-0	3	PC
10		Data Structure using C Lab	0-0-2	1	PC
11		Computational Perception and Cognition	2-0-0	2	PC
			Total	20	

Second Semester					
S. No	Code	Subject	L-T-P	Credit	Type
1		Mathematics II	3-0-0	3	IC
2		Makers Lab		6	IC
3		Data Science /Analytics/Visualization		2	IC
4		Introduction to Artificial Intelligence	3-1-0	4	PC
5		Mathematics for AIDE	2-0-0	2	PC
6		Signals and Systems	3-0-0	3	PL(EA S/BS)
			Total	20	

DATA STRUCTURES USING C				
Prerequisite: Nil	L	T	P	C
Total Hours: 42	3	0	0	3
Course Focus: Unit 1 establishes the required C programming foundation; all subsequent data structures and algorithms are represented, analyzed, and implemented using C.				

COURSE CONTENT		Hrs
Unit	Topics	Hours
Unit 1	C Programming Fundamentals: Introduction to computers, computational thinking, problem-solving steps, algorithms, flowcharts, fundamentals in C, data types, storage classes, operators, expressions, formatted input/output and command-line arguments. Control and Functions : Decision and looping statements; functions, parameter passing, scope, recursion,	8
Unit 2	Fundamentals of Data Structures: Concept and classification of data structures, memory allocation, dynamic memory allocation using malloc(), calloc(), realloc() and free(), abstract data types, asymptotic notation and analysis of time and space complexity. Linear Data Structures in C: Arrays and linked lists (singly, doubly and circular); stack representation, operations and applications; queue implementation, sequential and circular queues, deque, dynamic queue implementation and applications. C structures, pointers and dynamic memory are used throughout the implementations. basic file handling using C.	8
Unit 3	Searching and Sorting: Linear search and binary search; bubble, selection, insertion, merge, quick, counting, bucket, radix and heap sorting; stability, in-place behavior and comparison of sorting algorithms based on complexity and use cases. Hashing and Hash Tables: Hash functions; open and closed hashing; collision handling through chaining and probing; dynamic and extendible hashing; design and implementation of hash tables in C.	8
Unit 4	Trees: Binary-tree terminology and representations; tree traversals; binary search trees; threaded binary trees; list representation and dynamic implementation of binary trees; AVL trees and rotations; tree applications; interval trees; M-way search trees; B-trees and B+ trees. Heaps: Heap representation and operations, priority queues, heap applications and C-based implementations of tree and heap operations.	10
Unit 5	Graphs: Graph fundamentals; directed and undirected graphs; adjacency matrix and adjacency-list representations in C; graph traversal using depth-first search and breadth-first search; connected components and basic applications. Graph Algorithms: Shortest-path computation using Dijkstra's algorithm; minimum spanning trees using Prim's algorithm; implementation considerations, complexity analysis and comparative problem solving using suitable data structures.	8

REFERENCES

No.	Reference
1.	Tenenbaum, A. M., Langsam, Y., and Augenstein, M. J. Data Structures Using C. Pearson Education.
2.	Cormen, T. H., Leiserson, C. E., Rivest, R. L., and Stein, C. Introduction to Algorithms, 3rd ed. MIT Press, 2009.
3.	Kernighan, B. W., and Ritchie, D. M. The C Programming Language, 2nd ed. Prentice Hall.
4.	Aho, A. V., Hopcroft, J. E., and Ullman, J. D. Data Structures and Algorithms. Addison-Wesley.
5.	Levitin, A. Introduction to the Design and Analysis of Algorithms, 2nd ed. Pearson. 1
6.	Kanetkar, Y. Let Us C. BPB Publications.

DATA STRUCTURES USING C LAB					
Prerequisite: Basic C Programming		L	T	P	C
Total hours: 30		0	0	2	1
COURSE CONTENT					Hrs
	The following topics are broad laboratory areas. All programs shall be implemented using C. The instructor may adopt suitable variations in consultation with the corresponding theory course.				
Unit 1	Introduction to Linux and programming C Programming Fundamentals and Problem Solving: Programs using input/output, operators, decision and loop constructs, arrays, structures, functions, pointers, recursion, and dynamic memory allocation. Practice in compilation, debugging, and modular program development.				6
Unit 2	Linear Data Structures Using C: Implementation of arrays and sparse matrices; singly, doubly, and circular linked lists; stacks using arrays and linked lists; linear queues, circular queues, dequeues, and their applications.				6
Unit 3	Searching, Sorting and Hashing Using C: Programs for linear search, binary search, and hashing with chaining and probing. Implementation and comparison of bubble, selection, insertion, merge, quick, counting/radix, and heap sorting methods.				6
Unit 4	Trees, Heaps and Priority Queues Using C: Binary-tree creation and traversals; binary search tree operations; AVL-tree rotations; threaded-tree concepts; binary heaps and priority queues; introductory implementation of B-tree and B+ tree operations.				6
Unit 5	Graphs and Algorithm Applications Using C: Graph representation using adjacency matrix and adjacency list; graph traversal using DFS and BFS; implementation of Dijkstra shortest-path and Prim minimum-spanning-tree algorithms.				6
REFERENCES					
1.	Tenenbaum, A. M., Langsam, Y., and Augenstein, M. J., Data Structures Using C, Pearson Education.				
2.	Kernighan, B. W., and Ritchie, D. M., The C Programming Language, 2nd Edition, Prentice Hall.				
3.	Cormen, T. H., Leiserson, C. E., Rivest, R. L., and Stein, C., Introduction to Algorithms, 3rd Edition, Prentice Hall of India/MIT Press.				
4.	Aho, A. V., Hopcroft, J. E., and Ullman, J. D., Data Structures and Algorithms, Addison-Wesley.				
5.	Levitin, A., Introduction to the Design and Analysis of Algorithms, 2nd Edition, Pearson.				

Computational Perception and Cognition				
Prerequisite:		L	T	P
Total Hours: 28		2	0	0
Course Content				Hrs
Unit 1	Introduction; Philosophical, Psychological, and Cognitive approaches to modeling the mind; ingredients of computation and nature of representation; approaches to characterising, formalising, and modelling the mind; role of intentionality			4
Unit 2	The relevance of computation and AI; types of computation, physical symbol system hypothesis			4
Unit 3	Symbolic representations and models of cognition			4
Unit 4	Broader philosophical debates; challenges and limitations in modelling the mind; functionalism and the rise of AI The First AI Debate: Can Machines Think?			8
Unit 5	Connectionist models; Higher order perception like object and pattern recognition; The Second AI Debate: Symbolism or Connectionism? Connectionist models: RNNs, attention, transformers, LLMs; implications for cognitive science and notions of intelligence, knowing, and understanding			8
References				
1.	Jay Friedenber and Gordon Silverman. Cognitive Science: An Introduction to the Study of Mind (3rd ed.). SAGE, 2015.			
2.	Cameron J. Buckner. From Deep Learning to Rational Machines: What the History of Philosophy Can Teach Us about the Future of Artificial Intelligence. Oxford, 2023.			

3.	John Haugeland, Carl F. Craver, and Colin Klein. Mind Design III: Philosophy, Psychology, and Artificial Intelligence. MIT, 2023.
4.	Stan Franklin. Artificial Minds. MIT, 1995.

AIDE

Introduction to Artificial Intelligence					
Prerequisite: Some basic set theory (what is a set and elementary set operations), logic, probability, and continuous mathematics		L	T	P	C
Total Hours: 42		3	1	0	4
Course Content					Hrs
Unit 1	Introduction: What is AI, Foundation of AI and its history, Agents and Environment				8
Unit 2	Problem Solving: Solving problem by searching, Beyond classical search, Adversarial search, Constraint satisfaction problems				8
Unit 3	Knowledge, reasoning and planning: Logical agents, First order logic, Inference in First order logic, Knowledge representation.				9
Unit 4	Uncertain knowledge and reasoning: Quantifying uncertainty, Probabilistic reasoning, Probabilistic reasoning over time, Inference in temporal models, Hidden Markov models, The basis of utility theory, Utility functions, Multi-attribute utility functions				9
Unit 5	Learning: Learning from examples, Evaluating and choosing the best hypothesis, The theory of learning, Knowledge in learning				8
References					
1.	Artificial Intelligence: A Modern Approach, 3rd Edition, Stuart Russell and Peter Norvig.				
2.	Elaine Rich, Kevin Knight, and Shivashankar B. Nair, Artificial Intelligence, McGraw Hill, 3rd Edition, 2009.				
3.	Probability and Statistics for Machine Learning, Anirban DasGupta, Springer.				
4.	The Elements of Statistical Learning, Trevor Hastie and Robert Tibshirani, 2nd Edition, Springer.				

Mathematics for AI						
Prerequisite: Basic set theory, elementary algebra, vectors, matrices, and introductory calculus (derivatives and integrals).			L	T	P	C
Total hours: 28			2	0	0	2
Course Content						Hrs
Unit 1	Linear Algebra and Analytic Geometry: Systems of linear equations; matrices and matrix operations; vector spaces; linear independence; basis and rank; linear mappings and affine spaces; norms and inner products; lengths and distances; angles and orthogonality; orthonormal bases; orthogonal complements; and projections.					8
Unit 2	Matrix Decompositions and Vector Calculus: Determinant and trace; eigenvalues and eigenvectors; eigendecomposition and diagonalization; singular value decomposition; low-rank matrix approximation; differentiation of univariate and multivariate functions; partial derivatives and gradients; gradients of vector-valued functions and matrices; useful matrix-calculus identities; backpropagation and automatic differentiation; higher-order derivatives; and multivariate Taylor series.					8
Unit 3	Probability and Distributions: Probability spaces; discrete and continuous random variables; joint, marginal and conditional probability; sum rule, product rule and Bayes theorem; independence and conditional independence; expectation, variance and covariance; Gaussian distribution; exponential-family distributions; and change of variables.					6
Unit 4	Continuous Optimization and AI Applications: Optimization using gradient descent; constrained optimization and Lagrange multipliers; fundamentals of convex optimization; empirical risk minimization and parameter estimation; mathematical formulation of linear regression; dimensionality reduction using principal component analysis; and brief mathematical connections to Gaussian mixture models and support vector machines.					6
References						
1.	Marc Peter Deisenroth, A. Aldo Faisal and Cheng Soon Ong, Mathematics for Machine Learning, Cambridge University Press, 2020.					
2.	Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press.					
3.	Stephen Boyd and Lieven Vandenberghe, Convex Optimization, Cambridge University Press.					
4.	Sheldon M. Ross, A First Course in Probability, Pearson.					
5.	Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer.					

Scheme for B. Tech. in Chemical Engineering 1st Year**I Semester:**

S. No.	Course Code	Course Title	Category	Type	Credit	L	T	P
1.		Mathematics I	IC	Theory	3	2	1	-
2.		Chemistry (IC bucket*)	IC	Theory	3	3	-	-
3.		Makers Lab (ME+EE+ECE)	IC	Lab	6	-	3	6
4.		Data Science/ Analytics/ Visualization	IC	Theory	2	2	-	-
5.		Chemistry Lab (IC Lab bucket*)	IC	Lab	1	-	-	2
6.		Introduction to Chemical Engineering	PC	Theory	2	2	0	0
7.		Computer Aided Numerical Methods	PC	Theory	2	2	0	0
8.		Computer Aided Numerical Methods Lab	PC	Lab	1	0	0	2
Total					20	11	4	10

II Semester:

S. No.	Course Code	Course Title	Category	Type	Credit	L	T	P
1.		Mathematics II	IC	Theory	3	2	1	-
2.		Physics (IC bucket*)	IC	Theory	3	2	1	-
3.		Python Programming and Lab (IC bucket*)	IC	Lab	3	2	-	2
4.		Environmental Science	IC	Theory	1	1	-	-
5.		Soft Skills Foundational Lab	IC	Lab	1	-	-	2
6.		Ethics And Human Values	IC	Theory	1	1	-	-
7.		Physics Lab (IC Lab bucket*)	IC	Lab	1	-	-	2
8.		Engg. Drawing and Sketching Lab (IC Lab bucket*)	IC	Lab	1	-	-	2
9.		Chemical Engineering Thermodynamics-I	PC	Theory	3	2	1	0
10.		Chemical Process Calculations	PC	Theory	4	3	1	0
Total					21	13	4	8

I Semester Program Core Syllabus

Chemical Engg.

1. Subject Code: (To be assigned), **Subject Title:** Introduction to Chemical Engineering

2. Contact Hours: L-T-P: 2-0-0

3. Credits: 2, **Semester:** I

4. Pre-requisite: None

5. Course Objectives: To introduce the basic features and concepts of Chemical Engineering to the students.

6. Course Outcomes: Upon completion of this course, the students will be able to:

- i. Understanding the chemical engineering and its future prospects
- ii. To acquire knowledge of chemical process industries
- iii. To acquire knowledge of basic principles of chemical engineering
- iv. Knowledge of new developments in chemical engineering and career prospects

Details of course:

Unit No.	Contents	Contact Hours
1	Introduction: Definition of chemical engineering, historical perspective and contribution; job description and attributes of a chemical engineer, chemical engineering and its seamless integration with other sciences and engineering disciplines; Societal needs and role of chemical engineer for society development; Economic scale of production; Waste utilization and recycle, sustainable technology; Employment opportunities, knowledge resources; Frontiers & future roadmap; Challenges of chemical engineering practice.	8
2	Chemical Process Industries: Framework of chemical industry and its classification, Evolution of chemical industries, Technological developments in major challenges; Chemical industries structure and segments of chemical industry, raw material and production pattern; Petroleum, petrochemical and fertilizer industry integration; Cleaner and greener technologies.	7
3	Basic Principles of Chemical Engineering: Basic principles of chemical processes, unit processes and unit operations and various routes to produce chemicals; Material and Energy balances; Basic concept of mass, energy, and momentum transport; Equilibrium and rate-based processes.	7
4	Reaction engineering and reactors; Measuring instruments, automation, and control; Concept of equipment design, modelling and simulation.	7
	Total Contact Hours	28

Text Books:

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Nnaji, U., "Introduction to Chemical Engineering: For Chemical Engineers and Students", Wiley.	2019
2	Solen, K.A. and Harb, J.N., "Introduction to Chemical Engineering Tools for Today and Tomorrow", 5 th edition, John-Wiley.	2011
3	Denn, M.M., "Chemical Engineering: An Introduction", Cambridge University Press.	2012

Reference Books:

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Pushpavanam, S., "Introduction to Chemical Engineering", PHI Learning Pvt. Ltd.	2012
2	Ghosal, S.K., Sanyal, S.K., Datta, S., "Introduction to Chemical Engineering", Tata McGraw Hill.	1997
3	Himmelblau D.M. and Riggs J.B., "Basic Principles and Calculations in Chemical Engineering", 8 th Edition, PHI.	2014
4	Austin, G. T., "Shreve's Chemical Process Industries", 5 th Edition, McGraw-Hill.	1984

1. **Subject Code:** (To be assigned), **Course Title:** Computer Aided Numerical Methods

2. **Contact Hours:** L:2 T:0 P:0

3. **Credits:** 2 **Semester:** I

4. **Pre-requisite:** Nil

5. **Course objective:** To learn the different numerical techniques for solving algebraic, ordinary differential, partial differential equations and curve fitting of experimental data.

6. **Course outcome:** Upon completion of this course, the students will be able to:

- i. Apply numerical techniques for solving linear and nonlinear problems, including polynomials, single equation problems, and systems of linear and nonlinear equations
- ii. Use the regression techniques for linear and nonlinear parameter estimation
- iii. Able to apply the different techniques of numerical differentiation and integration
- iv. Use the numerical techniques for solving all the different types of ordinary and partial differential equations

7. **Details of Course:**

Unit No.	Contents	Contact Hours
1.	Linear Algebraic Equations: Introduction, Gauss-Elimination, Gauss-Siedel and LU Decomposition methods, Thomas' algorithm.	6
2.	Nonlinear Algebraic Equations: Single variable and multivariable successive substitution method, single variable and multivariable Newton-Raphson technique, Polynomial root finding methods.	4
3.	Function Approximation: Least squares curve fit, Newton's interpolation formulae, Lagrangian interpolation, Pade approximation, Cubic spline approximation. Numerical differentiation & Integration.	6
4.	Ordinary Differential Equations - Initial Value Problems: Explicit Adams Bashforth technique, Implicit Adams-Moulton technique, Predictor-corrector technique, Runge-Kutta methods, Stability of algorithms. Ordinary Differential Equations - Boundary Value Problems: Finite difference technique, Orthogonal Collocation (OC), Shooting Techniques.	7
5.	Partial Differential Equations: Partial Differential Equations (PDE) – Classification of PDE, Finite difference technique (Method of	5

	lines), Case Studies. Use of spreadsheets.	
	Total Contact Hours	28

8. Books:**(A) Text Books:**

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Sastry, S. S., Introductory Methods of Numerical Analysis, 5 th Ed., PHI, New Delhi.	2012
2	Gupta, S. K., Numerical Methods for Engineers, 4 th Ed. New Age International Ltd., New Delhi.	2019

(B) Reference Books:

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Constantinides, A., and Mostoufi, N., Numerical Methods for Chemical Engineers with MATLAB Applications, Prentice Hall.	1999
2	Hanna, O.T. and Sandall, O. C., Computational Methods in Chemical Engineering, Prentice-Hall.	1995
3	Davis, M. E., Numerical Methods & Modeling for Chemical Engineers, John Wiley.	1984
4.	Finlayson Bruce A., Introduction to Chemical Engineering Computing, Wiley.	2012

1. Subject Code: CHTXXX **Course Title:** Computer Aided Numerical Methods Lab

2. Contact Hours: L:0 T:0 P:2

3. Credits: 1 **Semester:** I

4. Pre-requisite: Nill

5. Course Objective: To develop proficiency in applying numerical methods and programming skills using simulation software to solve chemical engineering problems, including algebraic equations, data analysis, and differential equations relevant to process modeling and simulation.

6. Course outcome: On successful completion of this course students will be able to:

- i. Implement and apply numerical methods (e.g., Bisection, Newton-Raphson, Regula-Falsi, Gauss elimination, and interpolation techniques) to solve algebraic and data-driven chemical engineering problems using simulation software.
- ii. Develop programs for numerical integration, curve fitting, and solution of ordinary differential equations (ODEs) to model and analyze chemical engineering systems.
- iii. Utilize simulation tools and plotting techniques to visualize results, interpret numerical solutions, and evaluate the accuracy and stability of different numerical methods.

7. Details of Course:

Develop programs, incorporating numerical algorithms, in the required simulation software to solve the following numerical methods using chemical engineering-based problems.

- i. Basics of simulation software, plotting & error analysis
- ii. Nonlinear equations: Bisection, Regula-Falsi, Secant, Newton–Raphson
- iii. Multi-variable nonlinear algebraic equations: Newton–Raphson Method
- iv. Linear equations: Gauss Elimination, Gauss Jordan, LU decomposition
- v. Numerical differentiation methods
- vi. Data fitting using least squares & regression
- vii. Interpolation: Newton, Lagrange methods
- viii. Numerical integration: Trapezoidal, Simpson’s methods
- ix. ODE-IVP: Euler, Modified Euler, Runge–Kutta methods
- x. ODE-BVP: Finite difference & Thomas algorithm, Shooting method, Orthogonal Collocation method
- xi. Simulation-based mini case study

II Semester Program Core Syllabus

Chemical Engg.

1. Subject Code: CHTXXX Course Title: Chemical Engineering Thermodynamics-I**2. Contact Hours:** L: 2 T: 1 P: 0**3. Credits:** 3 **Semester:** II**4. Pre-requisite:** Nil.**5. Objective:** To learn the principles of work and energy and understand the laws of thermodynamics to apply in industries.**6. Course Outcomes:** Upon completion of this course, the students will be able to:

- i. To understand the basic concepts and first law of thermodynamics
- ii. To understand the PVT behaviour of fluids
- iii. To understand the heat effects
- iv. To understand the second law of thermodynamics
- v. To understand the concepts of statistical thermodynamics

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction to Thermodynamics First Law of Thermodynamics: First law analysis of control mass and control volume, steady state, and transient processes.	7
2.	Volumetric Properties of Pure Fluids: PVT behavior of pure substances, virial equation and cubic equations of states for gases and liquids.	7
3.	Heat Effects: Sensible and latent heat effects, standard heats of reaction, formation and combustion, effect of temperature on the standard heat of reaction.	7
4.	2nd Law of Thermodynamics: Limitation of 1 st law, Kelvin-Planck and Clausius Statements, reversible and irreversible processes, entropy, 2 nd law analysis of control volume processes.	7
	Total Contact Hours	28

8. Books:**(A) Text Books**

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Smith, J. M., Van Ness, H. C. and Abbott, M. M., "Introduction to Chemical Engineering Thermodynamics", 8 th Ed., McGraw-Hill.	2019
2	Rao, Y. V. C., "An Introduction to Thermodynamics," University Press.	2004

(B) Reference Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
72		10

1	Cengel, Y.A., "Thermodynamics: An Engineering Approach," 9 th Ed., McGraw-Hill.	2019
2	Nag, P.K., "Engineering Thermodynamics", 6 th Ed., McGraw-Hill	2017

Chemical Engg.

1. Subject Code: CHTXXX**Course Title:** Chemical Process Calculations**2. Contact Hours:** L:3 T:1 P:0**3. Credits:** 4 **Semester:** II**4. Pre-requisite:** Nil.**5. Objective:** To introduce to the fundamental principles of chemical process analysis.**6. Course Outcomes:** Upon completion of this course, the students will be able to:

- Correlate between different Unit systems and their conversions for various process variables.
- Learn how to perform materials balance in any chemical processes with or without chemical reactions.
- Apply the gas laws to solve problems related to ideal gases and mixtures.
- Apply the energy balance to solve particular problems with and without chemical reactions
- Solve de-coupled and coupled equations of mass and energy balance, numerically and computationally.

7. Details of Course:

Unit No.	Contents	Contact Hours
1.	Introduction to Chemical Engineering Calculations: Conversion of Units, dimensional consistency and data analysis, significant figures, precision and accuracy, concepts of molarity, molality, normality, ppm, weight fraction, mole fraction and volume fraction, density and specific gravity, process variables and principles of stoichiometry.	10
2.	Materials balance with and without chemical reactions: Flowchart, mole and mass balance for multi-component systems under: steady and unsteady state, single-phase and multiphase, material balances in processes including recycle, bypass and purge, Steady state material balances for reactions: species and elemental balances, combustion reactions, concept of limiting, excess reactants, fractional conversion and percentage of conversion, yield, ultimate and proximate analysis of fuels, excess air, air-fuel ratio calculations.	10
3.	Thermodynamics of Multi-phase System: Vapor-liquid equilibrium: Ideal and real gas, equation of state, Bubble point, dew point calculations, Phase diagram, Gibbs phase rule, Antoine equation, phase equilibria of vapour-liquid, solid-liquid and immiscible liquid-liquid systems.	10
4.	Energy Balance with and without Chemical Reactions: De-Coupled and coupled mass and energy balances, calculation of enthalpy changes, steady state mass and energy balance with and without reactions, heats of solution and mixing, Use of Psychometric chart, and steam table, thermochemistry, Hess's law of summation- heat of formation, Hess's Law and heats of combustion, Unsteady state material and energy	10

	balances, isothermal and adiabatic processes, Numerical and computation approach to solve problems with simultaneous mass and energy balance.	
	Total Contact Hours	40

8. Books:

(A) Text Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Himmelblau, D., Riggs, J., "Basic Principles and Calculations in Chemical Engineering", 8 th Ed., Pearson.	2012
2	Hougen, O.A, Watson, K.M and Ragatz R.A, "Chemical Process Principles: Part .1 (Chemical Process Principles: Material and Energy Balances)", 2 nd Ed., CBS	2004

(B) Reference Books

S.No.	Authors / Name of Book / Publisher	Year of Publication
1	Bhatt B.I, and Vora S.M, "Stoichiometry", 4 th Ed., McGraw-Hill.	2004
2	Felder, R.M., Rousseau, R.W., and Bullard, L.G., "Elementary Principles of Chemical Processes", 4 th Ed., John Wiley and Sons.	2016
3	Narayanan, K.V., and Lakshmikutty, B., "Stoichiometry & Process Calculations", 2 nd Ed., Prentice Hall Publishing.	2016
4	Chopey, N., Hicks, T., "Handbook of Chemical Engineering Calculations", 4 th Ed., McGraw-Hill Education.	2012

**MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY
DEPARTMENT OF CIVIL ENGINEERING**

Draft Minutes of DUGC Meeting held on July 24, 2026

The meeting was convened by the Convener, DUGC, Prof. Sumit Khandelwal at 11:30 PM on 24th July 2026. The meeting was attended by the following members:

- Prof. Sumit Khandelwal, Convener, DUGC
- Prof. Urmila Brighu, Head of the Department
- Dr. Rajesh Gupta, Convener, DPGC
- Dr. Sandeep Shrivastava, Program Advisor, 4th year
- Dr. Dhiraj Raj, Program Advisor, 3rd year
- Dr. Leelambar Singh, Program Advisor, 2nd year
- Dr. Abhishek Saha, Program Advisor, 1st year
- Prof. Arun Gaur, Special invitee
- Dr. Amit Kumar, Special invitee

The agenda items discussed in the meeting and resolution/recommendations of the committee are given hereunder.

1. Revision of the first-year UG curriculum

The DUGC reviewed the proposed first-year curriculum, submitted by different sub-committees, in detail. Members discussed the relevance of course content, credit distribution, and the balance between theoretical and practical learning. Following recommendations are made with respect to the courses to be taught to the I B.Tech. students:

- The syllabi of institute core courses (Environmental science and Engineering Drawing and Sketching Lab) were reviewed and finalized by the committee with the feedback received by the student representatives. These syllabi will be circulated to all faculty members of the institute for feedback and comments.
- The committee recommends that as the course on Environmental Science is of one credit only, its evaluation shall be different from other regular theory courses having 2 or more credits. **The Committee proposed that this course shall have ETE of one hour duration only. Also, the MTE and other components of evaluation shall be as per the other one credit courses.**
- **The theory course ‘Construction Materials’, proposed to be taught to the I Semester B.Tech. (Civil Engineering) students, shall be 3 credits to accommodate all the relevant topics of this course.** The revised program course scheme for I semester B.Tech. (Civil Engineering) is given below.

- The syllabi of program core courses (Surveying-I, Surveying-II, Surveying Lab, Construction Materials, Construction Materials Lab and Mechanics of Solid) was circulated to the faculty members of the department. The committee discussed the comments received and the suggestions were incorporated to finalize the syllabi. The final syllabi will be circulated for further comments and feedback.

S.N.	Course Name	Credit (L-T-P)	Sem.
1	Surveying-I	2 (2-0-0)	I
2	Construction Materials*	3 (3-0-0)	I
3	Construction Materials Lab	1 (0-0-2)	I
4	Mechanics of Solids	4 (3-1-0)	II
5	Surveying-II	2 (2-0-0)	II
6	Surveying Lab	1 (0-0-2)	II
Total PC Credit		13	

*: Revised as per the recommendation of DUGC

The meeting was concluded with thanks to the chair.

(Sumit Khandelwal)

(Urmila Brighu)

(Rajesh Gupta)

(Sandeep Shrivastava)

(Dhiraj Raj)

(Leelambar Singh)

(Abhishek Saha)

UG/PG: UG	Department: Civil Engineering
Course Code:	Course Name: Construction Materials
Credit: 3	L-T-P: 3-0-0
Pre-requisite Course:	
Syllabus Engineering Properties of materials (2 lectures) Stones- classification and properties (2 lectures) Bricks- composition, manufacturing, classification and tests as per BIS, Fly ash bricks, Light weight bricks (AAC) (4 lectures) Tiles- types and usages (2 lectures) Timber- classification, seasoning, application, defects (2 lectures) Lime- classification and usages (2 lectures) Cement- Chemical composition, manufacturing, hydration of cement, types of cement, Tests as per IS codes (4 lectures) Aggregates: Fine and coarse aggregates, properties and usages (3 lectures) Mortar- Cement and lime mortar, properties and applications (3 lectures) Concrete- Properties of fresh and hardened concrete, effect of w/c ratio, admixture, curing of concrete, various concrete mixes and their usages. (5 lectures) Steel- types, properties, structural steel sections. (3 lectures) Miscellaneous materials: Types of glass and its usages, applications of Aluminum and PVC in buildings, Eco-friendly materials, Epoxies, Fiber based materials. (3 lectures) Course Outcomes 1. Be able to understand application of basic building materials 2. Understand characteristics of conventional building materials like stone, brick, timber etc. 3. Be able to demonstrate knowledge of construction materials and their usages in projects. 4. Learn about Eco friendly construction materials and their characteristics. Text Books and References 1. Building Materials by Gambhir Jamwal , McGraw Hill 2. Engineering Materials, Rangwala SC 3. Concrete technology by A. M. Neville, Pearson education India 4. Sustainable Construction: Green Building Design and Delivery by C. Kibert, Wiley 5. National Building Code of India, BIS, Delhi.	

UG/PG: UG		Department: Civil Engineering
Course Code:		Course Name: Construction Materials Laboratory
Credit: 1		L-T-P: 0-0-2
Pre-requisite Course:		
LIST OF EXPERIMENTS		
Lab #	Name of the Experiment	
1	To determine consistency of cement and setting times	
2	To determine fineness and compressive strength of cement	
3	To determine Specific gravity, fineness modulus, and water absorption of fine/coarse aggregates	
4	To determine silt content and bulking of sand	
5	To determine slump, compaction factor of concrete and to cast specimen	
6	To determine compression strength of concrete	
7	To cast and test compressive strength of bricks/pavers	
8	To determine water absorption, efflorescence of bricks	
9	To develop stress-strain curve of Steel	
10	Demonstration of Sustainable/Eco-friendly/recycled material	
Course Outcomes 1. Able to identify different type of construction materials. 2. Able to measure different engineering properties of building materials like strength, water absorption, etc. 3. Able to analyze and choose different type of suitable material for construction projects.		
References 1. Relevant IS codes, BIS, Delhi		

Civil Engg.

UG/PG: UG	Department: Civil Engineering
Course Code: 26CETXXX	Course Name: Surveying-I
Credit: 2	L-T-P: 2-0-0
Pre-requisite Course:	
Syllabus Basic principles, Different units and their conversion; Maps, their scales, referencing system and uses, plotting accuracy; Map coordinate system; projections and their types; Compass; Measurement of distances and directions; Theodolite, Temporary and permanent adjustments of Theodolite, Traversing, Computation of coordinates, Adjustment of survey data, Area calculation; Levelling and contouring, Tacheometry, Trigonometrical levelling. Course Outcomes 1. Understand the basic skills of surveying work, including distance and angle measurement 2. Be able to choose and justify a particular type of survey and equipment suitable for a particular engineering application. 3. Be able to use different types of surveying equipment like Compass, Theodolite, levels etc., for direction measurement, angle measurement, differential levelling and contouring 4. Be able to prepare a surveying map using collected surveying data. Text Books and References 1. Surveying Instruments by James M. Anderson & Edward M. Mikhail 2. Surveying Vol. I & II by S.K. Duggal 3. Surveying, by A. M. Chandra, Narosa Pub. House., New Delhi 4. Punmia, B.C., Surveying Vol. II & III, 2005. 5. Kavanagh, B., Surveying Principles and Applications, Seventh Edition, Prentice Hall, 8th edition, 2008. 6. G.L. Hosmer, Geodesy, John Wiley & Sons, New York, 1946	

UG/PG: UG	Department: Civil Engineering
Course Code: 26CETXXX	Course Name: Surveying-II
Credit: 2	L-T-P: 2-0-0
Pre-requisite Course:	
Syllabus Theory of errors; Adjustment of surveying observations; Triangulation and Trilateration; Various triangulation schemes; Type of triangulations; Triangulation measurements; Adjustment of triangulation scheme; transmission and signals, Principles of photogrammetry; Aerial photography, Interpretation, Measurements from aerial photographs; Introduction to astronomy; Terms of reference planes and astronomical coordinates; Astronomical triangle / shortest distance determination; Time in astronomy; Uses of Total Station and other Advance surveying instruments; Introduction of Remote sensing, Global positioning system (GPS), Geographical Information System (GIS). Course Outcomes 1. Be able to plan and execute triangulation surveying schemes and survey. 2. Be able to make measurements on satellite images and aerial photographs using photogrammetric concepts 3. Be able to employ advance surveying equipment for preparation of maps, determination of positions. 4. Be able to measure time and other astronomical observations Text Books 1. Wolf, P. R., A text book on Photogrammetry, 4th edition, 2012. 2. C.D. Burnside, Electromagnetic Distance Measurement, Crosby Lockwood and Son Ltd., London. 3. Punmia, B.C., Surveying Vol. II & III, 2005. Reference Books 1. Kavanagh, B., Surveying Principles and Applications, Seventh Edition, Prentice Hall, 8th edition, 2008. 2. G.L. Hosmer, Geodesy, John Wiley & Sons, New York, 1946.	

UG/PG: UG		Department: Civil Engineering
Course Code: 26CEPXXX		Course Name: Surveying Lab
Credit: 1		L-T-P: 0-0-2
Pre-requisite Course:		
<u>LIST OF EXPERIMENTS</u>		
Lab #	Name of the Experiment	
1	To measure horizontal angles and magnetic bearings of lines using a surveyor's and prismatic compass.	
2	To measure horizontal and vertical angles using theodolite.	
3	To perform a closed/open compass traverse to establish horizontal control points in the field.	
4	To perform a theodolite traverse for network positioning and coordinate calculation.	
5	To determine the horizontal distance and vertical height of an inaccessible object using the tangential tacheometry method.	
6	To determine tacheometric constants and compute horizontal and vertical distances using a stadia diaphragm.	
7	To determine the reduced level (RL) of distant ground stations using fly levelling.	
8	To prepare a profile section for the given road section.	
9	To conduct contouring using the radial line method to map terrain elevations and variations.	
10	To utilize a Total Station to measure sloped distances, horizontal angles, and vertical heights directly.	
11	To generate a comprehensive contour map of a designated field area using coordinate data from a Total Station.	
12	To perform real-time navigation and spatial feature collection using a handheld GPS in mapping and surveying configurations.	
Course Outcomes		
1. Understand the working of different type of surveying equipment.		
2. Be able to choose surveying equipment in field for measurement of distance, direction and elevation.		
3. Be able to adjust the traverse and calculation of coordinates i.e., latitude and departures.		
4. Be able to prepare maps using surveying data.		
References		
1. Surveying Instruments by James M. Anderson & Edward M. Mikhail		
2. Surveying Vol. I & II by S.K. Duggal		
3. Surveying, by A. M. Chandra, Narosa Pub. House., New Delhi		
4. Punmia, B.C., Surveying Vol. II & III, 2005.		
5. Global Positioning System: Signal, Measurement & Performance by Per Enge and Pratap Misra.		

Department of Computer Science & Engineering
Updated UG (CSE) Scheme

(160 Credit)

First Semester					
SN	Course Code	Subjects	L-T-P	Credit	Type
		Mathematics I	3-0-0	3	IC
		Physics	3-0-0	3	IC
		Python Programming	2-0-0	2	IC
		Environmental Science	1-0-0	1	IC
		Ethics and Human Values	1-0-0	1	IC
		Soft Skills Foundational Lab	0-0-2	1	IC
		Programming with Python Lab	0-0-2	1	IC
		Physics Lab	0-0-2	1	IC
		Engineering Drawing & Sketching Lab	0-0-2	1	IC
				14	
	22CST103	Problem Solving using C	2-0-0	2	PC
	22CST104	Discrete Mathematic	3-0-0	3	PC
	22CSP105	Problem Solving using C Lab	0-0-2	1	PC
				6	
				20	

Second Semester					
SN	Course Code	Subjects	L-T-P	Credit	Type
		Mathematics II	3-0-0	3	IC
		Data Science /Analytics /Visualization	2-0-0	2	IC
		Makers Lab	0-0-12	6	IC
				11	
	22CST151	Data Structures	3-0-0	3	PC
	22CST152	Digital Logic and Circuits Design	3-0-0	3	PC
	22CSP153	Data Structures Lab	0-1-2	2	PC
	22CST154	Digital Logic and Microprocessor Lab	0-0-2	1	PC
				9	
				20	

Curriculum Structure of B. Tech. (Electrical Engineering)

I Semester

S.No.	Course Title	Course Type	Credits (L T P)
1.	Electrical Engineering Fundamentals	Program Core	4 (3 1 0)
2.	Measurements and Actuators	Program Core	3 (3 0 0)
3.	Mathematics I	Institute Core	3 (2 1 0)
4.	Physics	Institute Core	3 (2 1 0)
5.	Ethics And Human Values	Institute Core	1 (1 0 0)
6.	Environmental Science	Institute Core	1 (1 0 0)
7.	Python Programming And Lab (IC bucket*)	Institute Core	3 (2 0 2)
8.	Soft Skills Foundational Lab	Institute Core	1 (0 0 2)
9.	Physics Lab	Institute Core	1 (0 0 2)
10.	Engg. Drawing and Sketching Lab	Institute Core	1 (0 0 2)
Total Credits (I Sem)			14 (IC) + 7 (PC) = 21

II Semester

S. No.	Course Title	Course Type	Credits (L T P)
1.	Network Theory	Program Core	4 (3 1 0)
2.	Measurement and Instrumentation Lab	Program Core	1 (0 0 2)
3.	Electrical Engineering Materials	PLEAS-1	3 (3 0 0)
4.	Mathematics II	Institute Core	3 (2 1 0)
5.	Makers Lab	Institute Core	6 (3 0 6)
6.	Data Science/Analytics/Visualization	Institute Core	2 (2 0 0)
Total Credits (II Sem)			11 (IC) + 5 (PC) + 3 (PLC) = 19

Total Credits (I and II Sem) = 40

Semester: I

Course Title: Electrical Engineering Fundamentals

Course Category: Program Core

Credit: 4 (3 1 0)

CO1:	Be able to explain the philosophy and importance of electrical engineering.
CO2:	Be able to explain principles with solutions of various electrical laws.
CO3:	Be able to apply the various principles of network reduction techniques for solving electrical circuits.
CO4:	Be able to apply the different applications of single phase and three phase network /circuits.
CO5:	Be able to understand the concept of power generation.

Unit I - DC Circuits: Basic circuit elements, Dependent and Independent Sources, Source conversion, Delta-Star and Star-Delta transformations, Node Voltage and Mesh Current methods, Superposition principle, Thevenin's and Norton's Theorems, Maximum Power Transfer Theorem, Reciprocity Theorem, Substitution's Theorem, Tellegen's Theorem.

(12 Lectures)

Unit II - Single Phase AC Circuits: Phasor Algebra, Solution of R-L-C series and parallel circuits, Complex power, Resonance in Series and Parallel circuits, Bandwidth, Selectivity and Q-factor, self and mutual inductances, coefficient of coupling, dot convention, analysis of coupled circuits.

(10 Lectures)

Unit III - Three-Phase AC Circuits: Three-phase e.m.f. generation, Phase Sequence, Delta and Star Connections, Line and phase quantities, Measurement of Power, Blondel's Theorem, Solution of three-phase balanced and unbalanced circuits.

(10 Lectures)

Unit IV – Sources of Electrical Energy: Introduction to various conventional and non-conventional energy sources, concept of power generation, transmission and distribution systems.

(8 Lectures)

Text / References Books:

1. Electrical Engineering Fundamentals, V. Del Toro, PHI
2. Problems in Electrical Engineering, S. Parker Smith, CBS Publishers and Distributors Pvt. Ltd.
3. Electric Circuits, Joseph Edminister, Mahmood Nahvi, Schaum's Outlines, Tata McGraw-Hill
4. Fundamentals of Electric Circuits: Charles K. Alexander, Matthew N.O. Sadiku; McGraw Hill.
5. Electrical and Electronics Technology, Edward Hughes, Pearson.

Semester: I

Course Title: Measurements and Actuators

Course Category: Program Core

Credit: 3 (3 0 0)

CO1:	To introduce the fundamentals, characteristics and errors of electrical measuring instruments and methods for measurement of electrical quantities.
CO2:	To understand the principles and characteristics of transducers and sensors used for measurement of physical quantities.
CO3:	To provide basic knowledge of signal conditioning and modern sensing technologies.
CO4:	To understand the principles, characteristics and applications of different types of actuators.
CO5:	To introduce smart measurement systems, IoT-based sensing, wireless sensor networks and sensor fusion.

Unit I - Measuring Instruments: Types of analog and digital instruments and their characteristics, Electronic measuring instruments, Measurement of current, voltage, power, energy, power factor and frequency, Digital Storage Oscilloscope (DSO), Measurement errors and calibration.

(10 Lectures)

Unit II - Measurement of Electrical Quantities and Transducers: Measurement of resistance, inductance and capacitance, AC bridges for measurement of inductance, capacitance and frequency, Classification and characteristics of transducers, Measurement of temperature, pressure, flow, strain and displacement.

(10 Lectures)

Unit III - Sensors and Signal Conditioning: Resistive sensors (Potentiometer, Strain Gauge, RTD and Thermistor), Thermocouples, Capacitive, inductive, piezoelectric, Hall-effect and ultrasonic sensors, Introduction to optical and MEMS sensors, Basic signal conditioning.

(8 Lectures)

Unit IV - Actuators: Terminology, principles, characteristics and classification of actuators; Pneumatic, hydraulic, mechanical and electrical actuators; Solenoids and control valves.

(7 Lectures)

Unit V - Introduction to Smart Measurement Systems: Introduction to IoT, Sensors in IoT systems, Basic IoT architecture, Wireless sensor networks, Smart sensors, Industrial data acquisition and monitoring, Introduction to sensor fusion.

(5 Lectures)

Text / Reference Books

1. A. K. Sawhney and Puneet Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co.
2. A. D. Helfrick and W. D. Cooper, Modern Electronic Instrumentation and Measurement Techniques, Pearson Education.
3. D. Patranabis, Sensors and Actuators, PHI Learning Pvt. Ltd.
4. W. Bolton, Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, Pearson Education.
5. Raj Kamal, Internet of Things: Architecture and Design Principles, McGraw-Hill Education.
6. John G. Webster and Halit Eren (Eds.), Measurement, Instrumentation, and Sensors Handbook, CRC Press.

Semester: II

Course Title: Network Theory

Course Category: Program Core

Credit: 4 (3 1 0)

CO1:	To construct network graphs, formulate equilibrium equations using matrix methods, and apply the principle of duality.
CO2:	To analyze transient and steady-state behavior in first- and second-order circuits (R-L, R-C, R-L-C) using Laplace transform techniques.
CO3:	To employ source transformation, nodal/mesh analysis, and network theorems to determine circuit responses to non-sinusoidal periodic inputs.
CO4:	To derive network functions from pole-zero configurations, interpret time-domain responses from pole-zero plots, and evaluate two-port network parameters.
CO5:	To assess causality and stability via Hurwitz polynomials, verify positive real functions, and synthesize one-port networks using Foster and Cauer canonical forms.

Unit I - Fundamentals of Graph Theory: Network Graph, Network Matrices and Equilibrium Equations, Duality. (4 Lectures)

Unit II – Transient Analysis: Natural and steady-state response of R-L, R-C, and R-L-C circuits, Basics of Laplace Transform to electric networks, s-domain representation of passive circuit elements with initial conditions, transient response of electric networks using Laplace Transform for various inputs. (12 Lectures)

Unit III - Sinusoidal Steady-State Analysis: Source Transformation, Node and Mesh Analysis, Network Theorems, Response of non-sinusoidal periodic signals. (6 Lectures)

Unit IV – Network Functions: Complex frequency, poles and zeros, Necessary conditions for driving-points and transfer functions, Time-domain behaviour from pole-zero plot. (4 Lectures)

Unit V – General Two-port Networks: Two-port Parameters, Interconnection, Symmetry and Reciprocity, Image Parameters. (6 Lectures)

Unit VI - Network Synthesis: Causality and Stability, Hurwitz Polynomial, Positive real functions and their properties, Synthesis of one-port L-C, R-C, and R-L immittance functions using Foster and Cauer forms. (8 Lectures)

Text / References Books:

1. M. E. Van Valkenburg: Network Analysis, III Ed., Prentice Hall of India.
2. W. H. Hayt, J. E. Kemmerly and S. M. Durbin: Engineering Circuit Analysis, VII Ed., McGraw Hill.
3. Joseph Edminister: Electrical Circuits, III Ed., Schaum's Outline, Tata McGraw Hill.
4. Lawrence P. Huelsma: Basic Circuit Theory, III Ed., Prentice Hall of India.
5. D. Roy Choudhury: Network & Systems, Wiley Eastern Ltd.
6. De Carlo and Lin, Linear Circuit Analysis, Oxford Press
7. Franklin F Kuo, Network Analysis and Synthesis, Wiley, Second Edition, 2006

Semester: II

Course Title: Electrical Engineering Materials

Course Category: PLEAS (MRC)

Credit: 3 (3 0 0)

CO1:	Explain the basic structure, bonding, defects, and energy-band concepts governing the properties of engineering materials.
CO2:	Analyze the characteristics and applications of conductor, insulator, dielectric, ceramic, and magnetic materials used in electrical engineering.
CO3:	Evaluate the behavior and uses of semiconductor and superconducting materials in electrical and electronic systems.
CO4:	Explain the operating principles and applications of modern semiconductor devices, optoelectronic devices, and high-frequency devices.
CO5:	Assess the potential of nanomaterials, quantum materials, heterostructures, and emerging technologies for next-generation electrical and energy systems.

Unit 1: Solid-State Physics and Crystal Defects: Basics of solid-state physics; atomic bonding; crystal structures; crystalline and amorphous materials; lattice defects; effect of defects on electrical, thermal, magnetic, and optical properties; energy-band theory; classification of conductors, semiconductors, and insulators.

Unit 2: Conducting, Insulating, and Ceramic Materials: Conducting materials and their properties; resistivity, conductivity, and temperature coefficient. Insulating and dielectric materials: polarization, dielectric strength, loss, breakdown, and applications. Ceramic materials: electrical ceramics, ceramic insulators, capacitor and piezoelectric materials.

Unit 3: Magnetic Materials and Ferrites: Basics of magnetism; dia-, para-, ferro-, ferri-, and antiferromagnetic materials; magnetic domains; hysteresis; permeability; coercivity; retentivity; core losses; soft and hard magnetic materials; ferrites and their applications in electrical components.

Unit 4: Semiconductors and Superconductors: Intrinsic and extrinsic semiconductors; doping; carrier concentration; mobility; drift and diffusion; recombination; temperature effects; quantum confinement; semiconductor defects; pn junction basics; Superconductors: zero resistance, Meissner effect, critical parameters, types of superconductors, and applications in power cables, magnets, machines, levitation, and energy systems.

Unit 5: Other Materials and Applications: CNTs, graphene, quantum dots, nanowires, nano materials; photoconductivity; Power Devices (IGBT, SiC/GaN MOSFETs); Optoelectronic Devices (LEDs, Laser Diodes, Solar Cells); Sensors and High-Frequency Devices, Device Integration and CMOS Scaling Trends, Semiconductor Hetrostructures.

Text/ Reference Books:

1. S. P. Seth and P. V. Gupta, *A Course in Electrical Engineering Materials*, Dhanpat Rai & Co.
2. C. S. Indulkar and S. Thiruvengadam, *An Introduction to Electrical Engineering Materials*, S. Chand / Allied Publishers.
3. W. D. Callister Jr. and D. G. Rethwisch, *Materials Science and Engineering: An Introduction*, Wiley.
4. S. O. Kasap, *Principles of Electronic Materials and Devices*, McGraw Hill.
5. Charles Kittel, *Introduction to Solid State Physics*, Wiley.
6. B. D. Cullity and C. D. Graham, *Introduction to Magnetic Materials*, Wiley-IEEE Press.
7. B. S. Murty et al., *Textbook of Nanoscience and Nanotechnology*, Universities Press.
8. Michael Tinkham, *Introduction to Superconductivity*, Dover / McGraw Hill.

Electronics & Communication Department

B.Tech First Year Scheme

First Semester		
Course Category	Course Name	Proposed Credits
IC	Mathematics I	3
IC	Environmental Science	1
IC	Soft Skills Foundational Lab	1
IC	Ethics And Human Values	1
IC	Physics (bucket)	3
IC	Python Programming + Lab (bucket)	3
IC	Physics Lab (Lab bucket)	1
IC	Engg. Drawing and Sketching Lab (Lab bucket)	1
PC	Circuits and Networks	3
PC	Digital Electronics + Lab	3
Total		20

Second Semester		
Course Category	Course Name	Proposed Credits
IC	Mathematics II	3
IC	Makers Lab (ME+EE+ECE)	6
IC	Data Science/Analytics/Visualization	2
PC	Electronic Measurement and Instrumentation	2
PC	Signals and Systems	3
PC	Electronic Devices and Circuits + Lab (Prerequisite is Circuits and Networks Course)	4
Total		20

Course Name : Circuits and Networks

Course Code :

Credits : 3 (L-T-P : 3-0-0)

Syllabus:

Methods of Network Analysis: Mesh and node variable analysis; Star Delta transformation; Steady state analysis of AC circuits, Characteristics of the sinusoid: Average, peak and effective values, Impedance concept, Active, reactive and complex power, Power factor, Q of coils and capacitors, Series and parallel resonances, Series Parallel reduction of AC/DC circuits, Network Theorems (Superposition, Thevenin's, Norton's, Maximum Power Transfer, Reciprocity, Compensation, Tellegen's) in AC/DC circuits.

Two Port Networks Parameters: Open circuit impedance Z parameters, short circuit admittance Y parameters, Hybrid h parameters, Chain parameters ABCD and g parameters, Image Impedances, T and pie network, Relationship between different two port network, Interconnection of two-port network: cascade, series, parallel, series-parallel and parallel-series connections, Indefinite admittance matrix and applications.

Steady State & Transient Analysis: DC and sinusoidal response of R-L-C circuits, Laplace transforms and its properties, inverse transforms, initial and final value theorems, use of transfer function in network analysis. State Equations for Networks: Basic consideration in writing state equations, order of complexity, Formulation of state equations, Solutions of state equations, State transition matrix. Frequency domain analysis of RLC circuits, Poles & Zeros, Driving Point Function, Amplitude and Phase Response.

Passive Filters: Classification, Constant-K filters, m-Derived T-Section, Band pass filter, Band elimination filter, Tunable filter realization.

Network Graphs: Network Matrices, Incidence and Reduced Incidence matrix, Loop Matrix, Fundamental loop matrix, Cut set and cut set matrix, Fundamental cut set matrix, Relationship between network Matrices.

Course Outcomes :

- CO1- Is able to understand different networking theorem.
- CO2- Is able to understand methods of network matrixes, Incidence and reduced incidence matrix, loop matrix etc.
- CO3- Is able to perform two port networks as Z parameter, ABCD parameter, T parameter, Y parameter etc.
- CO4- Is able to know about state equation and solution of state equations.

References:

- 1) M. E. Valkenburg, Network Analysis, PHI, 1995
- 2) S. Ghosh, Network Theory: Analysis and Synthesis, PHI, 2005
- 3) T. S. K. Iyear, Circuit Theory, TMG Hill, 1985
- 4) Del Toro, Principles of Electrical Engg, PHI, 1994
- 5) A. Sudhakar & Shyammohan S. Palli, Circuits & Networks: Analysis & Synthesis, McGraw Hill, 2015

SYLLABUS OF B. Tech. (ECE)

Course Code :

LTP: 2-1-0 per week

Course : Digital Electronics

Credits: 02

Syllabus:

Unit 1	Digital Gates and Functions: Introduction to number systems and binary arithmetic, Unconventional number arithmetic, Binary Code, Gray code, Odd/Even Parity
Unit 2	Boolean Logic: Gates and universal gates, Boolean algebra, SOP & POS forms of a Boolean function, simplification of logical functions using Karnaugh map.
Unit 3	Combinational Circuits: Half and full adder, subtractor, multiplier, encoders, decoders, multiplexers, demultiplexers.
Unit 4	Sequential Circuit: Flip-Flops, Latches, Counters, Finite State Machine Concepts, Sequence generator, Sequence detectors

Digital Electronics Lab:

List of Experiments

1. Study of the Digital trainer kit and multi-output power supply.
2. Verify the truth table of AND, OR, NOT, NAND, NOR gates.
3. To derive all basic logic gates using NAND/NOR gates only.
4. To verify the truth table of half-adder and full-adder circuits.
5. To design a 2-bit multiplier and implement it.
6. To design and implement a latch using two NOR gates and verify its truth table.
7. Verify the operation of S-R, D, J-K and T flip-flops.
8. To implement a synchronous up/down counter

Textbooks:

1. Digital Circuits and Design, S Salivahanan, Vikas Publishers
2. Digital Electronics, Moris-Mano, PHI
3. **Modern Digital Electronics** – R. P. Jain, McGraw-Hill Education
4. Digital Logic, Anand Kumar, PHI learning Pvt Ltd.

SYLLABUS OF B. Tech. (ECE)

Course Code :

LTP: 3-0-0 per week

Course : Electronic Devices & Circuits

Credits: 03

Syllabus:

Unit 1	Bipolar Junction Transistor: Bipolar Junction Transistor, Current components in transistor, transistor construction, various configurations (CE, CB, CC), and characteristics (Input and Output) of BJT configurations. relation between α and β , small signal equivalent circuit, DC & AC load line, and Q point, Transistor biasing and stabilization
Unit 2	Field Effect Transistor: Introduction to JFET, MOSFET structure, regions of operation, carrier transport, I-V characteristics. JFET and MOSFETS Biasing.
Unit 3	Transistor at low frequencies: Graphical Analysis of the CE configuration, Two-Port devices and the hybrid Model, Transistor hybrid model, The h-parameter, Conversion formulas for the parameters of the three transistor Configuration, Analysis of a transistor Amplifier Circuit using h parameters, The Emitter follower, Comparison of transistor amplifier configurations, Linear Analysis of a Transistor Circuit, Cascading Transistor Amplifiers, Simplified Common-Emitter Hybrid Model, Simplified calculations for the Common Collector Configuration, The Common-Emitter Amplifier with an emitter resistance, High input resistance transistor circuits, Multistage amplifier analysis. .
Unit 4	Field Effect Transistors at Low Frequency: The FET and MOSFET Small-Signal model, The Low-Frequency Common-Source and Common-Drain Amplifiers, The FET as a Voltage-variable Resistor (VVR). High frequency model of BJT: High frequency hybrid- π model of BJT, Common emitter and common collector configurations, Cascade configuration.
Unit 5	Feedback amplifiers: Introduction to feedback, basic feedback topologies and their properties, analysis of practical feedback amplifiers, stability
Unit 6	Oscillators: Basic principle of sinusoidal oscillator (phase shift, Wein bridge), Hartley & Colpitts, Crystal Oscillator

Textbooks:

1. S. M. Sze and M. K. Lee, Semiconductor Devices: Physics and Technology, 3rd Edition, 2013, Wiley.
2. A. S. Sedra and K. C. Smith, Microelectronics Circuits, 5th Edition, 2005, Oxford University Press.
3. Milliman and Halkias: Integrated Electronics, TMH
4. Electronic principles, Bolysted

LIST OF COURSE OUTCOMES

CO 1: Understand the modelling of bipolar junction transistors (BJTs), analyse the different amplifier configurations using these transistors models, learn to simplify these models and analyse the different transistor configurations.

CO 2 : Acquire the basic understanding of the Field effect transistor (FET) and its small signal model, analyse the low frequency configurations of the amplifier using FET.

CO3: Understand the high frequency model of the bipolar junction transistors (BJTs) for the different configurations.

CO4: Learn the concept of feedback to stabilize the amplifiers, analyse the different topologies and synthesise the same using BJTs and FETs

CO5: Learn the principles of sinusoidal oscillators

CO6: After undergoing this course, the student will be able to acquire the basic knowledge of transistors and analyze the different type of its configurations for various applications.

ASSESMENT OF COURSE OUTCOMES

Assessment Method and Weightage:

- Mid Term Test 30%
- End Term Examination: 50%
- Assignment Quiz- 20%

Course Name : Electronic Measurements and Instrumentation

Course Code :

Credits : 2 (L-T-P : 2-0-0)

Syllabus:

Measurements: Errors & classification.

Analog Ammeters and Voltmeters: PMMC and MI Instruments, Construction, Torque Equation, Range Extension, Effect of temperature,

Analog Wattmeters and Power Factor Meters: Electrodynamometer type wattmeter, power factor meter, Construction, torque equation, active and reactive power measurement in single phase and in three phase.

DC and AC Bridges: Measurement of resistance (Wheatstone Bridge, Kelvin's Bridge, Kelvin's Double Bridge), Measurement of inductance, Capacitance (Maxwell's Bridge, Desauty Bridge, Anderson Bridge, Schering Bridge, Wien Bridge).

Electronic Instruments: Electronic Display Device, Digital Millimeters, CRO/DSO, measurement of voltage and frequency, Wave Analyzers, Harmonic Distortion Analyzer.

Course Outcomes:

CO1: To understand the working principle of different measuring instruments.

CO2: Analyse the MC, MI and Dynamometer types of measuring instruments, Watt-meters and Energy-meters

CO3: Determine the values of components of circuits using AC and DC bridges

CO4: To understand the functioning of CRO/DSO, wave analyser, and harmonic distortion analyzer

References:

- 1) J. B. Gupta: A course in Electrical and Electronic Measurements and Instrumentation, 13/E, Kataria and Sons, 2009.
- 2) U. A. Bakshi, A. V. Bakshi: Electrical Measurements and Instrumentation, Technical Publications, 2009.
- 3) K. Sawhney: A course in Electrical Measurements Electronic Measurements Instrumentation, Edition 11, Dhanpat Rai and Sons, 1996.
- 4) W.D. Coopers and Helfrick, Modern Electronic instrumentation and Measurements Techniques, Prentice Hall of India Pvt. Ltd, 2002.
- 5) E.W. Gowling and F.C.Widdis, Electrical Measurements and Measuring Instruments 5/e, Wheeler Publications 1998.

Course Name : Signals & Systems

Course Code :

Credits : 3 (L-T-P : 3-0-0)

Syllabus:

- Representation of Signals and Systems: Continuous & discrete time signals, LTI systems and their classification, System modelling using differential and difference equations
- Convolution, Transmission of signals through linear systems
- Analysis of signals: Fourier series, Fourier transforms and their properties
- Fourier Analysis for DTS: Discrete time Fourier series, Discrete time Fourier transform and their properties, DFT and its properties, Fast Fourier Transform
- Laplace transforms, Z-transforms & its properties, ROC, Inversion of Z-transform, application to System Analysis.

Course Outcomes :

- CO1. Understand the handling of signals in different domains- time and frequency -through Fourier transforms. Analysis and synthesis of different basic signals to be used in the communication systems.
- CO2. Acquire the basic mathematical understanding of the probability theory; methods of converting these results of the probability theory into different form of expressions-distribution and density functions, so as to be useful in the analysis of signals.
- CO3. Extend the concepts of probability theory to random processes. Learn to evaluate the different type of estimates generated through the probabilistic methods for use in the analysis of noise.
- CO4. After undergoing this course, the student will be able to analyze the different type of signals and noises in communication systems.

References:

1. Oppenheim A.V., Willsky A.S. and Nawab S.H.: Signals and Systems, 2/e, Prentice Hall of India, 1997
2. B.P. Lathi, Modern Digital and Analog. Communication Systems, 3rd ed., Oxford. University Press, 1998

Malaviya National Institute of Technology Jaipur

Department of Physics

Course Structure and Syllabi for B.Tech.

(Engineering Physics)

Curriculum Development Workshop

May 4-5, 2026

Course Structure of B. Tech. (Engineering Physics)

Semester I

S. No.	Course Code	Title of the course	Subject Area	L-T-P	Credits
1.		Mathematics I	IC	2-1-0	3
2.		Engineering Chemistry	IC	2-1-0	3
3.		Makers Lab	IC	3-0-6	6
4.		Data Science/ Analytics/Visualization	IC	2-0-0	2
5.	22BMT922	Management Principles for Engineers*	PL/EAS	3-0-0	3
6.		Applied Optics	PC	3-0-0	3
Total					20

Semester II

S. No.	Course Code	Title of the course	Subject Area	L-T-P	Credits
1.		Mathematics II	IC	2-1-0	3
2.		Python Programming + Lab	IC	2-0-2	3
3.		Environmental Science	IC	1-0-0	1
4.		Soft Skills Foundation Lab	IC	0-0-2	1
5.		Ethics and Human Values	IC	1-0-0	1
6.		Classical Physics Lab	IC	0-0-2	1
7.		Engg. Drawing and Sketching Lab	IC	0-0-2	1
8.		Mathematical Methods in Physics	PC	3-1-0	4
9.		Biophysics	PC	2-0-0	2
10.		Electromagnetic Theory	PC	3-0-0	3
Total					20

Semester III

S. No.	Course Code	Title of the course	Subject Area	L-T-P	Credits
1.		Soft Skills Advanced Lab	IC	0-0-2	1
2.		Design thinking for Innovation	IC	2-0-0	2
3.		Engineering Economics	IC	3-0-0	3
4.		Engineering Mechanics and Relativity	PC	2-1-0	3
5.		Foundations of Quantum Theory	PC	3-0-0	3
6.		Physics of Semiconductor Devices	PC	2-0-0	2
7.		Analog and Digital Electronics	PC	3-0-0	3
8.		Analog and Digital Electronics Lab	PC	0-0-6	3
9.		PE 01	PE	3-0-0	3
Total					23

Semester IV

S. No.	Course	Title of the course	Subject	L-T-P	Credits
1.		Thermodynamics and Statistical Mechanics	PC	3-1-0	4
2.		Physics of Energy Materials	PC	3-0-0	3
3.		Laser and Its Applications	PC	2-1-0	3
4.		Optoelectronics	PC	3-0-0	3
5.		Laser and Optoelectronics Lab	PC	0-0-6	3
6.	22MST241	Fundamentals of Materials Science and Engineering #	PL/EAS	3-0-0	3
7.		PE 02	PE	3-0-0	3
Total					22
	M/H	MINOR / HONOURS COURSE 1			3

Semester V

S. No.	Course Code	Title of the course	Subject Area	L-T-P	Credits
1.		Condensed Matter Physics	PC	3-0-0	3
2.		Numerical Analysis through MATLAB	PC	2-1-0	3
3.		Introduction to Quantum Technologies	PC	3-0-0	3
4.		Thin Film Deposition and Characterization	PC	2-0-2	3
5.		Semiconductor Device Modelling and Simulation	PC	3-0-0	3
6.		Engineering Materials Lab	PC	0-0-6	3
7.		PE 03	PE	3-0-0	3
8.		PE 04	PE	3-0-0	3
		Total			24
	M/H	MINOR / HONOURS COURSE 2			3

Semester VI

S. No.	Course	Title of the course	Subject	L-T-P	Credits
1.		Atomic & Molecular Spectroscopy	PC	3-0-0	3
2.		Advanced Computational Tools for Physicists	PC	2-1-0	3
3.		Physics of Nuclear Radiations and Applications	PC	2-1-0	3
4.		Nuclear Radiations and Spectroscopy Lab	PC	0-0-6	3
5.		PE 05	PE	3-0-0	3
6.		PE 06	PE	3-0-0	3
7.		PE 07	PE	3-0-0	3
8.		OE1	OE	3-0-0	3
		Total			24
	M/H	MINOR / HONOURS COURSE 3			3

Semester VII

S. No.	Course Code	Title of the course	Subject Area	L-T-P	Credits
1.		AI/ML for Physical Systems	PC	2-1-0	3
2.		OE 02	OE	3-0-0	3
3.		PE 08	PE	3-0-0	3
4.		PE 09	PE	3-0-0	3
5.		PE 10	PE	3-0-0	3
6.		Industrial Training/seminar	Industrial T/S		2
7.		Minor Project	Project	0-0-6	3
		Total			20
	M/H	MINOR / HONOURS COURSE 4			3

Semester VIII

S. No.	Course Code	Title of the course	Subject Area	L-T-P	Credits
1.		OE 03	OE	3-0-0	3
3.		Major Project	Project	0-0-12	6
		Total			9
	M/H	MINOR / HONOURS COURSE 5			3

Total Credits: 162

List of Program Electives

S. No.	Program Elective Basket
	Semiconductor & Photonics
1.	Semiconductor Devices and Circuits
2.	Semiconductor Device Processing and IC Fabrication
3.	Semiconductor Devices for Next Generation Field-Effect Transistors
4.	Surface Physics and Engineering
5.	Advanced Micro- and Nanofabrication Technology and Process
6.	Nanophotonics
7.	Advanced Photonic Materials
8.	Medical Applications of Radiation Physics
	Energy Systems
9.	Solar Energy and Physics of Solar Cells
10.	Energy Storage Systems
11.	Hydrogen Energy and Fuel Cells
12.	Physics of Renewable Energy Conversion
13.	Battery Technology and Electric Vehicles
14.	Nuclear Energy Systems and Sustainable Power Generation
	Soft Materials
15.	Engineering Biomaterials
16.	Organic Electronics Material and Devices
17.	Biomaterials and Tissue Engineering
18.	Wearable sensors for healthcare
19.	Nano-engineering of Soft Materials
20.	Soft Materials
	Quantum Science & Technology
21.	Quantum Communication
22.	Quantum Technology Lab
23.	Quantum Sensing and Metrology
24.	Quantum Materials and Devices
25.	Quantum Optics
26.	Foundation of Quantum Computation

27.	Quantum Computing for Physical Systems
	Theoretical Physics
28.	Astronomy and Astrophysics
29.	Advanced Quantum Mechanics for Engineers
30.	Introduction to General Relativity
31.	Group Theory and Applications
32.	Particle Detector and its Technology
33.	Plasma Science and Technology
34.	Accelerators and Applications
35.	Fundamentals of Space Physics and Applications

Honours offered by the Department of Physics

	Advanced Materials Physics
S. No.	Course Name
1.	Advanced Condensed Matter Physics
2.	Advanced Statistical Mechanics
3.	Frontiers in Nanomaterials and Nanotechnology
4.	Advanced Characterization Techniques
5.	Advanced Physics lab

Minor offered by the Department of Physics

	Quantum Technology
S. No.	Course Name
1-4	Any four Courses from the Quantum Science and Technology Program Elective Basket
5	Mini Project

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT111	Applied Optics	3	3	0	0	0

PREREQUISITE – Nil

COURSE OBJECTIVE(s)

The objective of the course is to provide students with a fundamental understanding of the theoretical principles and mathematical frameworks governing the behavior of light and its applications in various optical systems.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Wave Propagation: Review of Maxwell's equations and propagation of waves, Plane polarized light. Reflection and refraction of EM wave, Brewster's angle, Introduction to polarization, linear, circular and elliptical polarizations, Malus's law, Anisotropic Media: Plane waves in anisotropic media, Birefringence, Uniaxial crystals; Analysis of polarized light. Quarter and half wave plates, analysis of polarized light. **(No. of lectures:19)**

Interference: Michelson interferometer; Fabry-Perot interferometer and etalon, Antireflection coatings. Diffraction: Fresnel and Fraunhofer diffraction. Single slit, circular aperture; limit of resolution. Diffraction of a Gaussian beam. **(No. of lectures:13)**

Fourier Optics: Fourier transform operation spatial frequency and transmittance function, spatial-frequency filtering, Phase contrast, microscope. Basics concepts of holography, basics concepts and ray optics considerations of optical fiber, introduction to lasers. **(No. of lectures:07)**

TEXT BOOKS:

1. A. K. Ghatak, "Optics", 7th Edition, McGraw-Hill
2. F. A. Jenkins and H. E. White, "Fundamentals of Optics", 4th edition, McGraw-Hill Education

REFERENCE BOOKS:

1. Born and E. Wolf, Principles of Optics, 7th Edition, Cambridge University Press, 1999
2. P Hariharan, Optical Holography: Principles, Techniques and Applications. 2nd ed. Cambridge University Press; 1996.
3. A. K. Ghatak and K. Thyagarajan, Optical Electronics, Cambridge University Press

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
22BMT922	Management Principles for Engineers	3	3	0	0	0

PREREQUISITE – Nil

COURSE LEARNING OBJECTIVE(s)

By the end of this course student will be able to:

1. Understand the global transition towards a new normal of management.
2. Demonstrate the managerial roles, skills and functions for responsible management.
3. Develop the understanding and cognizance of the importance of Professional management (ethical, responsible, and sustainable).
4. Perform various tools and techniques to be used in the performance of the managerial job.
5. Make effective application of acquired knowledge to diagnose and solve organizational problems and develop optimal managerial decisions.
6. Diagnose and communicate the complexities associated with management of various issues in the organizations and integrate the learning in handling these complexities.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Management: Nature, Scope and Functions, Managerial Roles and Levels of Management;
General Management Processes and Principles, Management Practices;
Essentials of Planning; Strategies, policies and planning premises; Decision making;
Organizing: Organizational Design & Organizational Structures;
Leading: Motivation; Leadership, Power and Authority; Leadership Styles;
Controlling; Steps and types of Control Process;
Dimensions of Management: Ethical management, Responsible Management, Sustainable Management.

References

1. Robbins, Stephen P. And Coulter, Mary (2019) 'Management', 14th edition, 2019 Prentice Hall of India
2. Laasch, O. (2021).Principles of Management- Practicing Ethics, Responsibility, Sustainability, 2nd Edition, Sage Publications.
3. Hill, Charles WL and McShane, StevenL.(2017) Principles of Management, Special Indian Edition, McGraw-Hill Education
4. Robbins, Stephen P.,Decenzo,DavidA.& Bhattacharya,Sanghamitra (2009) Fundamentals of Management, latest edition, Pearson Education
5. Koontz, Harold and Weihrich, Heinz & Ramachandra Aryasri A.(2016).Principles of Management, Latest edition, McGraw Hill Education

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT121	Mathematical Methods in Physics	4	3	1	0	0

PREREQUISITE COURSES

None

COURSE OBJECTIVES

1. To impart mathematical concepts and techniques required for undergraduate studies in Engineering Physics.
2. To inculcate the ability to apply these ideas in existing and novel problems and situations, including those in other mathematical disciplines.

COURSE ASSESSMENT

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit 1: Complex Analysis

Complex functions, analyticity, Cauchy-Riemann equations, complex integration, contours, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor & Laurent series, singularities, poles vs essential singularities, residue theorem, applications of residue theorem to real and complex integrals, multi-valued functions, branch cuts (13 lectures)

Unit 2: Fourier Analysis

From Fourier series to Fourier transform, general properties, Convolution Theorem, Parseval's Theorem, Fourier transform of common functions, Dirac delta function, differential equations in Fourier space, applications to physical systems (10 lectures)

Unit 3: Functional Analysis

Functions as vectors, Inner product, norm, orthogonality, Dirac's notation, orthonormal bases & expansions, Hilbert spaces, Linear operators, differential operators, adjoint operators, self-adjoint operators and boundary conditions, eigenvalues & eigenfunctions, spectral decomposition, Sturm Liouville theory, standard orthogonal polynomials (Legendre, Hermite, Laguerre), Bessel functions (16 lectures)

TEXT BOOKS

1. *A Guided Tour of Mathematical Physics (Third Edition)*, Roel Snieder and Kasper van Wijk, (Cambridge University Press 2015)
2. *Mathematics for Physics*, Michael Stone and Paul Goldbart (Cambridge University Press) 2009

REFERENCE BOOKS

1. *A Course in Mathematics for Students of Physics Vol. 1*, Paul Bamberg and Shlomo Sternberg (Cambridge University Press 1991)
2. *Mathematical Methods for Physicists (Seventh Edition)*, George B. Arfken, Hans J. Weber, Frank E. Harris (Academic Press 2011)
3. *Mathematical Methods for Physicists: A Concise Introduction*, Tai L. Chow (Cambridge University Press 2000)
4. *Mathematical Physics: The Basics*, S. D. Joglekar (University Press 2005)
5. *Mathematical Physics: Advanced Topics*, S. D. Joglekar (University Press 2006)

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT122	Biophysics	2	2	0	0	0

PREREQUISITE – Basic knowledge of Thermodynamics

COURSE OBJECTIVE(s)

The objectives of this course are to:

Biophysics makes use of physical concepts and techniques to address problems in biology and ecology. Physics has been very successful at illuminating fundamental aspects of biological problems at the molecular level. For example, biophysicists use thermodynamics to understand enzyme reactions and X-ray diffraction or nuclear magnetic resonance to determine the structures of biological molecules such as proteins and DNA.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Life and energy, forces and energies at nanometer scales, intermolecular interactions and electrostatic screening, chemical bonding and stability of molecules, entropy, energy and electrostatics, laws of thermodynamics, brownian motion, metabolism in animals and photosynthesis in plants, chemical composition of living systems, structure and physical properties DNA & RNA, cell membrane, protein, stability of proteins, motions within proteins, how enzymes work
(No. of lectures: 09)

Unit II:

Nucleic acid and genetic information, deciphering the genetic code, how structure stores

information, replication process, from DNA to RNA to protein, mechanics and circuits in the cell, the cell as a basic unit of life& its organization, the cell interior, brownian motion and viscosity and their influence on particle motion in the cell, basic structure of mitochondria and the generation of ATP, energy and information flow in the cell

No. of lectures: 09)

Unit III:

The role of the cytoskeleton in cell motion, the role of motors within the cell, muscle, random walks, sense of a remarkable array of biophysical processes, from the diffusion of molecules to the swimming strategies of bacteria, life at low Reynolds number, the neuron, the role of channels and pumps, the biophysics of the synapse, two cases: muscle and retina

(No. of lectures: 09)

TEXT BOOKS:

1. Essentials of biophysics: P Narayanan (New Age International).
2. An introduction to biophysics: M.R. Rajeswari (Rastogi Publications)

REFERENCE BOOKS:

1. Biophysics: Rodney M.J (Wiley).
2. The rainbow and the worm: Mae-Wan Ho (World Scientific).
3. Newton rules biology: C.J. Pennycuick (Oxford).
4. How life learned to live: Helmut Tributsch (Cambridge).

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT123	Electromagnetic Theory	3	3	0	0	0

PREREQUISITE

None

COURSE OBJECTIVE(s)

This course aims to gain a deep understanding of the fundamental principles governing electrostatics, magnetostatics, and electrodynamics. Also, students learn how to develop problem-solving skills to analyze and solve complex problems in various practical scenarios, including applications in engineering, physics, and other fields.

COURSE OUTCOMES:

CO1	To understand the fundamental laws governing electric and magnetic fields.
CO2	Apply mathematical tools to analyze and solve electrodynamics problems.
CO3	Apply the knowledge of electrostatics, magnetostatics, and electrodynamics to real-world engineering applications.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1- Overview of Electrostatics, Poisson and Laplace's equations, Boundary conditions and Uniqueness theorems, Electrostatic boundary value problems, Method of images, Multipole expansion, Approximate potentials at large distances, Electric field of a dipole, Polarization, field of a polarized object, Bound charges and its physical interpretation, Gauss's law in dielectrics and boundary conditions. **(No. of lectures- 13)**

Module 2- Overview of Magnetostatics, Magnetization, Effect of a Magnetic Field on Atomic Orbits, Field of a Magnetized Object, Bound currents, Physical Interpretation of Bound Currents, Magnetic Field Inside Matter, Ampère's Law in Magnetized Materials, Magnetic Susceptibility and Permeability, Magnetic levitation.
(No. of lectures- 09)

Module 3- Electromagnetic wave equation, Electromagnetic waves in vacuum, Energy and Momentum in Electromagnetic Waves, Electromagnetic waves in matter, Reflection and Transmission at normal and oblique incidence, Electromagnetic waves in conductors, Wave guides, TE Waves in a Rectangular Wave Guide, Optical fibers.
(No. of lectures- 11)

Module 4- Scalar and vector potentials, Potential formulation of Maxwell's equations, Gauge transformations, Coulomb and Lorenz gauges, Retarded potentials, dipole radiation.
(No. of lectures- 6)

TEXT BOOKS:

1. Introduction to Electrodynamics: David J. Griffiths, (Prentice Hall of India).
2. Classical Electrodynamics: J.D. Jackson, (John Wiley and Sons).

REFERENCE BOOKS:

1. Elements of Electrodynamics: Matthew N. O. Sadiku
2. The Classical Theory of Fields: L.D. Landau, E.M. Lifshitz (Pergamon Press, Oxford).
3. Foundations of Electromagnetic Theory: J. Reitz and F.J. Milford (Addison-Wesley).
4. Electromagnetic Waves and Radiating Systems: E.C. Jordan (Prentice Hall of India).

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT211	Engineering Mechanics and Relativity	3	2	1	0	0

COURSE CONTENTS

Kinematics and dynamics- Polar coordinates. velocity and acceleration in polar coordinates, constraints, Generalized coordinates, Configuration space, Hamilton's action principle, Lagrangian and Lagrange's equation, velocity dependent potential and friction, phase space, Hamiltonian and Hamilton's equations, cyclic coordinates and conservation of linear and angular momentum, conservation of energy, momentum of variable mass system: motion of rocket.

(No. of lectures- 10)

Oscillations - Simple Harmonic Motion, Damped Harmonic Motion, Energy of damped oscillator, Quality factor for damped oscillator, Forced oscillations: Transient and steady states, Resonance: sharpness of resonance , Energy of forced damped oscillator, resonance curve and quality factor for forced damped oscillator.

.(No. of lectures- 5)

Rotational motion- Degrees of freedom for rigid body, direction cosine and orthogonal transformations, Euler angles, Euler's theorem, infinitesimal rotations, rate of change of a vector, angular velocity as time derivative of Euler angles, non-inertial frames and coriolis force, angular momentum, inertia tensor and kinetic energy of a rigid body, Euler's equations for rigid body motion, torque-free motion of a rigid body and precession of earth.

(No. of lectures- 7)

Special theory of relativity: Michelson-Morley experiment, postulates of special theory of relativity, inertial frames, Galilean transformation, simultaneity and order of events, Lorentz transformation, time dilation and length contraction, proper time and proper length relativistic addition of velocities, relativistic momentum and relativistic energy, collisions and conservation of energy and momentum in special relativity.

(No. of lectures- 5)

TEXT BOOKS/: -

1. Classical Mechanics –Goldstein, Poole and Safko (Pearson Education)
2. An Introduction to Mechanics, Daniel Kleppner and Robert Kolenkow (McGraw Hill Education)

REFERENCE BOOKS

1. Berkeley Physics Course Volume 1: Mechanics, Charles Kittel, Walter Knight, Malvin Ruderman, Carl Helmholz and Burton Moyer (McGraw Hill Education)
2. Mechanics, D. S. Mathur (S. Chand & Company limited)
3. Introduction to Classical Mechanics with Problems and Solutions: David Morin (Cambridge University Press)
4. Mechanics, Keith R. Symon (Addison-Wesley Publishing Company)
5. Concepts of Modern Physics, Arthur Beiser, Shobhit Mahajan, S. Rai Choudhury (McGraw Hill Education)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT212	Foundations of Quantum Theory	3	3	0	0	0

PREREQUISITE COURSES

None

COURSE OBJECTIVES

Upon successful completion of the course, students will be able to:

1. Understand the fundamental principles of quantum mechanics based on wave mechanics, operator methods.
2. Apply quantum mechanics to simple physical systems relevant in engineering physics.
3. Develop sufficient understanding of basic quantum computation concepts so as to be able to continue further studies.

COURSE ASSESSMENT

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit 1: Foundations

Failures of classical physics, wavefunction, states as vectors, observables as operators, measurement postulate, expectation values, basis change, heuristics of uncertainty principle, commutation relation, Schrodinger equation, Eigenvalue problem and stationary states

(No. of lectures- 9)

Unit 2: Simple 1D systems

Free particle, need for wave-packets, continuity equation for probability, particle in an infinite well, particle in a finite well and tunneling, harmonic oscillator, applications to quantum wells, tunneling devices, and nanoscale confinement

(No. of lectures- 11)

Unit 3: Higher-dimensional systems

Symmetries in quantum mechanics, rotations, angular momentum, angular momentum algebra, central potentials, hydrogen atom, spin, spin and SU(2) structure, Bloch sphere

(No. of lectures- 11)

Unit 4: Basics of quantum computation

Qubits, single-qubit gates, multi-qubit systems, entanglement, heuristical introduction to density matrix, Bell states, measurement

(No. of lectures-8)

TEXT BOOKS

1. *Principles of Quantum Mechanics (Second Edition)*, R. Shankar (Springer 2011)
2. *A Modern Approach to Quantum Mechanics (Second Edition)*, John S. Townsend (University Science Books 2012)
3. *Introduction to Classical and Quantum Computing*, Thomas G. Wong (Rooted Grove 2022)
<https://www.thomaswong.net/introduction-to-classical-and-quantum-computing-1e3p.pdf>

REFERENCE BOOKS

1. *Introduction to Quantum Mechanics (Second Edition)*, D. J. Griffiths (Cambridge India 2015)
2. *Quantum Mechanics (Third Edition)*, Eugen Merzbacher (John Wiley & Sons 1998)

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT213	Physics of Semiconductor Devices	2	2	0	0	0

PREREQUISITE – Fundamentals of Solid State & Quantum Mechanics

COURSE OBJECTIVE(s)

This course aims to equip the students with fundamental knowledge of semiconductor physics and explain the working and design of p-n junctions and low dimensional semiconductor structures and devices.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Introduction of crystals & carriers in semiconductors, doping, carrier concentrations, fermi level, electron & hole generation/recombination, drift & diffusion current, continuity equation

(No. of lectures- 8)

P-N junction, fabrication, equilibrium properties, space charge, capacitance of a junction, forward and reverse biased junctions, current-voltage characteristics, steady state conditions, reverse bias breakdown, graded junctions, metal-semiconductor contacts, Schottky barrier, rectifying contacts, ohmic contact, heterojunctions

(No. of lectures- 15)

BJT- fundamentals of operation, amplification, switching, JFET – pinch off & saturation, gate control, current voltage characteristics

(No. of lectures- 5)

TEXT BOOKS:-

1. Solid State Electronic Devices, B.G.Streetman, S. Banerjee, Prentice Hall
2. Semiconductor Physics and Devices- Basic Principles, Donald A. Neamen, 4th Ed., McGraw Hill
3. Principles of Semiconductor Devices - Sima Dimitrijevic, Oxford University Press

REFERENCE BOOKS :

1. Semiconductor Devices Physics and Technology, S M Sze, John Wiley and Sons, 2nd Ed.
2. Semiconductor Materials and Devices, M S Tyagi, John Wiley and Sons

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT214	Analog and Digital Electronics	3	3	0	0	0

COURSE OUTCOME (s)

This course provides a comprehensive overview of **analog and digital electronics**. Students will gain the ability to design, analyze, and implement circuits for practical applications in engineering physics.

- **CO1:** Understand fundamentals of diodes, BJT, op-amps, and digital logic circuits.
- **CO2:** Design and analyze analog and digital circuits for given specifications.
- **CO3:** Compare design issues, advantages, disadvantages, and limitations of analog and digital circuits.
- **CO4:** Apply knowledge of electronics in instrumentation, communication, and embedded systems.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I – Semiconductor Devices and Analog Circuits

PN junction diode, V-I characteristics, Zener diode, rectifiers, clippers, clampers, transistor CE configuration, hybrid model, h-parameters, conversion of h-parameters, emitter follower, high-frequency effects, amplifier classification, RC-coupled amplifier response, power amplifiers

(Class A, B, C), amplifier characteristics, feedback amplifiers, transfer gain, feedback topologies, negative feedback effects. **(number of lectures: 20)**

Unit II – Operational Amplifiers and Applications

Operational amplifier basics, parameters, golden rules, inverting and non-inverting amplifiers, summing, subtractor, integrator, differentiator, instrumentation amplifier, comparators, Schmitt Trigger, precision rectifiers, peak detectors, clippers, clampers, active filters, passive filters, Sallen-Key topology, second-order filters, transfer function, Bode plots, Wien bridge oscillator, phase-shift oscillator, voltage regulators, power supply design. **(number of lectures: 10)**

Unit III – Digital Systems and Microprocessors (9 Lectures)

Binary numbers and codes, error detection and correction codes, universal gates, Boolean simplification, minterms, maxterms, SOP and POS methods, Karnaugh maps, arithmetic circuits, programming logic devices, RS flip-flop, D flip-flop, JK flip-flop, preset and clear operations, race-around condition, master-slave JK flip-flop, shift registers, asynchronous counters, synchronous counters, ring counters, decade counter, D/A conversion, A/D conversion, timing circuits, display devices, microprocessor basics, microprocessor-based system design.

(number of lectures: 9)

TEXT BOOKS :

1. Electronic Principles: Malvino and Bates (McGraw Hill Education)
2. The Art of Electronics: Horowitz and Hill (Cambridge University Press)
3. Digital principles and applications By Donald P. Leach & Albert Paul Malvino,

REFERENCE BOOKS:

1. Integrated Electronics: Millman and Halkias (Tata McGraw Hill).
2. Op-Amps and Linear Integrated Circuits: Ramakanth A. Gayakwad (Prentice Hall of India)
3. Electronic Devices and Circuit Theory: Robert Boylestad and Louis Nashdsky (Prentice Hall of India)
4. Digital principles and applications By Donald P. Leach & Albert Paul Malvino,
5. Digital Fundamentals, 3rd Edition by Thomas L. Floyd
6. Digital Electronics by R.P. Jain
7. Fundamental of Digital Circuits, Anand Kumar
8. Microprocessor Architecture, Programming, and Applications with the 8085: R Gaonkar (Penram International Publishing)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHP215	Analog and Digital Electronics Lab	4	0	0	8	0

PREREQUISITE

None.

COURSE OBJECTIVE(s)

This course aims to equip the students with an understanding of the theoretical concept of analogue and digital electronics through laboratory, as well as an understanding of designing and implementing various electronics circuits.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based on assignments, quizzes, and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

1. To study the characteristics of BJT amplifiers
2. To study the characteristics of MOSFET amplifiers
3. To study the characteristics of FET amplifiers
4. To study the frequency response of transistor amplifiers
5. To study the diode clipping and clamping
6. To study the voltage regulator using Zener diode
7. To study the class B push pull power amplifier

8. To study the application of op-amps as Inverting Amplifier, Non-inverting Amplifier, and Summing Amplifier
9. To study the application of op-amps as Integrator and Differentiator
10. To study the characteristics of Filters using op-amps: Low pass, High Pass, and Band Pass
11. To study the Schmitt Trigger using op-amps (positive feedback and Hysteresis)
12. To study the Wien Bridge Oscillator using op-amps
13. To design Precision Half-Wave and Full-wave Rectifiers using op-amps
14. To study the Multivibrators using op-amps
15. To verify and design AND, OR, NOT, and XOR gates using NAND and NOR gates.
16. To derive all basic logic gates using NAND/NOR gates only
17. To design a 2-bit multiplier and implement it
18. Design half and full adder
19. Design half and full subtractor
20. Design a 4 1 Multiplexer using gates
21. To design and implement a latch using two NOR gates and verify its truth table
22. Design a counter using S-R, D/T/JK Flip-Flop
23. To realize the following shift registers using IC7474. (a) SISO (b) SIPO (c) PISO.
24. To implement a synchronous up/down counter
25. To realize 3-variable function using IC 74151
26. Clock-pulse generator: design, implement and test
27. Memory Unit: Investigate the behaviour of RAM unit and its storage capacity -16 X 4 RAM: testing, simulating and memory expansion
28. To perform 8 Bit Addition, Subtraction, Multiplication and Division by using MICROPROCESSORS (8086 Assembly Language Programming)

TEXT BOOKS:

1. Electronic Principles: Malvino and Bates (McGraw Hill Education).
2. The Art of Electronics: Horowitz and Hill (Cambridge University Press)
3. Operational Amplifiers & Linear Integrated Circuits: Theory and Application Laboratory Manual/3E, James M. Fiore (Dissident)
4. Fundamental of Digital Circuits, Anand Kumar
5. Digital principles and applications By Donald P. Leach & Albert Paul Malvino,

REFERENCE BOOKS:

1. Solid State Electronic Devices: Ben G. Streetman (PHI)
2. Integrated Electronics: Millman and Halkias (Tata McGraw Hill).
3. Op-Amps and Linear Integrated Circuits: Ramakanth A. Gayakwad (PHI)
4. Electronic Devices and Circuit Theory: Robert Boylestad and Louis Nashdsky (PHI)
5. Digital Fundamentals, 3rd Edition by Thomas L. Floyd
6. Digital Electronics by R.P. Jain

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT221	Thermodynamics and Statistical Mechanics	4	3	1	0	0

PREREQUISITE – Basic understanding of Physics, Chemistry and Mathematics

COURSE OBJECTIVE(s)

This course integrates macroscopic thermodynamics with microscopic statistical mechanics to explain the behavior of many-body systems. Students would learn the laws of energy and entropy before bridging to kinetic theory and ensemble formalisms. Students will learn to derive the thermodynamic properties of both classical and quantum systems by using the partition functions for the microcanonical, canonical, and grand canonical ensembles. The curriculum concludes with advanced applications in Bose-Einstein and Fermi-Dirac statistics, providing a unified theoretical framework essential for modern physics and engineering.

COURSE ASSESSMENT

The Course Assessment (culminating in the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Classical Thermodynamics

Thermal equilibrium, the zeroth law, and the concept of temperature; the first law of thermodynamics and its consequences, including reversible, irreversible, and quasi-static processes; the second law of thermodynamics, heat engines, and the concept of entropy; thermodynamic potentials, Maxwell's relations, and the Joule-Kelvin effect; phase transitions, including the Clausius-Clapeyron equation, order parameters, and critical exponents; applications to magnetism, superfluidity, and superconductivity. **(No. of lectures: 10)**

Module 2: Kinetic Theory and Foundations of Statistical Mechanics

Kinetic theory of gases and transport phenomena; statistical interpretation of entropy and the Boltzmann hypothesis; macrostates, microstates, and the ergodic hypothesis; phase space dynamics and Liouville's theorem; the microcanonical ensemble and the postulate of equal a-priori

probabilities; thermodynamic probability and the statistical basis of the second law.

(No. of lectures: 9)

Module 3: Classical Ensembles and Interacting Systems

The canonical ensemble, partition functions, and calculation of thermodynamic functions; applications to ideal gases, harmonic oscillators, and paramagnetism; classical entropy expressions and the Gibbs paradox; the law of equipartition of energy and its limitations regarding specific heat; the grand canonical ensemble and chemical potential; interacting systems including virial and cluster expansions, van der Waals theory, and liquid-vapor condensation.

(No. of lectures: 10)

Module 4: Quantum Statistical Mechanics

Foundations of quantum statistics involving bosons and fermions, symmetric and antisymmetric wave functions, and the density matrix formulation; quantization effects in molecular gases, phonons, and photons; Bose-Einstein distribution, Bose-Einstein condensation, and the properties of liquid He IV; Fermi-Dirac distribution law, Fermi energy, and the thermodynamic functions of a strongly degenerate Fermi gas.

(No. of lectures: 10)

TEXT BOOKS:-

1. Statistical Mechanics, Pathria, R. K. and Beale, P. D., Academic Press. 2011 (3rd ed).
2. Fundamentals of Statistical and Thermal Physics, Reif, F., Waveland Press. 2008.

REFERENCE BOOKS:-

1. Statistical Mechanics, Huang, K., Wiley India Pvt. Limited. 2008 (2nd ed).
2. Statistical Mechanics: An Introduction, Guha, E., Narosa Publishing House. 2013.
3. Thermal Physics: Kinetic Theory, Thermodynamics and Statistical Mechanics, Garg, S.C., Bansal, R.M., and Ghosh, C.K., McGraw Hill Education (India). 2017 (2nd ed).

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT222	Physics of Energy Materials	2	2	0	0	0

PREREQUISITE – Basic understanding of Solid State Physics, Thermodynamics, Quantum Mechanics, and Electromagnetism

COURSE OBJECTIVE(s)

This course introduces the physical principles governing energy materials used in energy generation, storage, and conversion technologies. The course emphasizes electronic structure, ionic transport, electrochemical processes, semiconductor physics, nanomaterials, and interfacial phenomena relevant to batteries, supercapacitors, solar cells, fuel cells, and hydrogen energy systems. Students will also gain exposure to modern characterization techniques and emerging sustainable energy materials.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Fundamentals of Energy Materials

Global energy scenario and sustainability; classification of energy materials; crystal structure, bonding, defects, vacancies, grain boundaries, and basic crystallography; electronic band structure, density of states, and Fermi level; electronic and thermal transport; ionic conduction, diffusion, hopping transport, ionic conductivity, grain boundary, and space-charge effects.

(No. of lectures: 6)

Module 2: Electrochemical Energy Storage Materials

Basics of electrochemistry and electrochemical cells; lithium-ion, sodium-ion, and metal-air batteries; cathode and anode materials; intercalation and deintercalation mechanisms; ion diffusion and storage; solid electrolytes and separators; qualitative introduction to supercapacitors and hybrid storage systems; SEI formation, degradation, and thermal stability.

(No. of lectures: 4)

Module 3: Materials for Energy Conversion

Photovoltaic effect and semiconductor junctions; carrier generation, recombination, and transport; silicon, thin-film, perovskite, organic, and quantum dot solar cells; fuel cells and hydrogen energy materials; electrolysis, photocatalysis, hydrogen storage; thermoelectric and piezoelectric materials. **(No. of lectures: 4)**

Module 4: Structure and Physics of Advanced Energy Materials

Crystal structures and structure–property relationships in energy materials; layered and intercalation materials; carbon-based energy materials including graphite, graphene, carbon nanotubes, activated carbon, and carbon aerogels; spinel, olivine, and perovskite structures; MXenes and transition metal dichalcogenides; nanomaterials, quantum confinement, and nanostructured electrodes; magnetic and ferroelectric energy materials; emerging materials for solid-state batteries, tandem solar cells, and photocatalytic systems. **(No. of lectures: 8)**

Module 5: Characterization Techniques and Applications

Basic structural and physical characterization of energy materials using XRD, SEM/TEM, Raman, FTIR, UV–Visible spectroscopy, XPS, and impedance spectroscopy; electrochemical characterization using cyclic voltammetry, charge–discharge analysis, and electrochemical impedance spectroscopy; case studies, commercialization, recycling, and sustainability of energy materials. **(No. of lectures: 4)**

TEXT/ REFERENCE BOOKS: -

1. The Physics of Energy, Jaffe, R. L. and Taylor, W. 2018, Cambridge University Press.
2. Energy Materials, Eswaramoorthy, M., George, S. J., Sundaresan, A. and Rao, C. N. R. 2023, World Scientific.

REFERENCE BOOKS: -

1. Introduction to Solid State Physics, Kittel, C. and McEuen, P. 2018 (9th ed), Wiley
2. Physical Chemistry of Ionic Materials: Ions and Electrons in Solids, Maier, J. 2023 (2nd ed), Wiley.
3. Electrochemical Energy Storage: Batteries, Fuel Cells, and Hydrogen Technologies, Petrovic, S., Kurzweil, P. and Garche, J. 2022, McGraw-Hill.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT223	Laser and Its Applications	3	3	0	0	0

COURSE OUTCOME (s)

This course provides a comprehensive overview of laser physics and its diverse applications. Students will gain the ability to understand, design, and analyze laser systems and apply them in scientific and industrial contexts.

- **CO1:** Understand fundamentals of laser radiation, atomic transitions, and gain media.
- **CO2:** Analyze cavity resonators, stability conditions, and pulse generation techniques.
- **CO3:** Compare design issues, advantages, disadvantages, and limitations of different laser systems.
- **CO4:** Apply knowledge of lasers in spectroscopy, communication, medicine, materials processing, and nonlinear optics.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I – Fundamentals of Laser Physics: Properties of laser radiation (spectrum, coherence), atomic levels, absorption, spontaneous and stimulated emission, Einstein coefficients, population inversion, gain media, rate equations, level broadening mechanisms. **(No. of lectures: 12)**

Unit II – Laser Systems and Resonators: Cavity modes, threshold conditions, 3-level and 4-level systems, transverse mode structure, optical resonators, time constant and quality factor, stability of resonators, Q-switching, mode-locking, ultrashort pulse generation (ns, ps, fs). **(No. of lectures: 12)**

Unit III – Types of Lasers: Gas lasers (He-Ne, CO₂, Ar⁺, Nitrogen), solid-state lasers (Ruby, Nd:YAG, Ti:Sapphire), dye lasers, semiconductor lasers, excimer lasers, free-electron lasers.

(No. of lectures: 9)

Unit IV – Applications of Lasers: Laser cooling, holography, optical communication (fiber lasers and amplifiers), medical applications, materials processing, spectroscopy (time-resolved, pump-probe), nonlinear optics (harmonic generation, optical parametric amplification).

(No. of lectures: 6)

TEXT BOOKS

1. O. Svelto – *Principles of Lasers*
2. W. Koechner – *Solid State Laser Engineering*
3. B.B. Laud – *Lasers and Nonlinear Optics*

REFERENCE BOOKS

1. P.W. Milonni & J.H. Eberly – *Lasers*
2. B.E.A. Saleh & M.C. Teich – *Fundamentals of Photonics*
3. Yariv – *Quantum Electronics*
4. W.T. Silfvast – *Laser Fundamentals*
5. A.E. Siegman – *Lasers*
6. D. Meschede – *Optics, Light and Lasers*
7. M. Young – *Optics and Lasers*
8. B.A. Lengyel – *Lasers*

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT224	Optoelectronics	3	3	0	0	0

COURSE OUTCOME (s)

This course provides a comprehensive overview of optoelectronic devices, optical waveguides, and communication systems. Students will gain the ability to understand, design, and analyze optoelectronic systems for practical applications in engineering physics.

- **CO1:** Understand the electronic and optoelectronic properties of semiconductors, PN junction operation, and light absorption/emission mechanisms.
- **CO2:** Study the principles of LEDs, semiconductor lasers, heterojunction lasers, quantum well lasers, VCSEL, DFB/DBR lasers, photodetectors, and solar cells.
- **CO3:** Understand total internal reflection, Snell's law, and light guiding mechanisms in planar and fiber waveguides.
- **CO4:** Design and analyze optical communication links, evaluate fiber types, and study loss and dispersion mechanisms.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I – Planar and Fiber Waveguides: Wave propagation in planar optical waveguides, ray theory, electromagnetic mode theory, phase and group velocity, dispersion. Cylindrical fiber waveguides, modes and mode coupling, step and graded index fibers, single-mode fibers.

((No. of lectures: 10))

Unit II – Transmission Characteristics of Fibres: Attenuation, material absorption and scattering loss, bend loss, intra-modal and inter-modal dispersion in step and graded fibers, overall dispersion in single and multi-mode fibers.

(No. of lectures: 10)

Unit III – Optical Fibre Connections: Optical fiber cables, stability of characteristics, fiber alignment; fiber splices, connectors, couplers. **(No. of lectures: 5)**

Unit IV – Optical Sources and Detectors: Absorption and emission of radiation, population inversion and laser oscillation, PN junction, recombination and diffusion, stimulated emission and lasing, heterojunctions, single-frequency injection lasers, LED structures and characteristics. Optical detection principles, PN, PIN, and avalanche photodiodes. **(No. of lectures: 8)**

Unit V – Optical Communication Systems and Networks: System description and design considerations of optical fiber communication systems, noise in detection process, power budgeting, rise-time budgeting, maximum transmission distance. Optical networks: WDM concepts, SONET/SDH basics, wavelength-routed networks, nonlinear effects, EDFA systems, solitons, optical CDMA. **(No. of lectures: 6)**

TEXT BOOKS

1. J.M. Senior – *Optical Fiber Communications*
2. G. Keiser – *Optical Fiber Communications*
3. A. Ghata & K. Thyagarajan – *Introduction to Fiber Optics*

REFERENCE BOOKS

1. P.K. Cheo – *Fiber Optics and Optoelectronics*
2. J. Govar – *Optical Communication Systems*
3. A.W. Snyder & J.D. Love – *Optical Waveguide Theory*

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHP225	Laser and Optoelectronics Lab	4	0	0	8	0

PREREQUISITE: Basic understanding of laser and optoelectronic devices.

COURSE OBJECTIVE(s): To gain practical knowledge by applying the experimental methods to correlate with the Physics theory.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon practical lab records, viva, and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

Experiments

S. No.	List of Experiments
1.	To measure the beam divergence of a laser (He-Ne Laser)
2.	To find the width of the wire or the width of the slit using a diffraction pattern obtained by a He-Ne or solid-state laser.

3.	To determine the grating radial spacing of the Compact Disc (CD) by reflection using He-Ne or a solid-state laser.
4.	To demonstrate self-powered optoelectronic operation using a Piezo–Triboelectric Nanogenerator
5.	To study the characteristics of LDR.
6.	To determine the characteristics of the Diode Laser.
7.	To calculate the spectral bandwidth of LEDs
8.	To measure the piezoelectric charge constant (d_{33}) of a ceramic sample.
9.	Study of the Fabry Perot interferometer.
10.	To measure the wavelength of light using a precision interferometer (Michelson interferometer).
11.	To plot the graph and study the birefringence with respect to applied voltage in an electro-optic crystal (Pockel Effect Apparatus)
12.	Determination of the Verdet constant of the material for a given wavelength of light (Magneto-Optic Effect) using the Faraday Effect Apparatus
13.	To measure the numerical aperture of an optical fiber
14.	To determine the refractive index of the optical fiber.
15.	To study the variation of the bending loss in a multimode fiber
16.	To determine the power loss at a splice between two multimode fiber
17.	To measure the split size of a single-mode fiber

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	22MST241	Fundamentals of Materials Science and Engineering	3	3	0	0	0

PREREQUISITE – Nil

COURSE OBJECTIVE(s)

The objective of this course is to provide basic understanding of the structure, properties and applications of materials to the undergraduate students. The course will also introduce the students to phases and enable them to understand the phenomenon of phase transformations in materials.

COURSE OUTCOME

Upon completion of this course, the students will be able to:

1. Classify various classes of materials and explain their structures and imperfections.
2. Construct the phase diagrams of some systems and interpret the phase transformations
3. Explain the types and applications of ceramics and polymers
4. Understand and appreciate the distinctive properties of materials.

COURSE CONTENTS

Introduction: Why study materials science and engineering? Review of basic types of interatomic bonds, Classification of materials, Processing/structure/properties/ performance correlations.

(No. of lectures: 3)

Structure and Imperfections: Lattices, Unit cells, Miller indices of directions and planes for cubic and hexagonal systems, Close packing in solids, Common metallic structures, Voids in close-packed structures, Common ceramics structures – NaCl, CsCl, Diamond Cubic, Zinc Blende, Wurtzite, Rutile, Fluorite, Fullerenes, Spinel, Perovskite, etc., Polycrystalline materials, X-Ray diffraction for determination of crystal structures, Solid state diffusion – Ficks laws of diffusion, Diffusion mechanisms, Temperature dependence of diffusivity, Defects in crystals - Point defects, Dislocations, Grain boundaries and Surfaces

(No. of lectures: 10)

Phase Diagrams and Phase Transformations: Phase rule, Solid solutions, Hume-Rothery rules, Intermediate phases and compounds, Unary and binary phase diagrams, Isomorphous and eutectic systems, Lever rule, Typical phase diagrams: Fe-C, Cu-Ni, Cu-Zn etc. Classification of phase transformations, Liquid to solid transformation, Homogeneous and heterogeneous Nucleation,

Nucleation growth and overall transformations, Kinetic considerations in solid state transformations, Microstructure evolution during solidification in isomorphous system.

(No. of lectures: 8)

Ceramics and polymers: Types and applications of Glasses, Glass- Ceramics, Clay products, Abrasives, Cements. Introduction to polymers, Types of polymerizations, Molecular weight, shape, structure and configuration, Thermoplastic and Thermosetting polymers. Glass transition, melting and glass transition temperature, factors affecting melting and glass transition temperatures. Plastics, elastomers, fibres, Advanced polymeric materials, Some applications of polymers

(No. of lectures: 7)

Properties of Materials Mechanical Properties: Stress-strain response of metallic, ceramic and polymer materials, yield strength, tensile strength and modulus of elasticity, toughness, plastic deformation, fatigue, creep and fracture;

Electronic Properties: Free electron theory, Fermi energy, density of states, elements of band theory, semiconductors, Hall effect, dielectric behaviour, piezo, ferro, pyroelectric materials;

Magnetic Properties: Origin of magnetism in metallic and ceramic materials, paramagnetism, diamagnetism, ferro and ferrimagnetism;

Thermal Properties: Specific heat, thermal conductivity and thermal expansion, thermoelectricity.

Optical Properties: Refractive index, absorption and transmission of electromagnetic radiation in solids, electrooptic and magneto-optic materials, spontaneous and stimulated emission, gas and solid state lasers.

(No. of lectures: 11)

TEXT BOOKS:-

1. V. . Raghavan, “Materials Science and Engineering- A First Course”, 5th Edition, PHI Learning Pvt. Ltd., New Delhi 2004
2. W. . D. Callister, Jr. and D. G. Rethwisch, “Materials Science and Engineering- An Introduction”, 10th edition, John Wiley and Sons, Inc. 2018.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT311	Condensed Matter Physics	3	3	0	0	0

PREREQUISITE – Quantum Mechanics

COURSE OBJECTIVE(s)

This course aims to equip the students with fundamental knowledge of condensed matter physics. To explain structural, electrical, and magnetic behavior of different types of condensed phases.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Crystal Physics - Classification of condensed matter - crystalline and nanocrystalline solids, bonding in solids - ionic, covalent and metallic solids, crystal symmetry, point groups, space groups, lattices and basis, typical crystal structures, reciprocal lattice, Brillouin zone, structure factor. Bragg's law of diffraction.
(No. of lectures- 10)

Lattice Vibrations and Thermal Properties - Monoatomic and diatomic lattices, normal modes of lattice vibration, phonons and density of states, dispersion curves, specific heat – classical, Einstein and Debye models. thermal expansion and thermal conductivity, normal and Umklapp processes.
(No. of lectures- 9)

Band Theory of Solids - Free electron theory of metals, density of states, origin of energy bands, Fermi energy, Bloch Theorem, Kronig-Penney Model, distinction between metals, semiconductors, and insulators, Intrinsic and extrinsic semiconductors and carrier concentration, Hall effect in metals and semiconductors.
(No. of lectures- 9)

Magnetism & Superconductivity - Introduction to magnetism, quantum theory of dia- and para-magnetism, magnetic ordering, Weiss molecular theory of ferromagnetism and antiferromagnetism. Introduction to superconductivity, Meissner Effect, concept of Cooper pairs, BCS theory, Type-I and Type-II superconductors. **(No. of lectures- 11)**

TEXT BOOKS: -

1. Introduction to Solid State Physics, Kittel C, 8th Ed. (Wiley Eastern Ltd. (2004))
2. Solid State Physics, Ashcroft N M and Mermin N D, 2nd Ed. (Holt-Saunders (2004))

REFERENCE BOOKS: -

1. Magnetism in Condensed Matter, S Blundell (Oxford University press (2001))
2. Solid State Physics, Neil W. Ashcroft and N. David Mermin, Brooks/Cole, 1976, ISBN: 978-0030839931.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT312	Numerical Analysis through MATLAB	3	2	0	2	0

PREREQUISITE – Basics of Computer

COURSE OBJECTIVE(s)

To develop the mathematical skills of the students in the areas of numerical methods. To apply computer programming to solve numerical methods and to find the solution of algebraic equations using different methods under different conditions, and the numerical solution of a system of algebraic equations.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Basics of MATLAB programming, Array operations in MATLAB, loops and execution control, working with files: scripts and functions, plotting and program output **(No. of lectures- 10)**

Linear Equations - Linear algebra in MATLAB, Gauss Elimination. LU decomposition and partial pivoting, Iterative methods: Gauss Seidel, Special Matrices: Tri-diagonal matrix algorithm
Nonlinear Equations: Nonlinear equations in single variable, Fixed-point iteration in single variable, Newton-Raphson in single variable **(No. of lectures- 9)**

Numerical Differentiation and Integration - Numerical Differentiation in single variable, Numerical differentiation: Higher derivatives, Differentiation in multiple variables, multi-step application of Trapezoidal rule, MATLAB functions for integration **(No. of lectures- 10)**

Ordinary Differential Equations (ODE) - Introduction to ODEs; Implicit and explicit Euler's methods, Second Order Runge-Kutta Methods, MATLAB ode45 algorithm in single variable, Higher order Runge-Kutta methods, Error analysis of Runge-Kutta method **(No. of lectures- 10)**

TEXT BOOKS:

1. Getting Started with MATLAB: A Quick Introduction for Scientists & Engineers by Rudra Pratap (Oxford University Press)
2. Computer Oriented Numerical Methods: V. Rajaraman (Prentice Hall of India)
3. Numerical Analysis: M. K. Jain (New Age International Publishers)

REFERENCE BOOKS: -

1. Introduction Methods of Numerical Analysis: C.S. Sastry (Prentice Hall of India)
2. Monte Carlo Simulation in Statistical Physics, Kurt Binder, Dieter W. Heermann (Springer-Verlag Berlin and Heidelberg)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT313	Introduction to Quantum Technologies	3	3	0	0	0

PREREQUISITE – Basic Quantum Mechanics

COURSE OBJECTIVE(s)

The course aims to provide a comprehensive overview of quantum technologies, covering fundamental principles like superposition and entanglement. Students will explore hardware implementations for quantum computation, the mechanics of quantum sensing (including gravimetry and atomic clocks), and the protocols for secure quantum communications across fiber and satellite-based networks.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
d)	Internal assessment (based upon assignments, quizzes and attendance)	20%
e)	Mid-term examination	30%
f)	End Semester Examination	50%

COURSE CONTENTS

Module I: Introduction

Introduction to Quantum Technologies – four verticals and Motivation for Quantum Technologies. A qualitative overview of salient aspects of quantum physics: Quantum States, Wavefunctions, Probabilistic interpretation; Physical observables, Hermitian operators, expectation values; Heisenberg uncertainty principle; Schrodinger equation, Time evolution; distinction from classical physics, Heuristic description of Superposition, Tunnelling and entanglement; No cloning theorem; Simulating classical systems – Feynman’s idea of a quantum simulator and the birth of the field
(no. of lectures- 6)

Module II: Quantum Computation

Basics of qubits -- what is a qubit? How is it different from a classical bit? – Review of classical logic gates; Di Vincenzo criteria for realising qubits; Basics of qubit gates and quantum circuits; Physical implementation of qubits (very qualitative description); Solid State Qubits, Semiconducting Qubits – quantum dots, spins, Superconducting Qubits – charge, flux and phase,

Topological Qubits – proposals and advantages, Atoms and Ions, Trapped ions, Rydberg atoms, Neutral atoms, Photonic Qubits, Conventional linear optical setups, Integrated Photonics, NMR qubits, Conventional NMR qubits, NV Centres. Overview of applications and recent achievements: RSA and Shor's algorithm; Quantum Advantage, Long term goals and strategies being followed, Error correction. **(no. of lectures- 10)**

Module III: Quantum Sensing and Quantum Communications

Basics of quantum sensing, Basics of Photon (single and entangled) generation and detection, Gravimetry, Atomic clock, Magnetometry, State of the art in Quantum Sensing. Basics of digital communication, quantifying classical information – Shannon entropy, Basic ideas of quantum communication, security, eavesdropping, Overview of quantum communication achievements, Terrestrial – fibre-based, Free space, Satellite-based **(no. of lectures- 10)**

TEXT/ REFERENCE BOOKS: -

1. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)
2. Quantum computation and quantum information – Nielsen M. A., and Chuang I. L., 10th Anniversary edition, Cambridge University Press (2010)
3. Elements of Quantum Computation and Quantum Communication, A. Pathak, Boca Raton, CRC Press (2015)
4. An Introduction to Quantum Computing, Phillip Kaye, Raymond Laflamme, and Michele Mosca, Oxford University Press (2006)
5. Quantum computing explained, David McMahon, Wiley (2008)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT314	Thin Film Deposition and Characterization	3	2	0	2	0

PREREQUISITE

None

COURSE OBJECTIVE(s)

The course Thin Film Deposition & Characterization aims to provide a comprehensive understanding of thin film processing and analysis techniques used in modern materials and device engineering. It introduces the principles of vacuum systems and thin film deposition methods such as PVD and CVD, along with hands-on exposure to fabrication processes. The course also further focuses on the characterization of thin films to evaluate their structural, morphological, and optical properties. It enables students to understand the relationship between processing conditions and material properties, and to apply this knowledge to optimize performance in optoelectronic devices and advanced material systems.

COURSE OUTCOMES:

CO1	To understand the fundamentals of vacuum systems, including pumps, and gauges.
CO2	To explain thin film deposition processes based on underlying physical principles and process parameters.
CO3	To interpret the data obtained from different characterizations and evaluate structural, morphological, and optical properties of thin films.
CO4	To correlate processing conditions with material properties and understand their impact on performance of optoelectronic and advanced material devices.

COURSE ASSESSMENT

The Course Assessment (culminating in the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid Term examination	30%
c)	End Term Examination	50%

COURSE CONTENTS

Unit 1: Vacuum Science and Technology

[Lectures: 6, Tutorials: 0, Practical: 2]

Introduction to vacuum science and its importance in thin film processing, Creation of vacuum: rotary, diffusion, getter ion, turbo molecular, and cryo-pumps, Measurement of vacuum: Penning, Pirani, ionization gauges.

Unit II: Thin Film Deposition Techniques

[Lectures: 13, Tutorials: 0, Practical: 7]

Fundamentals of thin film growth, Synthesis methods of thin films: PVD & CVD methods, Thermal evaporation, E-beam evaporation, RF magnetron sputtering, DC sputtering, Ion beam sputtering, Pulsed Laser Deposition, Spin coating, Dip coating, and Chemical vapor deposition. Film thickness measurement methods.

Unit III: Characterization of Thin Films

[Lectures: 7, Tutorials: 0, Practical: 4]

Structural characterization: X-ray diffraction (XRD), Morphological characterization: Scanning electron microscopy (SEM) and atomic force microscopy (AFM), Optical characterization: UV-Visible spectroscopy.

Text Books:

1. Materials Science of Thin Films: Deposition and Structure, 2nd Edition, M. Ohring, 2001
2. Thin Film Phenomena. K. L. Chopra (*McGraw-Hill*)

Reference Books:

1. Encyclopedia of Materials Characterization: C Ricbard Brundle Charles A. Evans, Jr. Shaun Wilson, (Materials characterization series)
2. Handbook of Thin Film Technology: Maissel and Glange (McGraw Hill)
3. Basic Vacuum Technology: A. Chambers, R. K. Fitch, B. S. Halliday
4. Introduction to Nanoscience and Nanotechnology: K. K. Chattopadhyay and A.N. Banerjee, (PHI Learning Private Limited)
5. Vacuum Technology: A. Roth (North Holland)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT315	Semiconductor Device Modelling and Simulation	3	2	1	0	0

PREREQUISITE – Basic knowledge of optics and quantum mechanics

COURSE OBJECTIVE(s)

The objectives of this course are to:

The course aims to provide a comprehensive understanding of concepts of semiconductor devices. Course objective is to develop a sound physical and intuitive understanding of semiconductor devices and achieve ability to make some key decisions while designing applications specific semiconductor devices. The course is devoted to the fundamental understanding of device modeling and numerical simulation techniques

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Metal-Semiconductor junctions, Current-Voltage Characteristics, Surface Effects. The pn junction, Step Junction, Linearly Graded Junction, Heterojunctions, Reverse-Biased p-n junctions and break down mechanism. Generation and Recombination. Basic MOSFET behaviour, MOSFET scaling and short channel model. Devices: Complementary MOSFETs (CMOS), electric fields and velocity-saturation, basic leakage currents, channel length modulation, body bias effect, threshold adjustment, sub-threshold conduction

(No. of lectures: 08)

Unit II:

Device Modeling: Limitation of long channel analysis, short-channel effects: velocity saturation, device degradation, channel length modulation, body bias effect, threshold adjustment, mobility degradation, hot carrier effects, MOSFET scaling goals, gate coupling, velocity overshoot, high field effects in scaled MOSFETs, substrate current and effects in scaled MOSFETs. Moore law, Technology nodes and ITRS, Physical & Technological Challenges to scaling, Nonconventional MOSFET – (FDSOI, SOI, Multi-gate MOSFETs) **(No. of lectures: 08)**

Unit III:

Drift-Diffusion (DD) model-1: Drift-Diffusion Model Derivation and dielectric relaxation time, Taylor series expansion and Finite Difference method, Normalization, Scaling and Linearization of Poisson's Equation and Scharfetter–Gummel Discretization of the Continuity Equation Drift-Diffusion (DD) model-2: Generation and Recombination models, Derivation of SRH model, Boundary conditions, Gummel's Iteration Method and Newton's Method, Drift-Diffusion Application example, Hydrodynamic Modeling: As extension of DD model, Carrier Balance, Energy balance and momentum balance Equations, Direct solution scheme through Monte Carlo simulations, Quantum Transport models: Tunneling, Schrodinger equation and free particle, potential step, potential barrier, Transfer Matrix Approach, Quantum Mechanical corrections to standard approach **(No. of lectures: 10)**

TEXTBOOKS:

1. Semiconductor devices- Physics and Technology, S. M. Sze and M.K. Lee (Wiley)
2. Device Electronics for Integrated circuits by Muller and Kkammins (Wiley)
3. Computational Electronics: Semiclassical and Quantum Device Modeling and Simulation, VagicaVasileska and Stephen M. Goodnick (CRC Press)

REFERENCE BOOKS:

1. Physics of Semiconductor Devices, S. M. Sze and Kwok K. Ng (Wiley)
2. Solid State Electronic Devices, Ben G. Steetman and Sanjay Banerjee (Prentice Hall)
3. Semiconductor Physics and Devices, Donald A. Neamen, (McGrawHill)
4. Semiconductor Devices- Basic Principles, Jasprit Singh (Wiley)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHP316	Engineering Materials Lab	4	0	0	8	0

COURSE CONTENTS

1. Deposition of thin films using PVD/CVD techniques and analysis of band gaps
2. Synthesis of nanomaterials through physical and chemical routes, and their structure analysis
3. Effect of grinding time and rotational speed on particle size reduction.
4. (a) To plot the I-V characteristics of a solar cell and measure the short circuit current, open circuit voltage and maximum power point.
(b) To calculate the energy conversion efficiency of a solar cell.
5. (a) To measure the Hall coefficient of a given material.
(b) To study the temperature dependence of Hall coefficient of a given material.
6. To study the Gaussian nature of laser beams and carry out the diffraction experiments.
7. To study the speed of ultrasonic velocity in liquids and measure elasticity parameters.
8. To record a Frank Hertz curve for Mercury and measure the energy emission of free electrons in a gas filled triode.
9. To measure the magnetic susceptibility of paramagnetic solution by Quincke's method and to find the ionic molecular susceptibility and magnetic moment.
10. To determine the Curie temperature of a given solid and study the magnetic transition.
11. To study Bragg's law by microwave diffraction.
12. To study the Faraday Effect and calculate the Verdet's constant.
13. To study the performance of different rechargeable batteries by using Battery tester.

TEXT BOOKS: -

1. Introduction to Solid State Physics: C. Kittel, 7th Ed. (John Wiley and Sons)
2. Solid State Physics: N. Ashcroft and N.D. Mermin (Holt, Rinehart and Winston).

REFERENCE BOOKS: -

1. Solid State Physics: Azaroff (McGraw Hill).
2. Solid State Physics: A.J. Dekker (Prentice Hall of India, New Delhi).

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT321	Atomic and Molecular Spectroscopy	4	3	1	0	0

PREREQUISITE – Modern Physics, Quantum Mechanics

COURSE OBJECTIVE(s)

This course aims to equip the students with fundamental knowledge of emission and absorption spectra of atoms and molecules, the hydrogen atom, total angular momenta and dipole moment, coupling schemes of angular momenta of many-electron atoms, effects of interaction of spectra under different fields, molecular spectra and lasers and their applications.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Atomic Physics (One-electron atom)

Introduction of atomic spectra (emission and absorption), Bohr model, Bohr's quantization law, Hydrogen spectra, Rydberg formula, Vector atom model, orbital angular momentum, magnetic dipole moment of electron, space quantization, Stern–Gerlach experiment, spin & total angular momentum, Spin-orbit interaction & fine structure, Hyperfine structure, Isotope shift.

(No. of lectures- 12)

Atomic Physics (Multi-electron atom)

Identical particles: exchange symmetry, Pauli exclusion principle, Helium atom, Introduction of Central field approximation, Angular momentum coupling schemes: LS & JJ Coupling, Interaction with external fields: Zeeman and Paschen-Back effect, Stark effect, General factors influencing spectral line width and intensities.

(No. of lectures- 13)

Molecular Physics

Born-Oppenheimer approximation, Rotational spectra of diatomic molecules, Types of molecules such as (symmetric, spherical top, etc.), Vibrational spectra, diatomic vibrating rotator, vibration rotation spectra, electronic transitions, Franck- Condon principle, Raman effect (classical and

quantum), Raman spectroscopy (applications). Einstein coefficients, the basic working of lasers and applications, and other advanced topics in atomic and molecular physics

(No. of lectures- 14)

TEXT BOOKS:-

1. Atomic Physics, Foot, C. J. 2023 (Reprint ed.), Oxford University Press.
2. Fundamentals of Molecular Spectroscopy, Banwell, C. N. and McCash, E. M. 1994 (4th ed.), McGraw-Hill.

REFERENCE BOOKS: -

1. Spectra of Atoms and Molecules, Bernath, P. F. 2020 (4th ed.), Oxford University Press.
2. Atomic and Molecular Spectra: Lasers, Kumar, R. 2023, KNRN Publishers.
3. Introduction to Atomic Spectra, White, H. E. 1934, McGraw-Hill.
4. Physics of Atoms and Molecules, Bransden, B. H. and Joachain, C. J. 2003 (2nd ed.), Pearson.

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT322	Advanced Computational Tools for Physicists	3	2	1	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

To train students in statistical methods for data analysis using python programming and build strong mathematical foundations and physics understanding of experimental data from physics analysis.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Basics of Statistical and Python tools in Physics

Overview of Python and its libraries, data types in physics experiments, descriptive statistics, mean, median, mode, variance, standard deviation, probability basics, random variables, normal distribution, error representation, Plotting scientific data.

(No. of lectures: 12)

Module II: Data Analysis techniques

Measurement errors and uncertainties, propagation of errors, confidence intervals, weighted mean, histogram analysis, curve fitting using least squares method, linear regression, chi-square test, Monte Carlo simulation basics, data handling from Physics experiments.

(No. of lectures: 15)

Module III: Advances Statistical Techniques

Hypothesis testing, p-value and significance, correlation and covariance, Poisson statistics, counting experiments, signal vs background analysis, maximum likelihood estimation, time series data analysis, Case studies: nuclear physics, solid state physics, astronomy and cosmology, space Physics and particle physics datasets. **(No. of lectures: 12)**

Books and References

1. The Elements of Statistical Learning, 2nd ed., T. Hastie, R. Tibshirani, & J. Friedman, Springer (2016)
2. Python Machine Learning - Second Edition, Sebastian Raschka, Vahid Mirjalili
3. Statistics, R J Barlow (John Wiley and Sons)

References

4. A Practical Guide to Data Analysis for Physical Science Students, L. Lyons (Cambridge University Press)
5. Data analysis techniques for HEP, Fruhwirth et al (Cambridge University Press)
6. Introduction to Machine Learning, 3rd ed., E. Alpaydin, MIT Press (2014)
7. Handbook of Radiotherapy Physics, Theory and Practice, P Mayles, A Nahum, J.C Rosenwald (Taylor & Francis)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT323	Physics of Nuclear Radiations and Applications	3	2	1	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

- To provide a comprehensive understanding of the physical principles governing nuclear radiations and their complex interactions with matter.
- To develop technical expertise in the operation, design, and calibration of various detection systems, including gas-filled, semiconductor, and scintillation detectors.
- To bridge the gap between theory and industry by exploring real-world applications in medical physics, nuclear power, and global high-energy research facilities.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Fundamentals of Nuclear Radiations

Introduction to the nuclear radiations, Production of nuclear radiations, Classification of nuclear radiations: Electromagnetic radiations and Particle radiations: X-rays: Bremsstrahlung x-rays and Characteristic x-rays, Gamma rays, electron, proton, neutron, Secondary radiations, alpha, beta,

gamma rays, heavy ions, Important Characteristic of nuclear radiations, Interaction of nuclear radiations with matter: Ionization, excitation, Bethe-Bloch Mechanism, Energy loss by particle radiations, Radiation flux, Absorbed dose, Dose equivalent, Radiation weight factor.

(No. of lectures: 13)

Module II: Detection Methods of Nuclear Radiations

Important properties of Nuclear radiation detectors, Gas-filled detectors: Ionization, Proportional, GM counter, Semiconductor detectors: Si detectors, Pixel and Strip detectors, Scintillation detector, Classification of Scintillation materials: Inorganic and Organic, Calorimeter detector, Tracking detectors, Superconducting solenoid: Important measurements from radiation detectors: Momentum, Energy, Mass, Tracking of particles, Types of radiations and their detections.

(No. of lectures: 15)

Module III: Technological Applications of Nuclear Radiations and Detectors

Applications of nuclear radiations and detectors in medical imaging (PET, SPECT) and cancer therapy, including dosimetry and radiation safety, Use in nuclear power reactors (e.g. DHURAVA) for neutron flux measurement, control, monitoring, and safety systems, Industrial and environmental applications such as non-destructive testing (NDT), thickness measurement, food irradiation, and radiation monitoring, Advanced applications in space research (ISRO / NASA), security scanning, high-energy physics experiments, and modern detector technologies (KEK Japan, EIC at BNL US, LHC at CERN),

(No. of lectures: 11)

Text books

1. Techniques for Nuclear and Particle Physics Experiments: W.R. Leo (Springer, 1994).
2. Radiation Detection and Measurement: G. F. Knoll (John Wiley, 1989).
3. Radiation and Detectors: Introduction to the Physics of Radiation and Detection Devices by Lucio Cerrito, Springer International Publishing AG (2017).

References books

4. Introduction to Elementary Particle Physics: David Griffith (Wiley).
5. Introduction to High Energy Physics: Donald H. Perkins (Cambridge University Press).
6. Concepts of Modern Physics: Aurthur Beiser (Mc GrawHill)
7. Particle Physics Reference Library (Detectors for Particles and Radiation) Publisher: Springer
8. Introductory Nuclear Physics: Kenneth S Keane (Wiley).

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHP324	Nuclear Radiations and Spectroscopy Lab	4	0	0	8	0

1. To calibrate and determine the resolution of the Gamma ray spectrometer.
2. Experimental studies of gamma ray spectrometer.
 - (a) To calibrate the energy of the spectrometer.
 - (b) To identify the unknown source.
3. (a) To study the characteristics of the GM tube and determine its operating voltage, plateau length and slope with determination of efficiency for beta and gamma radiation.
4. (b) To determine the linear and mass attenuation coefficients using gamma source using GM counter.
5. To study the electron spin resonance and to determine the Lande's g- factor.
6. To study normal Zeeman effect in transverse and longitudinal configurations.
7. To study the optical properties of polymer thin films grafted by fluorescence dye.
8. To measure the emission spectra of Hydrogen atom.
9. Lifetime of a short-lived radioactive source.
10. Compton Scattering Experiment to measure the scattering angle of scattered photons.
11. Resolving Time of G. M. Counter set-up.
12. To measure the Hydrogen Emission Spectra.
13. Alpha particle spectrometer: Energy resolved
14. Radiation Counter for Alpha and Beta Particles
15. χ^2 - Statistics using G. M. C
16. Cosmic radiation Detection using cloud chamber.

17. Simulated Experiments on Nuclear Radiation Detectors: To measure the nuclear radiation flux and energy loss in the detector material.
18. Experiments related to Device Physics

TEXT/ REFERENCE BOOKS:-

1. Techniques for Nuclear and Particle Physics Experiment: W. R. Leo (Springer).
2. Radiation Detection and Measurement: Glenn F. Knoll (Wiley).
3. Particle Detectors: Claus Grupen and Boris Schwartz (Cambridge University Press).
4. Physics of Particle Detectors: Dan Green (Cambridge University Press).

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHT411	AI/ML for Physical Systems	3	2	1	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

- Integrate fundamental physics principles with AI to enhance theoretical modeling and experimental accuracy.
- Develop proficiency in Python-driven machine learning for simulating complex quantum, semiconductor, and astrophysical systems.
- Apply AI to automate experiments, optimize space radiation shielding, and accelerate the discovery of new materials.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Fundamentals of Artificial Intelligence in Physics

Introduction to AI, History of AI, Role of AI in Physics (Theory & Experiments in Modern Physics), computational physics, understanding the data from physics experiments, for example, Particle Physics (LHC experiments), Space organizations (NASA, ISRO), Astronomy, Radiation oncology and automation of the physics experiments, building simulated experiments using AI, Basics of Python and Data visualization from physics experiments, Awareness on AI Ethics

(No. of lectures: 13)

Module II: Machine Learning Techniques in Physics

Mathematical formulation of Machine Learning, Employing Physical Concepts through ML using various techniques such as Supervised and Unsupervised learning, Regression: Linear, Non-Linear and Polynomial Regression, Classification: Logistic, KNN, SVM, Decision trees, Random Forest, Clustering (Unsupervised), Curve Fitting, Deep Learning & Neural Networks.

(No. of lectures: 14)

Module III: AI for Classical and Modern Physical Systems

Classical Physical systems: Motion prediction, Oscillation problems, Electrical load forecasting.

Modern physical systems: AI in quantum systems, semiconductor devices, detectors, space weather, solar flare data classification, radiation data prediction.

Applications: AI in Astronomy: Galaxy Classification, Satellite Image Processing, Weather forecasting, Spacecraft Radiation Shielding optimization, effect of gravitational waves on future space missions, Predicting material properties and discovering new materials.

(No. of lectures: 12)

Text Books

1. Python for data analysis (O' Reilly Media) 2022
2. Introduction to Machine Learning with Python (O' Reilly Media) 2016
3. Hands-on Machine Learning with Scikit-learn, Keras, and Tensorflow (O'Reilly Media) 2022

References

4. A.I. Ethics (MIT Press) 2020
5. Deep Learning & Physics (Springer) 2021
6. Machine Learning for Physics and Astronomy (Princeton University Press) 2023
7. Computational Physics: Problem Solving with Python (Wiley) 2015
8. Pattern Recognition & Machine Learning (Springer) 2006

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Semiconductor Devices and Circuits	3	3	0	0	0

COURSE CONTENTS

Solids: Formation of Bands, Kronig-Penny Model, Electrons and Holes, Crystals, Density of States, Fermi Function, Carrier Concentration, Doping, Recombination and Generation, Charge Transport, Continuity Equation. **(No. of lectures- 10)**

Bipolar Junction Transistors (BJT), IV Characteristics, Non-Idealities and Equivalent Circuit Modeling, Metal Oxide Semiconductor Capacitor (MOSCAP) and CV Characteristics, MOSFET: Introduction, I-V characteristics, Subthreshold swing, Additional concepts, MOSFET as a switch, Amplifiers using MOSFET, Circuits: Frequency Response, Noise, Amorphous Semiconductors, Thin Film Transistors. **(No. of lectures- 15)**

Introduction to compound semiconductor materials (e.g., GaAs, InP, GaN), structure & properties of III-V materials and their role in high-speed & optoelectronic devices, bandgap engineering and heterojunctions, high electron mobility transistors (HEMTs), 2-D semiconductor materials

(No. of lectures - 14)

TEXT BOOKS

1. Solid State Electronic Devices (7th Edn) - Ben G. Streetman & Sanjay K. Banerjee, Pearson India
2. Semiconductor Physics and Devices: Basic Principles (4th Edn) - Donald A. Neamen, McGraw Hill
3. Principles of Semiconductor Devices - Sima Dimitrijevic, Oxford University Press

REFERENCE BOOKS

1. Semiconductor Devices: Physics and Technology (3rd Edn) - Simon M. Sze & Kwok K. Ng, John Wiley & Sons
2. Semiconductor Devices and Circuits - Alok K. Dutta, Oxford University Press
3. Compound Semiconductor Device Physics - Sandip Tiwari, Academic Press

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Semiconductor Device Processing and IC Fabrication	3	3	0	0	0

COURSE CONTENTS

General Overview - history, integration and scaling trends in VLSI, IC Device Process Integration - patterning process and p-n junction diode as example devices, IC Device Process Integration CMOS Support Technologies - clean-rooms; and vacuum systems, plasma for processing, basic material and electrical characterisation. **(No. of Lectures – 12)**

Substrates - silicon wafer fabrication, silicon-on-insulator wafers, alternate substrates, Additive Processes: oxidation and nitridation of silicon, Unit Additive Processes: Diffusion and Ion-Implantation, Additive Processes: Thermal evaporation, chemical vapour deposition (CVD), sputter deposition, etc., Patterning Process - photo-lithography; Subtractive Processes - wet etching, reactive ion etching, chemical-mechanical polishing (CMP), etc. **(No. of Lectures – 20)**

Process Control - statistical quality control (SQC) and design of experiment (DoE), New Trends - 3-D integration in devices and packaging, electronics printing and flexible device processing **(No. of Lectures – 7)**

Books and references

1. Stanley Wolf and Richard N. Tauber, “Silicon Processing for the VLSI Era” Volume-1, Lattice Press.
2. S.M. Sze, “Semiconductor Devices Physics and Technology”, 2nd Edition, Wiley.
3. Sorab K. Ghandhi, “VLSI Fabrication Principles Silicon and Galium Arsenide”, 2nd Edition, Wiley.
4. Richard C.Jaeger, “Introduction to Microelectronic Fabrication”: Volume 5, 2nd Edition, Modular Series on Solid State Devised, Vol 5 (Or any basic book on semiconductor fabrication)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Semiconductor Devices for Next Generation Field-Effect Transistors	3	3	0	0	0

Course contents-

Introduction of Metal-Oxide-Semiconductor, Energy Band Diagram of MOS Capacitors, Second Order Effects in MOS Capacitors, C–V of MOS capacitor, Introduction of MOSFET, I-V and C-V Characteristics of MOSFETs, Capacitance Modeling, High and Low Frequency Modeling in Bulk MOSFET, MOSFET as Switch and Amplifier, Short Channel Effects, Introduction to 2nd Order Effects at Lower Technology Node, Gate Induced Drain Leakage (GIDL), Drain Induced Barrier Lowering (DIBL), and Subthreshold Swing (SS), Mobility and Scattering Effects, Velocity Saturation Effects, Hot Carrier Effect, Self-heating Effect
(No. of Lectures – 15)

Introduction to Double Gate MOSFET, SOI MOSFET, Partially and Fully Depleted MOSFET, Subthreshold Swing and Transconductance, Small and Large Signal Modeling, Introduction of Junctionless MOSFET
Introduction to FinFETs Structure, Structural Classification of FinFETs, RLC FinFET Modeling, High Frequency Small Signal Modeling, Device Circuit Co-Design using FinFET with Suitable Examples
(No. of Lectures – 12)

Introduction of III-V materials, Materials for High-Speed Devices and Circuits, High Electron Mobility Transistors (HEMT): Modelling and Simulation, III-V Semiconductor FET, Application of III-V material-based FET, Fundamental Understanding of 2D Material, Application of 2D Material, 2D-FETs
(No. of Lectures – 12)

Books and references

1. Neamen, Donald A. Semiconductor physics and devices: basic principles. New York, NY: McGraw-Hill, 2012.
2. R. F. Pierret, Semiconductor Device Fundamentals, 1996.
3. Jean-Pierre Colinge, FinFETs and Other Multi-Gate Transistors, 2008.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Surface Physics and Engineering	3	3	0	0	0

PREREQUISITE - None

COURSE OBJECTIVE(s)

The aim of this course is to give a comprehensive introduction of solid surfaces and interfaces and physics and chemistry on an atomic length scale. After successfully completing this course student should be able to understand the fundamental importance of surfaces, and how their structures and properties differ from that of bulk materials. They should be able to understand the results of surface science techniques such as XPS, AES, RBS, STM etc.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
g)	Internal assessment (based upon assignments, quizzes and attendance)	20%
h)	Mid-term examination	30%
i)	End Semester Examination	50%

COURSE CONTENTS

Physics of Surfaces

Introduction to surfaces and interfaces, importance of surface science, From Solid to Surface, Morphology and Structure of Surfaces, Surface thermodynamics (Surface tension and Surface energy), Surface relaxation and reconstruction, Surface Defects, Surface Creation; Surface cleaning, Adsorption (Physisorption & Chemisorption), Adsorption Isotherms, Desorption

(No. of lectures - 11)

Thin Film Deposition and Characterisation Techniques

Basics of vacuum and significance of vacuum, Vacuum pumps and vacuum gauges, Film growth modes (Volmer-Weber, Frank-van der Merwe, Stranski-Krastanov), Fundamentals of Thin Film Deposition techniques (thermal evaporation, sputtering, pulsed laser ablation), Surface modifications (Physical & chemical), Physical Vapour Deposition, Chemical Vapour Deposition, Auger Electron Spectroscopy, X-ray Photoelectron Spectroscopy, Scanning Tunneling Microscopy, Atomic Force Microscopy

(No. of lectures - 13)

Surfaces engineering applications

Surface coatings, Functional Coatings, Advanced Coating Practices, Applications of Nano-coatings; mechanical, physical, chemical and other properties; nanostructured coatings, Tribology & Its Classification, types and laws of friction, methods to control friction, Wear & Corrosion mechanisms, Lubrication, Effect of Tribology on Surface of Nanomaterials, hard coatings and hardness measurements, optical applications of surfaces, Catalytic applications of surfaces (Heterogeneous catalysis), electrochemical and energy applications (Electrocatalysis, Fuel cells, and Batteries), Semiconducting surfaces applications and passivation, Bio-applications of surfaces
(No. of lectures - 15)

Recommended Readings

Text books –

1. Surface Science: An Introduction, Oura, K., Lifshits, V. G., Saranin, A. A., Zotov, A. V., and Katayama, M. 2003 (1st ed). (Springer).
2. Materials Degradation and its control by surface engineering, Imperial College Press, (2006)
3. Surface Analysis: The Principal Techniques, Vickerman, J. C. and Gilmore, I. S. 2009 (2nd ed). (Wiley).

Reference books –

1. Physics of Surfaces and Interfaces, Ibach, H. 2006 (1st ed). Publisher: Springer.
2. Surface engineering in metals, CRC Press (1999) London
3. Solid Surfaces, Interfaces and Thin Films, Hans Luth (Springer) 2014/15(6th ed).

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Advanced Micro- and Nanofabrication Technology and Process	3	2	1	0	0

PREREQUISITE – Basic knowledge of semiconductor physics

COURSE OBJECTIVE(s)

The objectives of this course are to:

The course aims to build a strong foundation in the principles of micro- and nanofabrication while developing a clear understanding of lithography and pattern transfer techniques. It further introduces advanced nanofabrication approaches and device integration strategies, enabling students to connect fundamental concepts with practical implementations.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Introduction to micro- and nanotechnology: evolution and importance, Scaling laws and physical limits at micro/nanoscale Cleanroom technology and contamination control Substrates and materials: silicon, glass, polymers, compound semiconductors, Thin film deposition techniques: Physical vapor deposition (evaporation, sputtering), Chemical vapor deposition (CVD), Atomic Layer Deposition (ALD – basics), Thermal oxidation and diffusion, Basic characterization techniques (SEM, profilometry, ellipsometry) **(No. of lectures: 09)**

Unit II:

Photolithography: working principles, photoresists, masks, exposure, development, Resolution limits, alignment, and overlay accuracy, Advanced lithography techniques: Electron beam lithography, Focused ion beam (FIB), Nanoimprint lithography, Etching processes: Wet etching (isotropic and anisotropic), Dry etching (plasma etching, RIE, ICP), Lift-off processes and pattern transfer, Process integration and defect control **(No. of lectures: 09)**

Unit III:

Bottom-up approaches: self-assembly, chemical synthesis, Top-down vs bottom-up: comparison and hybrid fabrication, Fabrication of nanostructures: nanowires, quantum dots, thin films, Introduction to MEMS and NEMS fabrication, Applications: sensors, energy devices, biomedical systems, Emerging techniques: soft lithography, 3D nanofabrication, Reliability, scalability, and industrial challenges **(No. of lectures: 09)**

TEXTBOOKS:

1. The Science and Engineering of Microelectronic Fabrication: Stephen A. Campbell (Oxford)
2. Semiconductor Lithography: Principles, Practices, and Materials (Microdevices): Wayne M. Moreau (Springer)

REFERENCE BOOKS:

1. Materials Science of Thin Films: Milton Ohring (Academic Press)
2. Fundamentals of Microfabrication and Nanotechnology: Marc J. Madou (CRC Press)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Nanophotonics	3	2	1	0	0

PREREQUISITE – Basic knowledge of optics and quantum mechanics

COURSE OBJECTIVE(s)

The objectives of this course are to:

The course aims to provide a comprehensive understanding of light–matter interactions at the nanoscale while building a strong foundation in photonic and plasmonic materials. It further explores the principles and design of nanophotonic and quantum photonic structures and devices, enabling students to connect fundamental concepts with advanced technologies

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Review of electromagnetic waves and classical optics, Light–matter interaction at nanoscale, Optical constants: refractive index, dielectric function, Dispersion and absorption, Surface plasmon resonance (SPR) and localized plasmons, Quantum confinement effects (quantum wells, wires, dots), Introduction to quantum optics: photons, quantization of light, coherence, Optical characterization techniques (UV-Vis, PL, Raman basics) **(No. of lectures: 09)**

Unit II:

Dielectric, semiconductor, and metallic photonic materials, Plasmonic materials (Au, Ag, Al nanostructures), Photonic crystals: 1D, 2D, 3D and photonic bandgap, Metamaterials and metasurfaces, Waveguides and optical confinement, Nanostructures: quantum wells, wires,

quantum dots, Quantum materials for photonics: single-photon emitters, color centers, 2D materials, Fabrication techniques for photonic nanostructures **(No. of lectures: 09)**

Unit III:

Introduction to plasmonics, Surface plasmon polaritons (SPPs), Localized surface plasmon resonance (LSPR), Metallic nanoparticles, Surface-enhanced Raman scattering (SERS), Plasmonic waveguides, Optical nanoantennas, Applications in chemical and biosensing

(No. of lectures: 09)

TEXT/ REFERENCE BOOKS:

1. Plasmonics: Stefan Mayer (Cambridge Press)
2. Introduction to Nanophotonics: Sergey V. Gaponenko (Cambridge Press)
3. Quantum Theory of Light: Rodney Loudon (Oxford Science Publications)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Advanced Photonic Materials	3	2	1	0	0

PREREQUISITE – Basic knowledge of optics and quantum mechanics

COURSE OBJECTIVE(s)

The objectives of this course are to:

The course aims to provide a comprehensive understanding of light-matter interaction in engineered and nanostructured media, bridging the gap between classical optics and modern photonic device design. Students will explore the unique optical properties of photonic crystals, metamaterials, plasmonics, and emerging 2D materials, gaining a conceptual understanding of how light can be manipulated at the sub-wavelength scale.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Classification of photonic materials (Dielectrics, Semiconductors, Metals, Polymers, Nanomaterials), Two-dimensional photonic materials (Graphene, Transition metal dichalcogenides (TMDs), MXenes), Quantum dots and nanocrystals, Metal nanoparticles and localized surface plasmon resonance (LSPR), Photonic crystals, Metamaterials and metasurfaces

(No. of lectures: 08)

Unit II:

Electronic band structure and optical transitions, Direct and indirect band-gap materials, Excitons and quantum confinement, Luminescence: fluorescence, phosphorescence, electroluminescence

Optical characterization techniques (UV–Visible spectroscopy, Photoluminescence (PL), FTIR spectroscopy, Raman spectroscopy, Ellipsometry) **(No. of lectures: 08)**

Unit III:

Nanophotonic devices: LEDs, lasers, photodetectors, Plasmonic and photonic sensors, Optical sensors and biosensors, Integrated photonics and optical communication, Quantum photonic devices: single-photon sources, detectors, quantum dots in devices, Basics of quantum communication and computing (introductory concepts), Nanophotonics in solar cells and energy harvesting, Biomedical applications: imaging, therapy, Challenges, scalability, and future trends in quantum photonics **(No. of lectures: 10)**

TEXTBOOKS:

1. Advanced Photonic Materials & Devices, Jia-Ming Liu (Cambridge Press)
2. Optoelectronics and Photonics: Principles and Practices Safa O. Kasap (Pearson)

TEXT/ REFERENCE BOOKS:

1. Introduction to Nanophotonics: Sergey V. Gaponenko (Cambridge Press)
2. Fundamentals of Photonics, Bahaa E. A. Saleh and Malvin Carl Teich (Wiley)
3. Handbook of Electronic and Photonic Materials, Safa O. Kasap & Peter Capper (Springer)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHT XXX	Medical Applications of Radiation Physics	3	2	1	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

This course provides an overview of the principles and applications of physics in medicine and healthcare. Students will gain an understanding of the role of physics in modern healthcare and its impact on patient diagnosis and treatment.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments,	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

History of medical physics, Ethical and safety considerations in medical physics, overview of medical imaging, and radiation therapy; Medical imaging: X-ray imaging, computed tomography (CT), magnetic resonance imaging (MRI), Mammography, Bone Mineral Density (DEXA) and ultrasound imaging, Nuclear Medicine and Positron Emission Tomography (PET).

(No. of lectures: 09)

Unit II:

Principles of radiation therapy, external beam radiation therapy, Intensity-Modulated Radiation Therapy (IMRT), Image-Guided Radiation Therapy (IGRT), Stereotactic Radiosurgery (SRS) and

Brachytherapy; Radiation safety and protection: Radiation biology, radiation dosimetry, and radiation shielding, ALARA principle, Regulatory guidelines and safety measures;

(No. of lectures: 09)

Unit III:

Biological effects of radiation, DNA damage and repair mechanisms, Nuclear medicine, laser physics, and medical robotics, Particle therapy and its Advantages, Emerging technologies in cancer treatment, Patient-specific treatment planning, Nanotechnology in radiation medicine, Artificial intelligence in medical imaging

(No. of lectures: 08)

TEXTBOOKS:

1. "Introduction to Health Physics" by Herman Cember and Thomas E. Johnson (McGraw-Hill)
2. "Radiation Physics for Medical Physicists", Ervin B. Podgorsak (Springer)
3. "Radiation Therapy Physics" William R. Hendee and Geoffrey S. Ibbott (Wiley)

REFERENCES BOOKS:

1. "Introduction to Medical Imaging: Physics, Engineering, and Clinical Applications", NB Smith and A Webb (Cambridge)
2. "The Essential Physics of Medical Imaging", JT. Bushberg, JA Seibert, EM. Leidholdt Jr., and John M. Boone (Wolters Kluwer Health)
3. "Radiation Therapy Physics", William R. Hendee and Geoffrey S. Ibbott (Wiley)
4. "Radiobiology for the Radiologist" Eric J. Hall and Amato J. Giaccia (Lippincott Williams & Wilkins)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Solar Energy and Physics of Solar Cells	3	3	0	0	0

PREREQUISITE – Solid State Physics, Materials Science

COURSE OBJECTIVE(s)

This course aims to equip the students with fundamental knowledge of solar energy resource, solar energy conversion techniques, basics of semiconductor junction, design and operation of solar cells, performance testing and analyses.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Renewable and non-renewable energy resources, solar energy: origin, solar constant, spectral distribution of solar radiation, absorption of solar radiation in the atmosphere, global and diffused radiation, seasonal and daily variation of solar radiation, measurement of solar radiation, solar to thermal conversion, types of solar energy collectors, concentrating/non-concentrating solar collectors, collector efficiency and its dependence on various parameters, solar fuels: electrolysis of water, photoelectrochemical splitting of water. **(No. of lectures: 12)**

Fundamentals of solar cells: photo voltaic effect, p-n junction photodiodes, depletion region, electron and holes transports, absorption of photons, excitons and photoemission of electrons, band engineering, charge carrier generation, charge separation, recombination and other losses **(No. of lectures: 10)**

I-V characteristics, output power, efficiency, fill factor and optimization for maximum power, metal-semiconductor heterojunctions, surface structures for maximum light absorption, operating

temperature vs conversion efficiency.

(No. of lectures: 10)

Device physics, device structures, device construction, solar cell properties and design, materials for solar cells, silicon based solar cells: single crystal, polycrystalline and amorphous silicon solar cells, organic solar cells, organic-inorganic hybrid solar cells, advanced concepts in photovoltaic research, nanotechnology applications, plasmonic based solar cells.

(No. of lectures: 7)

TEXT/ REFERENCE BOOKS: -

1. Nelson, J. The Physics of Solar Cells. Imperial College Press, 2003. ISBN: 9781860943409.
2. Solar Engineering of Thermal Process: Duffie and Beckman, John Wiley, 2013. ISBN: 9780470873663
3. Solar Energy: S. P. Sukhatme, Tata McGraw Hill, 1996. ISBN: 1259081966, 9781259081965.
4. Principles of Solar Engineering, D. Yogi Goswami, Taylor and Francis, 2015. ISBN: 9781138569478.
5. Wenham, S., M. Green, et al., eds. Applied Photovoltaics. 2nd Ed. Routledge, 2006. ISBN: 9781844074013.
6. Green, M. A. Solar Cells: Operating Principles, Technology, and System Applications. Prentice Hall, 1981. ISBN: 9780138222703.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Energy Storage Systems	3	3	0	0	0

PREREQUISITE – Basic understanding of Physics, Chemistry and Mathematics

COURSE OBJECTIVE(s)

This course provides a comprehensive overview of energy storage technologies, focusing on their physical principles, performance metrics, and grid-scale applications. Students will evaluate the integration of mechanical, thermal, and electrochemical systems into modern energy infrastructures while analyzing the economic and safety frameworks required for sustainable deployment.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
d)	Internal assessment (based upon assignments, quizzes and attendance)	20%
e)	Mid-term examination	30%
f)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Fundamentals and Classification of Energy Storage

Introduction to energy storage necessity and renewable integration; classification by mechanical, electrical, thermal, and chemical types; analysis of energy/power density, efficiency, and performance metrics; comparative evaluation of storage technologies for grid stability.

(No. of lectures: 8)

Module 2: Mechanical and Thermal Energy Storage

Principles, working advantages, and limitations of pumped hydro, compressed air, and flywheel storage; thermal energy storage methods including sensible and latent heat; application of phase change materials; system-level material considerations for grid and industrial heat management.

(No. of lectures: 8)

Module 3: Electrical and Chemical Energy Storage Systems

Mechanics and characteristics of capacitors and supercapacitors; technical overview of battery

chemistries (Li-ion, Na-ion, flow, and Zn–air); hydrogen production and fuel cell system-level integration; comparative analysis of electrochemical storage applications.

(No. of lectures: 9)

Module 4: Energy Storage Integration and Applications

Grid integration strategies for solar and wind balancing; deployment in microgrids and distributed systems; electric vehicle (EV) storage requirements; operational roles in peak shaving and backup power; design and optimization of hybrid storage systems.

(No. of lectures: 8)

Module 5: Economics, Safety, and Future Trends

Economic cost analysis and lifecycle modeling; safety protocols and thermal management; environmental impact and sustainable recycling practices; overview of emerging materials and future industry outlook.

(No. of lectures: 6)

TEXT BOOKS: -

3. Engineering Energy Storage, Lamb, J. J. and Burheim, O. S. 2024 (2nd ed).
4. Renewable Energy - Volume 4: Energy Storage Systems - Mechanical, Hydro, and Thermal, Olabi, A. G. (Ed.). 2025 (1st ed).

REFERENCE BOOKS: -

1. Energy Storage and Conversion Materials: Properties, Methods, and Applications, Tran, N. T. T., Jan, J. S., Hsu, W. D., Lin, M. F., and Huang, J. L. 2023 (1st ed).
2. Materials for Sustainable Energy: A Collection of Peer-Reviewed Research and Review Articles, Dusastre, V. 2011 (1st ed).

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Hydrogen Energy and Fuel Cells	3	3	0	0	0

PREREQUISITE – Basic understanding of Physics, Chemistry and Mathematics

COURSE OBJECTIVE(s)

The objective of this course is to provide students with an understanding of hydrogen energy as an energy carrier, from sustainable production and storage methods to the electrochemical principles of various fuel cell technologies. This course aims to develop an understanding of the fundamental principles, performance characteristics, and practical challenges of hydrogen-based energy systems. The course also highlights the role of hydrogen and fuel cells in sustainable energy and future energy technologies.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
g)	Internal assessment (based upon assignments, quizzes and attendance)	20%
h)	Mid-term examination	30%
i)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Introduction, Production & Storage of Hydrogen

Basic Introduction to energy systems, hydrogen economy, properties of hydrogen, hydrogen versus conventional fuels, Sustainability and environmental impact, hydrogen production technologies: Alkaline & PEM electrolysis, basics of steam reforming, thermochemical & photochemical methods, Hydrogen Storage: high-pressure compressed gas and liquid hydrogen, Solid-state storage methods (metal hydrides, MOFs etc. handling, storage challenges and safety.

(No. of lectures: 17)

Module 2: Fuel Cell Technology

Introduction to Fuel Cells: History, Operating Principles, and Advantages, thermodynamics and efficiency of Fuel Cells, Nernst equation (conceptual use). Polarization and losses, Characterization techniques: Polarization curves (I-V curves) and Electrochemical Impedance

Spectroscopy (EIS), Types of Fuel Cells: PEM fuel cells, DMFC, basics of SOFC and AFC, Operating conditions and characteristics, performance comparison, advantages and limitations.

(No. of lectures: 16)

Module 3: Applications, Economics & Policy

Stationary Power: Micro-CHP (Combined Heat and Power) and Backup Power, Mobile Applications such as Fuel Cell Electric Vehicles (FCEVs), Integration with renewables, Economics: Levelized Cost of Hydrogen and market drivers, Global Policies, Standards, and Roadmap for the future.

(No. of lectures: 6)

TEXT BOOKS: -

5. Fuel Cell Systems Explained, Larminie, J. and Dicks, A.. 2018 (3rd ed).
6. Hydrogen and Fuel Cells: Emerging Technologies and Applications, Sorensen, B., and Spazzafumo, G., Academic Press. 2018 (3rd ed).

REFERENCE BOOKS: -

1. Fuel Cell Fundamentals, O'Hayre, R., Cha, S. W., Colella, W., & Prinz, F. B., , John Wiley & Sons, 2016 (3rd ed).
2. Research review articles (Renewable and Sustainable Energy Reviews 146 (2021) 111180, Energy Environ. Sci., 2019, 12, 463—491, etc.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Physics of Renewable Energy Conversion	3	3	0	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

This course aims to develop a fundamental understanding of the physical principles governing renewable energy conversion by integrating concepts from thermodynamics, electromagnetism, quantum physics, optics, fluid mechanics, and electrochemistry. It enables students to analyze diverse energy conversion mechanisms from first principles, evaluate the efficiency limits and transport phenomena underlying renewable energy technologies, and gain insight into emerging physical mechanisms for sustainable energy harvesting and conversion.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I: Thermodynamics of Energy Conversion

Global energy landscape, Forms of renewable energy, Energy and exergy, First and Second Laws of Thermodynamics, Entropy generation, Carnot efficiency, Irreversibility in energy conversion, Thermodynamic limits of renewable energy systems. **(No. of lectures: 07)**

Unit II: Radiation-Matter Interaction & Photonic Energy Conversion

Solar radiation and solar spectrum, Blackbody radiation, Optical absorption, Beer-Lambert law, Photon-material interaction, Semiconductor bandgap, Carrier generation and recombination, Photovoltaic conversion, Shockley-Queisser efficiency limit. **(No. of lectures: 08)**

Unit III: Transport Phenomena in Renewable Energy Systems

Heat transport, Charge transport, Diffusion, Fluid mechanics fundamentals, Wind formation, Lift

and drag, Betz limit, Electromagnetic induction in generators, Hydroelectric energy conversion.
(No. of lectures: 08)

Unit IV: Electrochemical & Thermal Energy Conversion

Electrochemical potential, Nernst equation, Electrochemical interfaces, Charge transfer, Ion diffusion, Butler-Volmer kinetics (qualitative), Fuel cells, Electrolyzers, Thermoelectric effect, Seebeck effect, Figure of merit (ZT).
(No. of lectures: 08)

Unit V: Emerging Energy Conversion Physics

Piezoelectric energy harvesting, Triboelectric nanogenerators, Pyroelectric energy conversion, Magnetocaloric energy conversion, Thermionic conversion, Thermophotovoltaics, Hybrid energy harvesting, Future sustainable energy technologies.
(No. of lectures: 08)

TEXT/ REFERENCE BOOKS: -

1. David J. C. MacKay, Sustainable Energy – Without the Hot Air, UIT Cambridge Ltd., 2009. ISBN: 978-0954452933.
2. John Twidell and Tony Weir, Renewable Energy Resources, 4th Edition, Routledge, 2021. ISBN: 978-0367654597.

REFERENCE BOOKS: -

1. D. Yogi Goswami, Frank Kreith and Jan F. Kreider, Principles of Solar Engineering, 3rd Edition, CRC Press, 2015. ISBN: 978-1466563780.
2. David M. Rowe (Ed.), Thermoelectrics Handbook: Macro to Nano, CRC Press, 2005. ISBN: 978-0849322648.
3. Gilbert M. Masters, Renewable and Efficient Electric Power Systems, 2nd Edition, Wiley, 2013. ISBN: 978-1118074480

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Battery Technology and Electric Vehicles	3	3	0	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

The objectives of this course are to:

Introduce fundamentals of electric vehicles and their architecture, develop understanding of battery technologies and performance characteristics, explain battery pack design and Battery Management Systems (BMS), familiarize students with EV powertrain and charging systems, and provide exposure to industry practices, safety standards, and emerging trends.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I: EV Systems & Industry Overview

Evolution of EVs and market trends; Types: BEV, HEV, PHEV; EV architecture and subsystems; Performance metrics: range, efficiency, cost; EV vs IC engine vehicles; EV ecosystem (OEMs, suppliers, infrastructure).

(No. of lectures: 06)

Unit II: Battery Technology

Basics of electrochemistry; Battery types: Lead-acid, NiMH, Lithium-ion; Li-ion chemistries (LFP, NMC, NCA); Battery parameters: energy density, power density, C-rate; Charging/discharging characteristics; Battery degradation and lifecycle; Thermal behavior; Battery selection for EVs; Introduction to solid-state batteries.

(No. of lectures: 09)

Unit III: Battery Pack Engineering & BMS

Cell → module → pack design; Mechanical and electrical integration; Thermal management systems; Safety issues (thermal runaway, protection); BMS architecture and functions; State estimation (SoC, SoH); Cell balancing techniques; Fault detection and diagnostics; Case study of EV battery pack.
(No. of lectures: 09)

Unit IV: EV Powertrain & Charging Systems

Electric motors (BLDC, PMSM, Induction); Motor control basics; Power electronics (inverters, converters); EV drivetrain; Regenerative braking; Charging systems (AC/DC); Charging standards (CCS, CHAdeMO, Bharat EV); Vehicle-to-Grid (V2G).
(No. of lectures: 08)

Unit V: Industry Practices & Future Trends

EV safety standards and testing; Battery manufacturing overview; Cost and supply chain considerations; Battery recycling and second-life applications; EV maintenance and diagnostics; Emerging technologies (solid-state, wireless charging); Future trends in EVs.
(No. of lectures: 07)

TEXT/ REFERENCE BOOKS: -

1. Electric and Hybrid Vehicles: Design Fundamentals. Iqbal Husain, CRC Press (Taylor & Francis Group), 2021, ISBN: 978-0367693930.
2. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz M. Ebrahimi, CRC Press, 2018, ISBN: 978-1498761772.
3. Battery Management Systems, Volume I: Battery Modeling. Gregory L. Plett, Artech House, 2015. ISBN: 978-1630810238.
4. Battery Management Systems, Volume II: Equivalent-Circuit Methods. Gregory L. Plett, Artech House, 2015. ISBN: 978-1630810276.
5. Electric Vehicle Technology Explained. James Larminie, John Lowry, Wiley, 2012, ISBN: 978-1119942733.
6. Hybrid Electric Vehicles: Energy Management Strategies. Simona Onori, Lorenzo Serrao, Giorgio Rizzoni, Springer, 2015, ISBN: 978-1447167815.
7. Advances in Battery Technologies for Electric Vehicles. Bruno Scrosati, Jürgen Garche, Werner Tillmetz, Woodhead Publishing (Elsevier), 2015, ISBN-13: 978-1782423775.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Nuclear Energy Systems and Sustainable Power Generation	3	3	0	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

To provide a comprehensive understanding of fundamental reactor physics, advanced power plant engineering, safety systems, and the integration of modern nuclear technologies into sustainable energy grids.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments,	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Fundamentals of Nuclear Energy and Reactor Physics

Atomic structure, binding energy, radioactivity, fission and fusion, chain reactions, multiplication factor, neutron life cycle, moderation and diffusion, reactor kinetics, Types of reactors (PWR, BWR, PHWR, fast breeder), reactor components, materials, control mechanisms

(Number of Lectures: 12)

Module 2: Nuclear Power Plant Engineering and Safety Systems

Nuclear plant layout, working of Pressurized Water Reactor, Boiling Water Reactor, Pressurized Heavy Water Reactor, fuel cycle, thermal hydraulics, cooling systems, moderators, control rods,

shielding Radiation detection, safety systems, nuclear accidents, waste management and disposal, environmental protection
(Number of Lectures: 14)

Module 3: Grid-Level Integration and Energy Applications of Nuclear Power generation, turbines and generators, grid-level integration, power system stability, hybrid systems (solar/wind with nuclear) Smart grids, economic analysis, sustainability, environmental impact, present and future technologies (SMRs, fusion, Dhruva reactor)
(Number of Lectures: 13)

Textbooks

1. Lewis, E. E. (2008). *Fundamentals of Nuclear Reactor Physics*. Academic Press.
2. Glasstone, S., & Sesonske, A. (1994). *Nuclear Reactor Engineering: Reactor Systems Engineering*. Springer.
3. Lamarsh, J. R., & Baratta, A. J. (2022). *Introduction to Nuclear Engineering*. Pearson.
4. Shultis, J. K., & Faw, R. E. (2016). *Fundamentals of Nuclear Science and Engineering*. CRC Press / Wiley.

Reference Books

5. Todreas, N. E., & Kazimi, M. S. (2011). *Nuclear Systems Volume I: Thermal Hydraulic Fundamentals*. CRC Press.
6. Nag, P. K. (2014). *Power Plant Engineering*. McGraw Hill Education.
7. Kothari, D. P., & Nagrath, I. J. (2019). *Modern Power System Analysis*. McGraw Hill Education.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Engineering Biomaterials	3	2	1	0	0

PREREQUISITE – Basic knowledge of biology, materials science, and engineering principles is required to comprehend the course material effectively

COURSE OBJECTIVE(s)

The objectives of this course are to:

This course aims to gain insight into biological and bioinspired materials, nanotechnology, and tissue engineering, with a focus on understanding design principles and applications in biomedical engineering.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Introduction to biological and bio inspired materials, biomimetic and bioinspired engineering, inspiration from nature, bio-inspired designs, biological engineering principles, basic building blocks found in biological materials, adhesive surfaces, gecko inspired adhesion, lotus surface, nature against nature: repellency against adhesion, bio-inspired nanostructures

(No. of lectures: 09)

Unit II:

Introduction to nanotechnology, surface engineering, bio-inspired nanoparticles, polymer-reinforced and ceramic-toughened composites, lightweight biological and bioinspired materials, bio-functional interfaces, components of a bio-functional interface and fabrication, biocompatibility

vs. bio-functionality, bio-inspired functional interfaces, characterization of bio-functional interfaces
(No. of lectures: 09)

Unit III

Introduction to tissue engineering, bio-inspired scaffolds for tissue engineering, self-healing and adaptive materials, bio-sensing, components of a biosensor, nature-inspired sensing, drug delivery, smart targeted drug delivery, micro and nano robots, lab-on-chip devices, examples of bio-inspired lab on chip devices, examples of organs on chips, modelling diseases on a chip

(No. of lectures: 09)

TEXT BOOKS:

1. Bio and bioinspired nanomaterials: Daniel Ruiz-Molina, F. Novio, C. Roscini (WileyVCH).
2. Bioinspired approaches for human-centric technologies: Roberto Cingolani (Springer).

REFERENCE BOOKS:

1. Biological materials science: M. A. Meyers and P-Y. Chen (Cambridge).
2. Biomimetics, biologically inspired technologies: Yoseph Bar-Cohen (Taylor and Francis).
3. Materials design inspired by nature: P. Fratzl, J. W. C. Dunlop and R. Weinkamer (RSC).
4. Nanobiotechnology: Oded Shoseyov and Ilan levy (Human Press)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Organic Electronics Material and Devices	3	2	1	0	0

PREREQUISITE – Basic knowledge of semiconductor physics

COURSE OBJECTIVE(s)

The objectives of this course are to:

The course Organic Electronics – Materials and Devices aims to provide students with a fundamental understanding of organic semiconducting materials and their role in electronic devices. It covers the structure, properties, and charge transport mechanisms of organic materials, along with common fabrication and characterization techniques.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Introduction to Organic Electronics: scope, advantages, and limitations, Electronic structure of organic materials: π -conjugation, HOMO–LUMO levels, Charge transport mechanisms: hopping and band transport, Optical properties: absorption, photoluminescence, excitons, Types of organic semiconductors: small molecules, polymers, oligomers, Conducting polymers (e.g., Polyaniline, Polypyrrole, Polythiophene), Doping mechanisms in organic semiconductors, Thin film fabrication techniques: spin coating, printing, evaporation, Structure–property relationships and morphology effects
(No. of lectures: 09)

Unit II:

Device physics: charge injection, transport, recombination, Organic Light Emitting Diodes,

(OLEDs): structure, working principles, Organic Photovoltaics (OPVs): exciton dissociation, bulk heterojunctions, Organic Field Effect Transistors (OFETs): device design and operation, Electrode materials and interface engineering, Device fabrication and patterning techniques, Performance parameters: efficiency, mobility, stability, Degradation mechanisms and lifetime issues, Flexible and wearable organic electronics **(No. of lectures: 09)**

Unit III:

Introduction to polymer-based sensors: principles and classifications, Conducting polymer sensors using Polyaniline, Polypyrrole, PEDOT:PSS, Sensing mechanisms: chemiresistive, capacitive, electrochemical, Gas sensors: detection of NH₃, NO₂, VOCs using polymer composites, Biosensors: enzyme-based and affinity-based detection, Polymer nanocomposites for sensing (polymer–metal oxide hybrids), Flexible and wearable sensors, Fabrication techniques: printing, coating, nanostructuring, Performance parameters: sensitivity, selectivity, response time, stability, Applications: environmental monitoring, healthcare diagnostics, Emerging trends: self-powered sensors, smart sensing systems **(No. of lectures: 09)**

TEXT BOOKS:

1. Organic Electronics Materials and Devices: Shuichiro Ogawa (Springer)
2. Organic Electronics for Electrochromic Materials and Devices: Hong Meng (Wiley)
3. Organic Electronics, Foundations to Applications: Stephen R. Forrest (Oxford).

REFERENCE BOOKS

1. Polymeric Sensors and Actuators: Johannes Karl Fink (Wiley)
2. Sensors: An Introductory Course: Kourosh Kalantar-zadeh (Springer)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Biomaterials and Tissue Engineering	3	2	1	0	0

PREREQUISITE – Basic knowledge of material science

COURSE OBJECTIVE(s)

The course Biomaterials and Tissue Engineering aim to provide students with a fundamental understanding of the design, properties, and applications of biomaterials in biological systems, along with the core principles of Tissue Engineering. It focuses on the interactions between materials and living tissues, scaffold-based regeneration strategies, and the role of cells and signaling in tissue repair.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Introduction to biomaterials: definition, history, and classification, Types of biomaterials: metals, ceramics, polymers, and composites, Structure–property relationships in biomaterials, Concept of Biocompatibility, biofunctionality, and biodegradability, Host response to biomaterials: inflammation, immune response, toxicity, Surface properties: wettability, roughness, surface energy, and protein adsorption, Biomaterial–tissue interactions and interfacial phenomena, Mechanical properties: strength, elasticity, fatigue, and wear, Nanostructured biomaterials and nanoparticle–tissue interactions, Bio-inspired surfaces for enhanced cell adhesion and anti-fouling behavior

(No. of lectures: 09)

Unit II:

Introduction to Tissue Engineering and regenerative medicine, Key components: cells, scaffolds, and signaling molecules, Types of cells: stem cells, progenitor cells, primary cells, Extracellular matrix (ECM): composition and role in tissue regeneration, Scaffold design criteria: porosity, biodegradability, mechanical integrity, Scaffold materials: natural polymers, synthetic polymers, hybrid systems, Fabrication techniques: electrospinning, 3D printing, freeze-drying, solvent casting, Nanocomposite scaffolds (polymer–nanoparticle hybrids), Smart scaffolds with stimuli-responsive behavior (No. of lectures: 09)

Unit III:

Regenerative medicine and engineered tissues, Applications: bone, cartilage, skin, and cardiovascular tissue engineering, Drug delivery systems: controlled and targeted delivery, Nanobiomaterials for drug delivery and diagnostics, Bioactive and smart biomaterials (self-healing, stimuli-responsive systems), Biosensors in biomedical applications: principles and components, Integration of Nanotechnology in healthcare, Bio-functional interfaces and surface engineering for implants, 3D bioprinting and organ fabrication, Implantable biosensors and real-time physiological monitoring, Nanomaterial-based sensing platforms for disease detection

(No. of lectures: 09)

TEXT/ REFERENCE BOOKS:

1. Biomaterials and Tissue Engineering: Christophe Egles, Oguzhan Gunduz, Román A Pérez (Springer)
2. Tissue Engineering, Clemens van Blitterswijk (Academic Press)
3. Biomaterials for Neural Tissue Engineering: Oguzhan Gunduz, Cem Bulent Ustundag , Mustafa Sengor (Elsevier)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Wearable Sensors for Healthcare	3	2	1	0	0

PREREQUISITE – N/A

COURSE OBJECTIVE(s)

The objectives of this course are to:

The course aims to develop a fundamental understanding of Wearable Sensors and their role in modern healthcare systems. It focuses on the design, materials, and fabrication of flexible and stretchable sensing platforms, along with the integration of electronics, data acquisition, and communication technologies.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I:

Introduction to wearable healthcare technologies and their significance, Basics of Wearable Sensors, Physiological parameters: heart rate, temperature, respiration, motion, biochemical markers, Types of sensors: physical, chemical, and biosensors, Materials for wearable sensors: flexible polymers, textiles, nanomaterials, Conductive materials: graphene, carbon nanotubes, metallic nanowires, Flexible and stretchable electronics: design principles, Substrates and encapsulation materials for wearables, Skin-sensor interface and ergonomics, Signal acquisition and noise considerations

(No. of lectures: 09)

Unit II:

Sensor design principles and device architecture, Fabrication techniques: printing, coating,

lithography, laser patterning, Flexible and stretchable sensor fabrication methods, Integration with electronics: circuits, microcontrollers, Power sources: batteries, energy harvesting (piezoelectric, triboelectric), Wireless communication: Bluetooth, NFC, IoT integration, Data acquisition systems and embedded electronics, Packaging and durability of wearable devices, Calibration, sensitivity, selectivity, and response time, Reliability and long-term stability **(No. of lectures: 09)**

Unit III:

Wearable sensors for vital sign monitoring, Biochemical sensing: sweat, saliva, glucose monitoring, Motion and activity tracking, Smart textiles and e-skin technologies, Implantable vs wearable sensors, Integration with Nanotechnology for enhanced performance, Biosensing platforms and real-time monitoring, Data analytics, AI, and machine learning in healthcare monitoring, Telemedicine and remote healthcare systems, Challenges: biocompatibility, data security, regulatory issues, Emerging trends: self-powered sensors, soft robotics, digital health

(No. of lectures: 09)

TEXTBOOKS:

1. Wearable Electronics Sensors: Subhas C. Mukhopadhyay (Springer)
2. Wearable Physical Chemical and Biological Sensors: Eden Morales-Narvaez, Can Dincer (Elsevier)

REFERENCE BOOKS:

1. Portable and Wearable Sensing Systems: Qingjun Liu (Wiley)
2. Wearable Sensors: Fundamentals, Implementation and Applications: Edward Sazonov (Academic Press)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Nano-engineering of Soft Materials	3	2	1	0	0

PREREQUISITE

Basic understanding of soft materials

COURSE OBJECTIVE(s)

The purpose of this course is to discuss fundamentals and the types of soft (polymer, organic, and biological) nanomaterials and corresponding hybrid nanostructures that have been discovered and synthesized for prospective applications in nanotechnology. It will also help to learn how to create nano patterns on Soft Surfaces, particularly on Polymer films by various techniques such as lithography and finally about Atomic Force Microscopy (techniques widely used for polymer based nanostructures)

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
j)	Internal assessment (based on assignments, quizzes, and attendance)	20%
k)	Mid-term examination	30%
l)	End Semester Examination	50%

COURSE CONTENTS

Unit:1

Introduction to soft materials, Chemical composition/structures, polymers/biopolymers, Surface and interfacial organization, Colloidal assemblies, Nanoparticles, Molecular films and Polymer Brushes, Layer-by-layer assemblies, block copolymers, Responsive nanomaterials, self-healing, Hybrid nanoparticles, Soft membranes, Soft nanocomposites **(No. of Lectures: 09)**

Unit:2

Polymer blends and its composites, Polymer recycling, Physics of polymer degradation, recycling methods, and the circular economy, Polymers in packaging, electronics, and medicine, Polymer extrusion, injection molding, and blow molding; Biodegradable polymers, Polymer-based nanomaterials, nanofibers, and nanocomposites, Polymer based drug delivery systems, Controlled release of drugs from polymer matrices, polymer-based hydrogels **(No. of Lectures: 09)**

Unit:3

Different Nano Fabrication Regimes including self-assembly, Lithography, Discussion on Photo Lithography: Photo Resists, Spin Coating, Exposure, Development, Soft Lithography: Introduction, Different Soft Lithography Techniques, Basic Concepts of Atomic Force Microscopy Different Imaging Modes of Atomic Force Microscopy **(No. of Lectures: 09)**

TEXTBOOKS:

1. Fundamentals of Polymer Physics by M. Rubinstein and R. P. Colby (Cambridge University Press)
2. Creating Micro and Nano Patterns on Polymeric Materials, A del Campo and E. Arzt (Wiley)
3. Processing of Polymer-based Nanocomposites, Suprakas Sinha Ray (Springer)

REFERENCE BOOKS:

1. Atomic Force Microscopy Understanding Basic Modes And Advanced Applications Haugstad G (Wiley)
2. Nanofabrication: Techniques and Principles; Maria Stepanova & Steven Dew (Springer)

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Soft Materials	3	2	1	0	0

PREREQUISITE – Basic knowledge of materials science, particularly in polymers and colloidal systems, is recommended.

COURSE OBJECTIVE(s)

This course provides an introduction to the fundamentals of various soft matters like polymers, biopolymers, colloids and gels. Soft matter and applications

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit 1:

Introduction to soft materials and soft matter, generic aspects of soft materials, classification in terms of their thermal, mechanical, and often unusual physical properties. examples of soft systems: are polymers, foams, granular media, colloids, liquid crystals, micelles, vesicles and biological membranes, polymers in solution, gels, emulsions, and foams **(No. of lectures- 9)**

Unit 2:

Shape and directional interaction, crystal structure, effect on maximum packing density, anisotropic and directionally interacting colloids, complex shape particles, deforming and stretching, soft lithography and micro molding. Building blocks for self-assembled soft materials, learning from small molecules, block copolymers, phase diagram, experimental methods for study of block copolymers. **(No. of lectures- 12)**

Unit 3:

Soft matter in nature. Applications of soft matter: Soft matter in materials science, biology, and medicine; active matter

(No. of lectures- 6)

TEXT/ REFERENCE BOOKS:

1. Fundamentals of soft matter science: Linda S. Hirst (CRC).
2. Introduction to soft matter: Ian W. Hamle (Wiley).

REFERENCE BOOKS:

1. Polymer surfaces and interfaces: M Stamm (Springer).
2. Soft condensed matter: R.A.L. Jones (Oxford)
3. Soft materials: structure and dynamics: John R. Dutcher, A. G. Marangoni (CRC).

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHT XXX	Quantum Communication	3	2	1	0	0

PREREQUISITE – Basic Quantum Mechanics and Optics courses

COURSE OBJECTIVE(s)

The course aims to provide a foundational understanding of polarization optics, advanced photodetection, and classical information theory. Students will master key quantum communication protocols and analyze hardware implementations across fiber, free-space, and satellite networks for the future quantum internet.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1.	Internal assessment (based upon assignments, quizzes and attendance)	20%
2.	Mid-term examination	30%
3.	End Semester Examination	50%

COURSE CONTENTS

Module 1:

Basics of Polarization optics, Quarter and half-wave plates, Polarizing beam splitters, Basics of linear and square-law detectors, Quadrature amplitude modulation, Heterodyne and Homodyne demodulation and linear detectors, Intensity measurements and square law detectors, Photomultipliers, Avalanche Photo diodes etc. **(No. of lectures- 9)**

Module II:

Digital communication – information theory (basics), Information entropy, Noiseless channel encoding, Noisy channel encoding, No cloning theorem, Quantum Memories, Quantum repeaters, Entanglement and Bell Theorems, Bell Measurements and Tests. **(No. of lectures- 7)**

Module III:

Quantum Teleportation protocol, Quantum Dense coding, Introduction to Quantum Key Distribution protocols, Quantum Networks and Quantum Internet. Survey of Hardware implementations, Free space communications, Satellite based communications, Fibre optics-based communications. (No. of lectures- 10)

TEXT/ REFERENCE BOOKS: -

1. Quantum computation and quantum information – Nielsen and Chuang Cambridge University Press, Cambridge (2010)
2. A Pathak, Elements of Quantum Computation and Quantum Communication, Boca Raton, CRC Press (2015).

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHPXXX	Quantum Technology Lab	3	0	0	6	0

COURSE CONTENTS

Note: Students need to perform minimum 8 selected experiments

1. To measure the de Broglie wavelength of the electrons.
2. To study the interference of polarized beams using a Mach-Zehnder-interferometer
3. To study the Single-Photon Interference using Quantum Eraser.
4. To measure sub-shot-noise phase sensitivity in an optical interferometer using squeezed states of light.
5. Quantum Sensing of Magnetic Fields using Nitrogen-Vacancy (NV) Centers in Diamond.
6. To calculate and validate the quality factor of series and parallel RLC circuits using theoretical and experimental data.
7. To observe and quantify the thermal noise generated by resistors at varying temperatures using a spectrum analyser.
8. To study and compare the principles of homodyne and heterodyne signal demodulation techniques.
9. To perform data acquisition and digitization using Analog-to-Digital Converters (ADCs), and to analyse the effects of under-sampling (aliasing), oversampling, and quantization noise on signal reconstruction.
10. To deposit a high-quality thin film of SrTiO_3 or BaTiO_3 onto a single-crystal substrate using Pulsed Laser Deposition, and to optimize the film thickness by controlling the laser pulse count and repetition rate.
11. To synthesize large-area, high-quality monolayer graphene on a catalytic copper foil substrate via methane decomposition in a thermal CVD furnace.
12. To identify and characterize the layer count, structural defects, and doping levels of exfoliated 2D materials using Raman effect.
13. To fabricate a functional quantum electronic device by patterning source, drain, and gate contacts onto a CVD-grown 2D material using optical lithography and metal evaporation techniques.
14. To study the time-resolved absorption of quantum dots and graphene-based materials.
15. To synthesize and evaluate the electrochemical performance of quantum dot/2D material-based heterostructures as electrodes for high-capacity lithium-ion batteries and supercapacitors.

16. To evaluate the surface roughness, grain size distribution, and step-terrace morphology of a thin film or a transferred 2D material flake using AFM.
17. To simulate a single qubit on the Bloch sphere and visualize the state transformations under the action of Pauli and Hadamard gates using Qiskit.
18. To compute and analyse the electronic band structure of 2D materials using open-source Density Functional Theory (DFT) software.
19. To design, execute, and validate a quantum entanglement circuit on a real cloud-based IBM Quantum processor.
20. To simulate a 2D ferromagnetic Ising model and study its phase transitions using the Metropolis-Hastings algorithm.
21. To solve the time-independent Schrödinger equation for non-trivial potentials using Python-based numerical eigenvalue solvers.
22. To map out the current-voltage characteristics of a superconducting Josephson junction to observe the DC Josephson effect and AC Josephson effect.
23. Measurement & study characteristics of a single photon detection system using Quantum Simulations.

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHPXXX	Quantum Sensing and Metrology	3	3	0	0	0

PREREQUISITE – Basic Quantum Mechanics

COURSE OBJECTIVE(s)

The course aims to provide a foundational understanding of classical and quantum measurement theories, including Cramer-Rao bounds and Fisher information, quantum states of light, tomography, and advanced sensing applications like gravimetry and magnetometry using atomic and spin-based systems for high-precision technologies.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
4.	Internal assessment (based upon assignments, quizzes and attendance)	20%
5.	Mid-term examination	30%
6.	End Semester Examination	50%

COURSE CONTENTS

Module 1: Classical Foundations and Sensitivity Limits

Classical sensing: Photo detection, Classical noise: Johnson Noise, Telegraph noise, flicker or $1/f$ noise, Sensitivity of classical measurements, Classical Fisher information, Cramer-Rao bounds, Information theory basics.

(No. of lectures- 7)

Module II: Quantum Measurement Theory and States of Light

Quantum measurements: Projective/orthogonal and Approximate/non-orthogonal measurements, Weak continuous measurements, Error-disturbance relations, Standard quantum limits, Quantum

non-demolition measurements, States of light: Fock states, Coherent states, and Squeezed states, Tomography, Wigner quasi-probability distribution, P-distribution, and Husimi Q function.

(No. of lectures- 11)

Module III: Quantum Detection and Sensing Applications

Quantum photo detection: Square-law detectors, Intensity measurements, and Photo-detection, Linear Detectors and Quadrature Measurements, Quantum Cramer-Rao bounds, Single photon-based sensing applications, Entanglement based sensing applications, Atomic state-based sensing, Solid-state spin-based sensing applications: Metrology, Gravimetry and Magnetometry.

(No. of lectures- 8)

TEXT/ REFERENCE BOOKS: -

1. Quantum Measurement and Control, Howard Wiseman and David Milburn, Cambridge University Press (2014)
2. Quantum Measurement, Vladimir Braginsky and Farid Ya Khalili, Cambridge University Press (1995)
3. Quantum Information Science – Manenti R., Motta M., 1st Edition, Oxford University Press (2023)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Quantum Materials and Devices	3	3	0	0	0

PREREQUISITE – Basic Quantum Mechanics and Condensed Matter Physics

COURSE OBJECTIVE(s)

The course aims to provide students with a comprehensive understanding of electronic band theory, superconductivity, and magnetism. Students will explore 2D materials like graphene and TMDCs, master the basics of topological phases, and learn practical material growth techniques, including MBE, CVD, and lithography for quantum technology applications.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
m)	Internal assessment (based upon assignments, quizzes and attendance)	20%
n)	Mid-term examination	30%
o)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Basics of Material's Physics

Review of band theory basics: Metals, Semiconductors, and Insulators, Band structure of solids, Correlated systems, Review of magnetism: Para and ferro magnetism basics, Magnetic measurements, Hall effect, and Magnetoresistance, Faraday and Kerr effects. Survey of semiconducting and superconducting devices for quantum technologies (electronic, quantum optical devices and principle of operation).
(No. of lectures- 7)

Module II: Superconductivity and Topological Phases

Superconductivity: BCS theory and Ginzburg Landau theory, Josephson Effect: AC and DC Josephson effects, Survey of superconducting devices for quantum technologies, Basics of Topology, Geometric phases: Berry Phase, Aharonov Bohm effect, Topological phases of matter.
(No. of lectures- 8)

Module III: Low-Dimensional Materials and Growth Techniques

2D materials: Graphene and its properties (single and few layers), Transition Metal Dichalcogenides: Electronic and Optical Properties, Survey of material growth techniques: Molecular beam epitaxy (MBE), Chemical vapor deposition (CVD) and MOVPE, Pulsed laser deposition (PLD), Crystal growth techniques. Materials to devices: lithography for device fabrication. **(no. of lectures- 11)**

TEXT/ REFERENCE BOOKS: -

4. Condensed Matter Physics, M P Marder, 2nd Edition, John Wiley and Sons (2010)
5. Introduction to Superconductivity, Michael Tinkham, standard ed., Medtech (2017)
6. Topological Phases of Matter, Roderich Moessner, Joel E. Moore, 1st Edition Cambridge University Press (2021)

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHT XXX	Quantum Optics	3	2	1	0	0

PREREQUISITE – Basic Quantum Mechanics and Electrodynamics

COURSE OBJECTIVE(s)

The course aims to provide a rigorous understanding of electromagnetic field quantization and optical coherence. Students will master phase-space representations, analyze light-matter interactions via the Jaynes-Cummings model to model decoherence for advanced photonic applications.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1.	Internal assessment (based upon assignments, quizzes and attendance)	20%
2.	Mid-term examination	30%
3.	End Semester Examination	50%

COURSE CONTENTS

Module I: Field Quantization and Optical Coherence

Electromagnetic field quantization, Number, coherent, and squeezed states, Hanbury-Brown and Twiss experiments (Photon bunching and anti-bunching), Hong-Ou-Mandel interference, Young's double slit experiment and first order coherence, Coherence functions of arbitrary order, Operator ordering (Normal, symmetric, and anti-normal), Interferometry **(No. of lectures- 13)**

Module II: Phase-Space Representations and Non-Classicality

Wigner distribution, P-function and the notion of non-classicality with some examples of nonclassical states like squeezed states and their applications, Husimi Q function **(No. of lectures- 6)**

Module III: Light-Matter Interaction and Open Quantum Systems

Classical model of light-matter interaction, Semi-classical model of light-matter interaction, Quantum light-matter interaction, Rabi Model, Jaynes-Cummings model, Fermi's golden rule, Born-Markov Lindblad Master Equation. **(No. of lectures- 7)**

TEXT BOOKS: -

1. Introductory Quantum Optics, Christopher Gerry and Peter Knight, Cambridge University Press (2004)
2. Quantum Optics, D. F. Walls, Gerard J. Milburn, 2nd Edition, Springer (2008)

REFERENCE BOOKS: -

3. Quantum Optics: An introduction, Mark Fox, Oxford University Publishers (2006)
4. Quantum Optics for Beginners, Z. Ficek and M. R. Wahiddin, 1st edition, Jenny Stanford Publishing (2014)

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXX X	Foundation of Quantum Computation	3	3	0	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

- To develop a strong mathematical foundation required for quantum computing, including vector spaces, linear algebra, and Hilbert space formalism.
- To understand the fundamental principles of quantum mechanics relevant to computation, such as qubits, superposition, entanglement, and measurement.
- To introduce quantum operators, gates, and circuit models used in quantum information processing.
- To familiarize students with multi-qubit systems, tensor products, and quantum correlations like entanglement.
- To provide basic knowledge of quantum algorithms and their physical interpretation.
- To enable students to simulate quantum systems using modern tools like Qiskit.
- To understand the impact of noise, decoherence, and errors in practical quantum computing systems.
- To build a foundation for advanced study or research in quantum computing and quantum information science.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Mathematical Foundation

Vector spaces and complex Hilbert spaces, Dirac notation (bra-ket formalism), Inner products and norms, Linear operators and matrix representation, Eigenvalues and eigenvectors, Unitary and Hermitian operators, Tensor products and composite systems, Basic probability theory and entropy (introductory level), Matrix decomposition. (No. of lectures: 11)

Module II: Physics of Quantum Systems

Qubits and state representation, Measurement postulate and probabilities, Bloch sphere representation, Multi-qubit systems and tensor structure, Quantum entanglement and Bell states, Quantum gates (Pauli, Hadamard, Phase, CNOT), Quantum circuits and unitary evolution, Density matrix formalism (basic introduction), Interaction with environment and decoherence (introductory) (No. of lectures: 13)

Module III: Quantum Computing using Qiskit

Quantum circuit model, Circuit composition and measurement, Basic quantum algorithms (Deutsch, teleportation, superdense coding), Introduction to Qiskit, Building and simulating quantum circuits, Visualization of results, Variational Quantum Eigensolver (introductory concept), Noise and error in quantum systems (basic understanding) (No. of lectures: 14)

Text books

1. Nielsen, M. A., & Chuang, I. L. (2010). *Quantum computation and quantum information* (10th anniversary ed.). Cambridge University Press.
2. Hidary, J. D. (2019). *Quantum computing: An applied approach*. Springer Nature Switzerland AG. <https://doi.org/10.1007/978-3-030-23922-0>
3. Griffiths, D. J., & Schroeter, D. F. (2018). *Introduction to quantum mechanics* (3rd ed.). Cambridge University Press.
4. Zettili, N. (2009). *Quantum mechanics: Concepts and applications* (2nd ed.). John Wiley & Sons.

Reference Books

1. Javadi-Abhari, A., Treinish, M., Krsulich, K., Wood, C. J., Lishman, J., Gacon, J., Martiel, S., Nation, P., Bishop, L. S., Cross, A. W., Johnson, B. R., & Gambetta, J. M. (2024). *Quantum computing with Qiskit*. arXiv:2405.08810. <https://doi.org/10.48550/arXiv.2405.08810>
2. IBM Quantum. (2024). *IBM Quantum documentation*. IBM Corporation. <https://docs.quantum.ibm.com>
3. Bernhardt, C. (2019). *Quantum computing for everyone*. The MIT Press.

Engg. Physics

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXX X	Quantum Computing for Physical Systems	3	2	1	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

- To train the UG students about Quantum Computing and Simulations, and compare the results with the classical simulations.
- Bridge the gap between theoretical quantum mechanics and the mathematical framework of quantum computing.
- Implement core quantum algorithms and Hamiltonian-mapping techniques for physical-system simulations.
- Gain hands-on expertise in using Qiskit to solve variational problems (VQE/QAOA) and model real-world problems of Physical systems and modern physics applications.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Foundations of Quantum Computing in Physics

Introduction to quantum computing and limitations of classical computing, Four Postulates of Quantum mechanics, Hilbert Spaces, State Vectors and Dirac notation, Density Matrix, Operators and Matrices: Hermitian, Unitary and Projection operators, Composite systems (Tensor products),

Multiparticle Physical system, State in Quantum computing, Single Qubit Gates: Pauli-X, Y, Z, Hadamard (H) and Phase gates (S, T), Multi-Qubit Gates: Controlled-NOT (CNOT) and Controlled-U gates, Universal Quantum Gates, Design and analysis of basic quantum circuits and the concept of “Quantum Parallelism” in solving the combinatorial optimization problem in Physics.

(No. of lectures: 14)

Module 2: Quantum Algorithms & Tools for Quantum Simulations

SparsePauliOp: Decomposing complex Hamiltonians into weighted sums of Pauli strings (X, Y, Z, I), Fermionic-to-Qubit Mapping: The necessity of mapping, Jordan-Wigner (JW) Mapping, Bravyi-Kitaev (BK) Mapping, Parity Mapping, Binary mapping, Initial Quantum algorithms: Quantum parallelism, Deutsch’s algorithm, The Deutsch–Jozsa algorithm, Quantum Phase Estimation (QPE), Introduction to Variational Algorithms (eg. VQE, QAOA etc), Hamiltonian Simulation Theory: Trotter-Suzuki Decomposition: Approximating e^{-iHt} for non-commuting operators.

(No. of lectures: 14)

Module 3: Qiskit Implementation for Physics Problems

Gates and simple & complex circuits for Physical systems, Variational Algorithms in Practice: VQE (Variational Quantum Eigensolver): Implementation using Ansatz circuits (like RealAmplitudes or EfficientSU2), Optimising parameters using classical routines (COBYLA, SLSQP), Dynamics and Evolution, using qiskit_algorithms. QUBO, QAOA for various applications, Simulating real-world conditions using FakeBackend. Trotterization using Pauli Evolution Gate.

(No. of lectures: 11)

Textbooks

1. Nielsen, M. A., & Chuang, I. L. (2010). *Quantum Computation and Quantum Information* (10th Anniversary ed.). Cambridge University Press.
2. Zettili, N. (2009). *Quantum mechanics: Concepts and applications* (2nd ed.). John Wiley & Sons.
3. Kaye, P., Laflamme, R., and Mosca, M. (2007). *An Introduction to Quantum Computing*. Oxford University Press.

References

1. Asfaw, A., Bello, L., Müller, M., Marquardt, F., & Siraichi, L. (2022). *Qiskit Pocket Guide: Swift Machine Learning with Quantum Computing*. O'Reilly Media.
2. Bernhardt, C. (2019). *Quantum Computing for Everyone*. MIT Press.
3. Combarro, E. F., & González-Castillo, S. (2023). *A Practical Guide to Quantum Computing with Qiskit*. Packt Publishing.
4. Griffiths, D. J., & Schroeter, D. F. (2018). *Introduction to Quantum Mechanics* (3rd ed.). Cambridge University Press.
5. Hidary, J. D. (2019). *Quantum Computing: An Applied Approach*. Springer.
6. IBM Quantum. (2026). *Qiskit Documentation*. <https://docs.quantum.ibm.com/>

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Astronomy and Astrophysics	3	3	0	0	0

COURSE OBJECTIVES:

1. To impart fundamentals and application based knowledge education to Masters' students of Physics, primarily in areas: Astronomy & Astrophysics.
2. To enable students to solve problems independently based on these concepts.
3. To equip students with the basics of the field so that they may pursue it as a career.
4. To have periodic evaluation of students through class work sessional / mid-term and end term examinations.

PREREQUISITES:

1. Basic Mathematics (+2 Level).
2. Basic Thermodynamics & Classical Mechanics (Graduation Level).
3. Basic Quantum Mechanics. (Graduation Level).

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1.	Internal assessment (based upon assignments, quizzes and attendance)	20%
2.	Mid-term examination	30%
3.	End Semester Examination	50%

COURSE CONTENTS

Astronomy - Coordinate Systems For Celestial Objects & Their Interrelations, Cardinal Points In The Sky, Time Measurements in Astronomy, Proper & Peculiar Motion of Stars, Parallaxes, Photometry, Magnitude System, Distance Modulus, Color Indices. **(No. of lectures- 15)**

Astrophysics- - Stellar spectra and Structure, Ionization Equation & Elemental Abundances, H-R Diagram, Stellar Evolution, Nucleosynthesis and Formation of Elements, Variable stars, Compact stars, Star clusters and Binary stars; **(No. of lectures- 11)**

AstroLab- Astronomy softwares. Descriptive Astronomy & Planetary motions (Stellarium). Distance & Age of Open Cluster (Topcat), Double line Binary Star (Splatview). Handling of Photometers, CCD imaging devices & Telescopes. Astro-Python (Astropy & Sunpy) – Measurement of Solar Differential Rotation. Spotting GW events in the sky (Aladin)

(No. of Lab-sessions- 13)

TEXT BOOKS/ REFERENCE BOOKS: -

1. An Introduction to Modern Astrophysics : by B. W. Carrol & D. A. Ostlie (Addison Wesley)
2. Textbook of Astronomy & Astrophysics with Elements of Cosmology : V. B. Bhatia (Narosa)
3. An introduction to astronomy & cosmology: by Ian Morisson (John Wiley)
4. An Introduction to Astrophysics, B. Basu, T. Chattopadhyay, S.N. Biswas

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Advanced Quantum Mechanics for Engineers	3	3	0	0	0

PREREQUISITE

Quantum Mechanics

COURSE OBJECTIVE(s)

This is an advanced level course in Quantum mechanics which objects to teach about various approximation methods in physics to calculate the approximate values of energy for various systems. Students will be able to learn the methods to find transition probability for absorption and emission. The objective is to give them ideas about laboratory and center of mass frame and study the scattering phenomena in both these frames. This course will let students appreciate the beauty of quantum mechanics in the form of the Born approximation and its validity. Students will be able to study the wave functions of system of identical particles.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module- I

Time Independent perturbation theory, First order correction to the energy, First order correction to the wave function, Second order correction to the energy, Second order correction to the wave function, Example of stationary state perturbation theory, Example of Time-Independent perturbation theory (non-degenerate case), Variational principle, Example of variational principle, WKB method.

(No. of lectures- 10)

Module- II

Time dependent perturbation theory, first order perturbative expression for the transition amplitude and probability, harmonic perturbations, transition probability under constant perturbation, Fermi's golden rule.

(No. of lectures-10)

Module-III

Interaction of radiation with matter, spontaneous emission, absorption, induced emission, dipole transitions, selection rules, identical particles, Pauli exclusion principle. **(No. of lectures- 10)**

Module-IV

Non-relativistic scattering, solution of scattering problem by the method of Green's function, Born approximation and its validity for scattering problems, partial wave analysis, optical theorem. **(No. of lectures-9)**

TEXT BOOKS/ REFERENCE BOOKS: -

1. L. I. Schiff, Quantum Mechanics, 3rd edition, (McGraw Hill Book Co., New York 1968).
2. E. Merzbacher, Quantum Mechanics, 3rd edition, (John Wiley & Sons, Inc1997)
3. Quantum Mechanics, Nouredine Zettili, Wiley
4. A. Ghatak & S. Lokanathan, Quantum Mechanics: Theory and Applications, 5th Edition, (Macmillan India, 2004)
5. Quantum Mechanics A Modern Approach: A. Das and A. C. Milissiones (CRC Press).
6. Advanced Quantum Mechanics: J.J. Sakurai (Addison Wesley Publishing Co.)
7. Principles of Quantum Mechanics: R. Shankar.
8. Introduction to Quantum Mechanics: David J. Griffiths (Pearson Education).
9. Quantum Mechanics by Mathews and Venkatesan (McGraw Hill)

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Introduction to General Relativity	3	3	0	0	0

PREREQUISITE

Quantum Mechanics

COURSE OBJECTIVE(s)

After successfully completing this course student should be able to understand the equivalence principle and description of gravity as geometry. In addition, student should be able to understand applications of general relativity in astrophysics and cosmology.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1

Geometrical approach to special theory of relativity: Inertial observers, Minkowski metric, spacetime diagrams, light cone, invariant hyperbolae, length contraction and time dilation using spacetime diagrams, Lorentz transformations, Four-vector formulation of special relativity, Tensors and tensor manipulation, Energy and momentum in special relativity and energy-momentum tensor for perfect fluid. (No. of lectures- 9)

Module 2

Curved Spacetime: manifolds and coordinates, curves and surfaces, coordinate transformations, vector and tensor fields, metric tensor and tensor densities, partial derivative of a tensor, the affine connection and covariant derivative, parallel transport and geodesics, Riemann curvature tensor and its properties, Ricci tensor and scalar, Weyl tensor. geodesic deviation. (No. of lectures-12)

Module 3

Equivalence principle, principle of general covariance, gravity as a curvature of spacetime, geodesics as trajectories under the influence of gravitational field, Einstein's field equation and its properties.
(No. of lectures- 4)

Module 4

Schwarzschild solutions of Einstein's field equation, motion of a particle in Schwarzschild metric, experimental tests of general relativity: precession of the perihelion, bending of light, correction to GPS satellites due to general and special relativity, singularities, horizons, black holes.
(No. of lectures- 7)

Module 5

Gravitational radiation, weak-field approximation, gauge transformations, plane gravitational waves, generation of gravitational waves, quadrupole radiation, detection of gravitational waves.
(No. of lectures-7)

REFERENCES

Text Books:

1. A First Course in General Relativity: Bernard Schutz (Cambridge University Press).
2. Introducing Einstein's Relativity: Ray D'Inverno (Oxford University Press)
3. Gravity: An introduction to Einstein's General Relativity; J. B. Hartle (Pearson India Education).

Reference Books:.)

1. Spacetime and Geometry: An Introduction to General Relativity, Sean M. Carroll (Pearson Indian Education)
2. General Relativity: R. M. Wald (University of Chicago Press).
3. Gravitation and Cosmology: S. Weinberg (Wiley India PVT. LTD).
4. Classical Theory of Fields: L. D. Landau and E. M. Lifshitz (CBSP)

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXX X	Group Theory and Applications	3	3	0	0	0

PREREQUISITES:

1. Basic Nuclear Physics (Graduation Level).
2. Basic Quantum Mechanics (Graduation Level).
3. Basic Spectroscopy (Graduation Level).

COURSE OBJECTIVES

- To introduce the fundamental concepts of group theory and algebraic structures.
- To develop skills in using symmetry groups for physical systems.
- To explore representation theory and its applications in quantum mechanics and solid-state physics.
- To apply group theory to engineering problems in materials science, crystallography, and spectroscopy.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1.	Internal assessment (based upon assignments, quizzes and attendance)	20%
2.	Mid-term examination	30%
3.	End Semester Examination	50%

COURSE CONTENTS

Unit 1

Introduction to Groups, Sets and mappings; Binary operations; Groups, subgroups, and cyclic groups; Lagrange's theorem; Cosets and normal subgroups; Quotient groups.

(No. of lectures- 6)

Unit 2

Group Structure and Permutation Groups, Symmetric and alternating groups; Dihedral groups; Conjugacy classes; Centre of a group; Group actions. (No. of lectures- 6)

Unit 3

Representation Theory, Representations of groups; Matrix representations; Reducible and irreducible representations; Schur's lemma; Orthogonality theorems. (No. of lectures- 6)

Unit 4

Character Theory, Characters of representations; Orthogonality of characters; Character tables; Burnside's lemma for counting orbits. (No. of lectures- 6)

Unit 5

Point Groups and Symmetry, Finite point groups; Crystallographic point groups (C_n , C_{nv} , D_n , etc.); Space groups; Continuous groups ($SO(3)$, $SU(2)$). (No. of lectures- 10)

Unit 6

Applications in Physics, Selection rules in quantum mechanics; Molecular vibrations and spectroscopy; (No. of lectures- 5)

Textbooks

1. Group Theory in a Nutshell for Physicists by A. Zee (Princeton University Press, 2016) – Primary text for physics applications.
2. Group Theory and Its Application to Physical Problems by Morton Hamermesh (Dover Publications, 1962; Reprint) – Classic introductory text.

Reference Books

1. Finite Group Theory by M. Aschbacher (Cambridge University Press, 2000) – For deeper algebra.
2. Group Theory: Birdtracks, Lie's, and Exceptional Groups by P. Cvitanović (Princeton University Press, 2008) – Advanced applications.
3. Symmetry and Group Theory in Physics by M. S. Dresselhaus et al. (Lecture Notes, MIT OpenCourseWare or similar).
4. Molecular Symmetry and Spectroscopy by P. R. Bunker and P. Jensen (NRC Research Press, 1998) – For molecular applications.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHT XXX	Particle Detectors and Its Technology	3	2	1	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

This course aims to equip the students with fundamental knowledge of Particle Detector and Technology.

COURSE ASSESSMENT

The Course Assessment (culminating in the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1

Overview of the detector technology used in particle physics experiments starting from the Rutherford scattering experiment to the present world's largest experiments at the Large Hadron Collider (LHC), basic concept of energy loss by excitation and ionization, Bethe-Bloch formula, density effects, mean energy loss as a function of velocity, fluctuations in energy loss, interaction of electrons with matter: Bremsstrahlung, interaction of photon with matter: photo-electric effect, Compton scattering, pair production.

(No. of lectures- 6)

Module 2

Fundamental physics principle of particle detectors: ionization and excitation, construction, working, and operational characteristics of particle detectors: gaseous detectors, ionization chambers, proportional counters, drift chambers, bubble chambers, semiconductor detectors: introduce silicon detectors technology, pixel and strip detectors, CCDs, electromagnetic

calorimetry, hadronic calorimetry, general characteristics of particle detectors, development of a detector system concept. **(No. of lectures- 11)**

Module 3

Signal formation, electronic noise, optimization of signal-to-noise ratio, pulse processing electronics, amplification, applications: position, tracking, and energy measurements in modern particle physics experiments, radiation detection in space applications: advanced space radiation detector technology at NASA/ISRO, radiation detectors for medical imaging: beam monitoring and 3D imaging, nuclear techniques for material analysis. **(No. of lectures- 9)**

TEXTBOOKS-

1. Techniques for Nuclear and Particle Physics Experiment: W. R. Leo (Springer).
2. Radiation Detection and Measurement: Glenn F. Knoll (Wiley).
3. Semiconductor Radiation Detectors, Device Physics: Gerhard Lutz (Springer).
4. Particle Detectors: Claus Grupen and Boris Schwartz (Cambridge University Press).

REFERENCE BOOKS

1. Physics of Particle Detectors: Dan Green (Cambridge University Press).
2. Evaluation of Silicon sensor technology in particle physics: Frank Hartmann (Springer).
3. Handbook of Particle Detection and Imaging: Grupen, Claus, Buvat, Irene (Springer).

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXX X	Plasma Science and Technology	3	3	0	0	0

PREREQUISITES:

1. Basic Mathematics (+2 Level).
2. Basic Fluid Dynamics (Graduation Level).
3. Basic Electrodynamics (Graduation Level).

COURSE OBJECTIVES

- To introduce the fundamental concepts of plasma as the fourth state of matter.
- To understand plasma behavior using single-particle, fluid, and kinetic models.
- To explore plasma waves, instabilities, and confinement techniques.
- To familiarize students with plasma technologies and applications in engineering, such as fusion energy, plasma processing, and propulsion.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1.	Internal assessment (based upon assignments, quizzes and attendance)	20%
2.	Mid-term examination	30%
3.	End Semester Examination	50%

COURSE CONTENTS

Unit 1

Introduction to Plasmas, Definition and characteristics of plasma; Debye shielding; Plasma parameters (density, temperature); Criteria for plasmas (Debye length, plasma frequency).

(No. of lecture – 6)

Unit 2

Single Particle Motion in Plasmas, Motion in uniform E and B fields ($E \times B$ drift, gradient B drift, curvature drift); Adiabatic invariants; Magnetic moment.

(No. of lecture – 6)

Unit 3

Fluid Description of Plasmas, Plasma as a fluid; MHD equations; Frozen-in flux theorem; Alfvén waves; Magnetosonic waves; Pinch effect; Theta pinch and Z-pinch. **(No. of lecture – 8)**

Unit 4

Kinetic Theory and Waves, Plasma Wave generation and EMW propagation; Vlasov equation; Landau damping; Plasma waves (Langmuir, ion acoustic, electromagnetic); Dispersion relations; Cold and warm plasma approximations. **(No. of lecture - 8)**

Unit 5

Plasma Confinement and Instabilities, Magnetic confinement (tokamaks, stellarators); Inertial confinement; Two Stream & Weibel instability; (RT & kink instability optional); Bootstrap current **(No. of lecture - 6)**

Unit 6

Plasma Technologies and Applications: Fusion plasmas (ITER, tokamak physics); Plasma processing (etching, deposition, PECVD); Plasma propulsion; Glow discharges; **(No. of Lecture – 5)**

Textbooks

1. Introduction to Plasma Physics and Controlled Fusion by F. F. Chen (3rd Edition, Springer, 2016) – Primary text.
2. Plasma Physics: An Introduction to Plasma Theory by Richard Fitzpatrick (Available online, CRC Press).

Reference Books

1. Principles of Plasma Discharges and Materials Processing by M. A. Lieberman and A. J. Lichtenberg (Wiley, 2005).
2. Physics of Plasmas by J. D. Callen (Online notes from University of Wisconsin).
3. Fusion: The Energy of the Universe by Garry McCracken and Peter Stott (Academic Press, 2005).

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Accelerators and Applications	3	3	0	0	0

PREREQUISITE –

COURSE OBJECTIVE(s)

To provide a comprehensive understanding of the fundamental physics, advanced engineering systems, and diverse real-world applications of particle accelerators across research, medicine, and industry.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module 1: Basic Principles and Beam Dynamics

Introduction to particle accelerators, History and evolution (Cyclotron, Synchrotron), Classification of accelerators (electrostatic, linear, circular), Motion of charged particles in electric and magnetic fields, Lorentz force and beam trajectory, Basic beam optics (focusing and defocusing, quadrupole magnets), Phase stability and acceleration mechanisms, RF cavities and resonance

(No. of Lectures 12)

Module 2: Advanced Accelerator Systems and Components

Linear accelerators (LINAC), Circular accelerators (synchrotrons and storage rings), Magnetic systems (dipole, quadrupole, sextupole magnets), RF systems and accelerating structures, Beam

diagnostics and instrumentation, Vacuum systems, Beam injection and extraction techniques, Superconducting accelerators and cryogenics, Large-scale facilities (CERN, Large Hadron Collider)
(No. of Lectures 14)

Module 3: Industrial, Medical, and Research Applications

High-energy physics applications, Nuclear physics and material science applications, Medical applications (Proton therapy, radioisotope production), Industrial applications (material modification, sterilization, imaging), Space radiation studies and simulation, Accelerator-driven systems (ADS), Synchrotron radiation applications, Future trends (compact accelerators, plasma wakefield acceleration)
(No. of Lectures 13)

TEXT BOOKS: -

1. Wiedemann, H. (2015). *Particle Accelerator Physics* (4th ed.). Springer.
2. Wille, K. (2000). *The Physics of Particle Accelerators: An Introduction*. Oxford University Press.
3. Lee, S. Y. (2018). *Accelerator Physics* (4th ed.). World Scientific.
4. Edwards, D. A., & Syphers, M. J. (1993). *An Introduction to the Physics of High Energy Accelerators*. Wiley-VCH.

REFERENCE BOOKS

1. Appleby, R., Burt, G., Clarke, J., & Owen, H. (2020). *The Science and Technology of Particle Accelerators*. CRC Press.
2. Myers, S., & Schopper, H. (Eds.). (2020). *Particle Physics Reference Library: Volume 3: Accelerators and Colliders*. Springer.
3. Minty, M. G., & Zimmermann, F. (2003). *Measurement and Control of Charged Particle Beams*. Springer.

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
B. Tech Minor	26PHTXX X	Fundamentals of Space Physics and Applications	3	3	0	0	0

PREREQUISITE – None

COURSE OBJECTIVE(s)

- To gain a foundational knowledge of space weather and cosmic radiations in space.
- To be aware of the current space missions of NASA and ISRO organisations
- To train the students about experimental data analysis for practical pathways for student research and internships.
- To examine how space radiation interacts with sensors, materials, and electronics to understand radiation detection and its effects on materials and sensors.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Module I: Fundamentals of Space Radiation Environment and Space Weather:

Introduction to space environment, Earth atmosphere, Magnetosphere, Ionosphere, Van Allen radiation belts, Solar radiation, Solar wind, Galactic Cosmic Rays, Solar Energetic Particles,

Radiation environment in Low Earth Orbit, Geostationary Orbit and Deep Space, Introduction to space weather, Sunspots, Solar flares, Coronal Mass Ejections, Geomagnetic storms, Auroras, Solar cycle, Effects on satellites and astronauts
(No. of lectures: 18)

Module II: Overview of Space Missions and Exploration:

Introduction to space agencies, ISRO overview: Chandrayaan missions, Mangalyaan, Aditya-L1, Gaganyaan, NASA overview, Apollo missions, International Space Station, Mars Rover missions, Artemis mission, Future lunar and Mars exploration missions, Opportunities for students' visit to ISRO/NASA Space Centre (s) for internships OR research.
(No. of lectures: 12)

Module III: Effect of Space Radiations on Sensors & Materials:

Radiation sensors: Silicon detectors, Geiger Muller counter, Scintillation detectors, Dosimeters for spacecraft, Shielding materials used in space, Aluminum, Polymers and composites, Metal Hydride, and Carbon composites, Interaction of radiation with materials, Ionization, Excitation, Energy loss, Secondary radiations, Radiation damage in electronics, Absorbed dose, Equivalent dose, Dose units Gray and Sievert, Radiation protection methods

Applications: Satellite communication, Space weather forecasting, Radiation monitoring, Spacecraft protection, Human space missions, Defence systems, Disaster warning, Agriculture monitoring
(No. of lectures: 09)

Text Books

1. Moldwin, M. (2022). *An Introduction to Space Weather* (2nd ed.). Cambridge University Press
2. Tascione, T. F. (2010). *Introduction to the Space Environment* (2nd ed.). Krieger Publishing.
3. Kivelson, M. G., & Russell, C. T. (Eds.). (1995). *Introduction to Space Physics*. Cambridge University Press.

Reference Books

1. Sellers, J. J. (2005). *Understanding Space: An Introduction to Astronautics* (3rd ed.). McGraw-Hill Education.
2. Indian Space Research Organisation (ISRO). (2023). *Aditya-L1: First Indian Mission to Study the Sun* [Booklet/Technical Report]. ISRO Media.
3. Knoll, G. F. (2023). *Radiation Detection and Measurement* (4th ed., Indian Adaptation). Wiley India.
4. Pisacane, V. L. (2016). *The Space Environment and Its Effects on Space Systems* (2nd ed.). AIAA.
5. Koskinen, H. E. J., & Kilpua, E. (2022). *Physics of Earth's Radiation Belts: Theory and Observations*. Springer.
6. Radiation and Detectors: Introduction to the Physics of Radiation and Detection Devices by Lucio Cerrito

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Advanced Condensed Matter Physics	3	3	0	0	0

PREREQUISITE – Basics of Solid State Physics, Quantum Mechanics

COURSE OBJECTIVE(s)

Build on prior knowledge of solid state physics, introduce deeper physical concepts and modern topics, connect condensed matter physics with devices and emerging technologies, and develop ability to analyze real materials and systems.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I: Electronic Structure Beyond Basics

Quick recap: Bloch theorem, bands, Effective mass and band curvature, Density of states (2D, 3D systems), Fermi surface and its significance, Band engineering (direct vs indirect gap), Semiconductor physics (advanced view), Applications: diodes, transistors, optoelectronics

(No. of lectures- 07)

Unit II: Phonons & Electron-Phonon Physics

Phonons (brief recap + dispersion relations), Debye model (quick revision), Lattice thermal conductivity, Electron-phonon interaction, Phonon scattering and resistivity, Thermoelectric materials (Seebeck effect intro), Applications: thermal management, energy materials.

(No. of lectures- 07)

Unit III: Transport & Low-Dimensional Physics

Beyond Drude: limitations and corrections, Boltzmann transport equation (conceptual), Electrical and thermal transport, Hall effect (advanced interpretation), Magnetoresistance, Quantum transport basics, 2D electron gas and quantum confinement, Introduction to mesoscopic physics, Applications: nanoelectronics, sensors. **(No. of lectures- 09)**

Unit IV: Magnetism & Superconductivity

Microscopic origin of magnetism, Exchange interaction (qualitative + insight), Magnetic ordering and domains, Spin waves (intro), Superconductivity: phenomenology, Meissner effect and London equations, BCS theory (conceptual understanding), Ginzburg-Landau Theory, Applications: superconducting devices. **(No. of lectures- 08)**

Unit V: Modern Condensed Matter & Devices

Quantum confinement & nanomaterials, Graphene and 2D materials, Topological insulators (conceptual intro), Spintronics and magnetic devices, Strongly correlated systems (overview), Experimental techniques (XRD, STM, ARPES basics), Condensed matter in real devices, Future trends. **(No. of lectures- 08)**

TEXT/ REFERENCE BOOKS: -

1. Introduction to Solid State Physics, Charles Kittel, Wiley, 8th Edition, 2004, ISBN: 978-0471415268
2. Solid State Physics, Neil W. Ashcroft and N. David Mermin, Brooks/Cole, 1976, ISBN: 978-0030839931.
3. Condensed Matter Physics, Michael P. Marder, Wiley, 2nd Edition, 2010, ISBN: 978-0470949948
4. Magnetism in Condensed Matter, S Blundell (Oxford University press (2001)
5. Physics of Semiconductor Devices, Simon M. Sze and Kwok K. Ng, Wiley, 2006, ISBN: 978-0471143239
6. Electronic Transport in Mesoscopic Systems, Supriyo Datta, Cambridge University Press, 1997, ISBN: 978-0521599436
7. Introduction to Nanoscience, Stuart Lindsay, Oxford University Press, 2009, ISBN: 978-0199544219

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DEPARTMENT OF PHYSICS

DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Advanced Statistical Mechanics	3	3	0	0	0

PREREQUISITE – Thermodynamics, Mathematical Physics, Quantum Mechanics, Basic Statistical Mechanics

COURSE OBJECTIVE(s)

After completing this course, students should be able to:

1. Use statistical methods to connect microscopic models with macroscopic thermodynamic behavior.
2. Apply canonical, grand canonical, and microcanonical ensembles to physical systems.
3. Analyze interacting systems and phase transitions using model Hamiltonians.
4. Understand fluctuations, correlations, response functions, and transport at an introductory advanced level.
5. Use simple analytical and computational techniques for lattice and many-particle systems.
6. Appreciate applications in condensed matter, soft matter, and engineering physics.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid-term examination	30%
c)	End Semester Examination	50%

COURSE CONTENTS

Unit I: Foundations of Advanced Statistical Mechanics: Review of probability theory, Random walks, multiplicity, entropy, Thermodynamic limit, Equal a priori probability, ergodic hypothesis, Microstates, macrostates, density of states
[No. of lectures - 3]

Unit II: Ensembles: Microcanonical ensemble, Canonical ensemble and partition function, Grand canonical ensemble, Energy fluctuations and equivalence of ensembles, Maxwell-Boltzmann statistics (No. of lectures – 6)

Unit III: Quantum Statistical Mechanics: Indistinguishability and Gibbs paradox, Bose-Einstein and Fermi-Dirac statistics, Ideal quantum gases Degenerate Fermi gas, Bose-Einstein condensation, Blackbody radiation and phonons (No. of lectures – 6)

Unit IV: Interacting Systems and Phase Transitions: Ising model: physical motivation and 1D transfer matrix idea, Mean-field theory, Order parameter, symmetry breaking, Landau theory of continuous and first-order phase transitions, Critical temperature, susceptibility, heat capacity Critical exponents and universality: introductory treatment (No. of lectures – 12)

Unit V: Fluctuations, Correlations, and Response: Correlation function and correlation length, Gaussian fluctuations, Fluctuation-dissipation theorem: introductory treatment, Diffusion and random processes, Linear response ideas, Structure factor and pair correlations: qualitative introduction (No. of lectures – 6)

Unit VI: Selected Advanced Topics: XY model and BKT transition: concept only, Potts model: overview, Liquid crystals / polymers / colloids / superconductivity: one or two application modules, Optional computational introduction: Monte Carlo idea for Ising model (No. of lectures – 6)

Textbooks / References

1. R. K. Pathria and Paul Beale, *Statistical Mechanics*.
2. Kerson Huang, *Statistical Mechanics*.
3. F. Reif, *Fundamentals of Statistical and Thermal Physics*.
4. Mehran Kardar, *Statistical Physics of Particles and Statistical Physics of Fields*.
5. Nigel Goldenfeld, *Lectures on Phase Transitions and the Renormalization Group*.
6. Chaikin and Lubensky, *Principles of Condensed Matter Physics*.
7. Daniel Arovas, lecture notes on thermodynamics and statistical mechanics.

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTX XX	Frontiers in Nanomaterials and Nanotechnology	3	3	0	0	0

PREREQUISITE

None

COURSE OBJECTIVE(s)

The course Frontiers in Nanotechnology and Nanoscience aims to provide a fundamental understanding of nanoscale science and nanotechnology, including their engineering applications. It covers fabrication techniques, cleanroom processes, and characterization methods for nanomaterials and devices. The course emphasizes the role of nanomaterials in electronic, energy, sensing, and optoelectronic applications while introducing emerging technologies and industrial challenges, preparing students for careers in advanced materials and semiconductor industries.

COURSE OUTCOMES:

CO1	To understand the fundamentals and properties of nanomaterials and nanoscale systems.
CO2	To learn various growth techniques & cleanroom processes for device fabrication.
CO3	Analyze the results of various characterizations and correlate them with device performance.
CO4	Explore the applications of nanomaterials in electronic, energy, sensing, and optoelectronic sectors.

COURSE ASSESSMENT

The Course Assessment (culminating in the final grade) will be made up of the following three components;

S. No.	Component	Weightage
a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
b)	Mid Term examination	30%
c)	End Term Examination	50%

COURSE CONTENTS

Unit I: Fundamentals and Nanoscale Physics in Devices

Science behind nanotechnology: concept and importance, History of nanoscience and key developments, Overview and Classification of nanomaterials: 0D, 1D, 2D, Quantum confinement, Density of states in low-dimensional systems, Size dependent properties of Nanomaterials, Applications of thin films in device fabrication, Role of surface and interface effects in nanotechnology, Defects in nanomaterials and their types, Effect of defects on device performance, Reliability issues in nanoscale devices. **(No. of lectures -8)**

Unit II: Fabrication of Nanomaterials

Basics of vacuum technology, Cleanroom basics and Wafer processing steps, top-down and bottom-up approaches, Lithography and Etching techniques, Thin film deposition: sputtering, CVD, ALD, E-beam evaporation, Doping and defect control, Heterostructure and multilayer fabrication, Process integration and device fabrication, Fabrication challenges in nanoscale devices (uniformity, defects, reproducibility). **(No. of lectures -12)**

Unit III: Characterization of Nanomaterials and Devices

Structural characterization: X-ray Diffraction (XRD), Morphological analysis: Scanning Electron Microscope (SEM), Transmission electron microscopy (TEM), Topographical characterization: Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Spectroscopic techniques: Raman, UV-Visible spectroscopy, X-ray Photoelectron Spectroscopy (XPS), Electrical characterization: I-V, C-V, Optical characterization for device applications, Correlation of characterization results with material properties and device performance, Defect and interface analysis. **(No. of lectures -11)**

Unit IV: Nanomaterials in Devices and Emerging Applications

Nanomaterials in electronic devices: transistors, memory (RRAM), Optoelectronic devices: photodetectors, LEDs, solar cells, Energy applications: batteries, supercapacitors, Sensors: gas sensors, biosensors, Flexible and wearable electronics, Spintronics and quantum devices, "Role of nanomaterials and thin films in device performance, Neuromorphic devices and AI hardware, Nanotechnology for sustainability (water purification, green energy), Biomedical nanotechnology (drug delivery, diagnostics) Challenges in device integration and commercialization.

(No. of lectures -8)

TEXT BOOKS:-

1. Nanostructures and Nanomaterials Synthesis, Properties and Applications: G. Cao (Imperial College Press-2006).
2. Introduction to Nanoscience and Nanotechnology, K K Chattopadhyay & A N Banerjee (PHI, EEE, October 2012)

REFERENCE BOOKS:

1. Introduction to Nanotechnology: Charles P. Poole, Jr. and Frank J. Owens (Wiley).
2. Nanotechnology: Basic Science & Emerging Technology: M. Wilson, K. Kannangara, G. Smith, M. Simmons and B. Raguse (Overseas Press-2005).
3. Nanotechnology: Principles and Practices, Sulabha K. Kulkarni (Springer)
4. Fundamentals of Nanotechnology: G. L. Hornyak, H. F. Tibbals, J. Dutta, and J. J. Moore (CRC Press, 2008).
5. Semiconductor Device Fundamentals: R. F. Pierret (Pearson Education, 1996).

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PE	26PHTXXX	Advanced Characterization Techniques	3	2	1	0	0

PREREQUISITE – Basic Solid State Physics

COURSE OBJECTIVE(s)

The course aims to Impart fundamental knowledge of material characterization phenomena, develop capabilities to apply these concepts in structural, morphological, and compositional applications, and train students to solve analytical problems independently.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S. No.	Component	Weightage
1	Internal assessment (based upon assignments, quizzes and attendance)	20%
2	Mid-term examination	30%
3	End Semester Examination	50%

COURSE CONTENTS

Module 1: Structural and Morphological Characterization

Surfaces, interfaces, bulk solid materials, X-ray Diffraction (XRD), Structure determination and indexing, Scanning electron microscopy (SEM), High-resolution transmission electron microscopy (HRTEM), Low-energy electron diffraction (LEED), Scanning tunneling microscopy (STM), Atomic force microscopy (AFM), Morphology and grain size determination.

(no. of lectures- 13)

Module II: Chemical Composition and Surface Analysis

Elemental composition, chemical states, depth profiles, Electron Probe Micro Analysis (EPMA), Energy Dispersive X-ray Analysis (EDAX), Wavelength Dispersive Analysis (WDS), X-ray Fluorescence (XRF), X-ray Photoelectron Spectroscopy (XPS), Surface oxidation states.

(no. of lectures- 8)

Module III: Mini Project

Processing and analysis of selected characterization techniques data using software.

(no. of lectures- 5)

TEXT/ REFERENCE BOOKS: -

1. Surface Analysis Methods in Materials Science: D. J. O. Conner (Springer Verlag).
2. Surface and Interfaces of Solids: H. Lueth (Springer).
3. Advanced Techniques for Materials Characterization: A. K. Tyagi, M. Roy, S. K. Kulshrestha, S. Banerjee (Materials Science Foundations-Trans Tech Publications).

Engg.

Physics

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DETAILS OF THE COURSE

Course Type	Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
PC	26PHPXXX	Advance Physics Lab	3	0	0	6	0

COURSE CONTENTS

Fabrication of Materials

1. Preparation of 3-D bulk materials (superconductor, ferromagnetic, ferroelectric) using solid state reaction method.
2. Synthesis of metal oxide particles by hydrothermal method.
3. Preparation of material/polymer composites using wet chemical method.
4. Determination of band gap of optical materials by UV-visible spectroscopy.
5. Determination of resistivity of Al and Cu thin film using four probe method (Van der Pauw method).
6. Determination of different modes of a Raman active material.
7. Determination of electrochemical activity of energy materials by electrochemical techniques.
8. Measurement of pressure, strain and torque using strain gauge.
9. Measuring change in resistance of Light Dependent Resistor (LDR) with light.
10. Measurement of displacement using Linear Variable Differential Transformers (LVDT).
11. Measurement of force and pressure using load cells.
12. Measurement of displacement using inductive transducer and capacitive transducer.
13. Measurement of Temperature using Temperature Sensors/RTD To study the performance characteristics of an analog PID controller
14. Measurement of magnetic field and current using Hall effect sensors.

TEXT BOOKS/ REFERENCE BOOKS: -

1. Nanotechnology: Principles and Practices; S. K. Kulkarni, 3rd edition, Springer, 2014.
2. Polymer Synthesis and Characterization: A Laboratory Manual; S. S. Sandler et al. 1998.
3. Essentials of Inorganic Materials Synthesis; CNR Rao, K. Biswas, John Wiley & Sons, 2015
4. Rangan C S, Sharma G R and Mani V S V, "Instrumentation Devices and Systems", 2nd Ed., Tata McGraw-Hill (2008)
5. Doebelin E O and Manik D N, "Measurement Systems", 5th Ed., Tata

- McGraw-Hill (2008)
6. Cooper W D and Helfrick A D, “Modern Electronic Instrumentation and Measurement Techniques”, Pearson Education (2008).
 7. Anand M M S, “Electronic Instruments and Instrumentation Technology”, Pearson Education (2008).
 8. Nakra B C and Chaudhry K K, “Instrumentation Measurements & Analysis” McGraw Hill (2002).
 9. Sayer M and Mansingh A, “Measurement, Instrumentation & Experiment Design in Physics & Engineering”, PHI (1999).

मालवीय राष्ट्रीय प्रौद्योगिकी संस्थान जयपुर
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

गणित विभाग
DEPARTMENT OF MATHEMATICS

पाठ्यक्रम कार्यशाला
CURRICULUM WORKSHOP

13 जुलाई, 2026
13th July, 2026



गणित एवं कंप्यूटिंग में बी.टेक. (प्रथम एवं द्वितीय वर्ष)
B.Tech. in Mathematics and Computing
(First and second year)

प्रस्तावित पाठ्यक्रम
PROPOSED CURRICULUM

जुलाई 2026
July 2026

Semester-I

S. No.	Code	Course Title	L-T-P	Credits	Type
1.		Mathematics-I	2-1-0	3	IC
2.		Physics		3	IC
3.		Physics Lab		1	IC
4.		Python Programming+ Lab		3	IC
5.		Environmental Science		1	IC
6.		Soft Skills Foundation Lab		1	IC
7.		Ethics and Human Values		1	IC
8.		Engg. Drawing and Sketching Lab		1	IC
9.		Discrete Mathematics for Computing	3-0-0	3	PC
10.		Problem Solving with C	2-0-0	2	PC
11.		Problem Solving with C Lab	0-0-2	1	PC
			Total Credits	20	

Semester-II

S. No.	Code	Course Title	L-T-P	Credits	Type
1.		Mathematics-II	2-1-0	3	IC
2.		Makers Lab (ME+EE+ECE)		6	IC
3.		Data Science/ Analytics/Visualization		2	IC
4.		Real Analysis	3-1-0	4	PC
5.		History of Mathematics and Computing	1-0-0	1	PC
6.		Data Structures and Algorithms	3-0-0	3	PC
7.		Data Structures and Algorithms Lab	0-0-2	1	PC
			Total Credits	20	

Mathematics – I

COURSE OBJECTIVE(s)

This course aims to familiarize and equip the students with fundamental knowledge of Calculus. The learned knowledge would enable the students to tackle standard engineering problems.

COURSE OUTCOMES

CO1	Learn the concepts related to differential calculus of functions of several variables and analyze multivariable functions to evaluate partial derivatives, approximate local errors.
CO2	Learn the concept and methods of evaluating multiple integrals and their applications to various problems
CO3	Understand vector fields and apply differential and integral vector theorems to solve real-world physical and engineering problems

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S.No.	Component	Weightage
(a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
(b)	Mid-term examination	30%
(c)	End Semester Examination	50%

Mathematics-I					
Prerequisite: None		L	T	P	C
Total hours: 28		2	1	0	3
Course Content					Hrs.
Unit 1	Differential Calculus: Review of calculus of one variable and ϵ - δ definition, functions of several variables, Limit, Continuity, Partial derivatives, Euler's theorem on homogeneous functions, Chain rule, Jacobians, Taylor's theorem for two variables (Statement only), Error approximations.				10
Unit 2	Integral Calculus: Double and Triple integrals, Change of order of integration. Change of variables. Improper Integrals(Gamma and Beta functions).				8
Unit 3	Vector Calculus: Differentiation of vectors, gradient, directional derivative, divergence, curl and their physical meaning. Identities involving gradient, divergence and curl, Line and surface integrals, Green's, Gauss and Strokes' theorem (Statement only) and their applications				10

Text Books	
1.	Kreyszig E., Advanced Engineering Mathematics, 10th Edition, Wiley, 2011.
2.	Hass J., Heil C. and Weir M. D., Thomas' Calculus, 14th Edition, Pearson Education, 2018.
Reference books	
1.	Jain R. K. and Iyengar S. R. K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House, 2016.
2.	Zill D. G. and Wright W. S., Advanced Engineering Mathematics, 4th Edition, Viva, 2011.
3.	O'Neil P. V., Advanced Engineering Mathematics, 8th Edition, Cengage Learning, 2017.
4.	Grewal B.S., Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2021.

Discrete Mathematics for Computing						
Prerequisite: None			L	T	P	C
Total hours: 42			3	0	0	3
Course Content						Hrs
Unit 1	Logic: Syllogism in Nyay (Logic in India). Well-formed formula, interpretations, propositional logic, predicate logic, theory of inference for propositional logic and Proof techniques.					9
Unit 2	Set Theory: Review of Basic Set Operations, cardinality of a set, relations, equivalence relations, partially ordered sets, functions, countability. Halayudha commentary. Paravartya sutra method for division of polynomials, lattices and Boolean algebras.					9
Unit 3	Combinatorics: Permutations, combinations, Pigeon Hole principle, inclusion exclusion principle, recurrences, generating functions, partitions, Virahanka Fibonacci sequence, Recurrence relations, special numbers.					12
Unit 4	Group Theory: Modular Arithmetic, Kuttaka problem. Groups-Binary operation, and its properties, Definition of a group, Groups as symmetries, cyclic, dihedral, symmetric, matrix groups, Subgroups, Cosets, normal subgroups and quotient groups, Conjugacy classes, Lagrange's theorem, Historical evolution of algebra and symmetry: Bhaskara II, development of group theory, and applications in modern computing, Monoids. Introduction to rings and fields.					12
Course outcomes:						
• Apply the concepts of sets, relations, functions, logic, and proof techniques to solve discrete mathematical problems. • Use combinatorial methods and recurrence relations to analyze and solve computational problems. • Analyze algebraic structures such as groups, monoids, rings, and fields and their applications in computing. • Appreciate the historical development of discrete mathematics, including significant Indian contributions, and their relevance to modern computing.						
Text Books						
1.	Herstein I. N., Abstract Algebra. 3rd ed. John Wiley & Sons, 1996.					
2.	Tremblay J. P., and Manohar R., Discrete Mathematics with Applications to Computer Science. Tata McGraw-Hill, 1997.					

3.	Raju C. K., Cultural Foundations of Mathematics: The Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe in the 16th c. CE. Pearson Longman, 2007.
Reference books	
1.	Huth M., and Ryan M., Logic in Computer Science: Modelling and Reasoning about Systems. Cambridge University Press, 2004.
2.	Gallian J. A., Contemporary Abstract Algebra. 9th ed. Cengage Learning, Boston, 2017.
3.	Liu C. L., and Mohapatra D.P., Elements of Discrete Mathematics. 4th ed. Tata McGraw-Hill Education, 2012.
4.	Rosen K. H., Discrete Mathematics and Its Applications. 6th ed. Tata McGraw-Hill, 2007.
5.	Joseph G. G., The Crest of the Peacock: Non-European Roots of Mathematics. 3rd ed. Princeton University Press, 2011.

Problem Solving with C						
Prerequisite: None			L	T	P	C
Total hours: 28			2	0	0	2
Course Content					Hrs	.
Unit 1	Introduction: Problem-solving strategies, algorithms and flowcharts, introduction to C, structure of a C program, variables, constants, data types, operators, input/output statements, expressions and type conversion.					6
Unit 2	Decision Making and Iterative Constructs: Conditional statements, switch statement, loops (for, while, do-while), nested loops, break and continue statements, programming applications involving numerical and logical problems.					6
Unit 3	Functions and Arrays: User-defined and library functions, parameter passing, recursion, one-dimensional and two-dimensional arrays, searching and sorting algorithms, string handling using character arrays, introduction to modular programming.					7
Unit 4	Pointers and Structures: Pointers and pointer arithmetic, pointers with arrays and functions, structures and unions.					6
Unit 5	File Handling: File operations, dynamic memory allocation.					3
Course Outcomes:						
• Ability to develop algorithms and flowcharts to solve computational problems. • Write, compile, debug, and execute C programs using fundamental programming constructs. • Design modular programs using functions, arrays, pointers, and structures. • Apply file handling and dynamic memory allocation techniques to solve real-world programming problems. • Analyze and implement efficient solutions for mathematical and engineering applications with C.						
Text Books						
1.	J.R. Hanly and E.B. Koffman, <i>Problem Solving and Program Design in C</i> , Pearson					

	Education, 2016.
2.	B.W. Kernighan and D.M. Ritchie, <i>The C Programming Language</i> , Pearson Education, 1988.
Reference books	
1.	Dromey R.G., <i>How to solve it by computer</i> , Prentice-Hall International, 1982.
2.	B.S. Gottfried, <i>Programming with C</i> , McGraw-Hill Education, 2018.
3.	E. Balagurusamy, <i>Programming in ANSI C</i> , McGraw Hill Education, 2019.
4.	P. Deitel and H. Deitel, <i>C How to Program</i> , Pearson Education, 2016.

Problem Solving with C Lab				
Prerequisite: Basic Programming Skills	L	T	P	C
Total hours: 24	0	0	2	1
Course Content				
	Implementation of programs involving: - Algorithms and flowcharts - Basic input/output and arithmetic computations - Decision making and iterative programming - Number-theoretic and mathematical problems - Functions and recursive algorithms - Array manipulation, searching and sorting - String processing - Pointers and structures - File handling - Mini problem-solving assignments integrating multiple programming concepts.			
Course Outcomes: - Ability to develop algorithms and flowcharts to solve computational problems. - Write, compile, debug, and execute C programs using fundamental programming constructs. - Design modular programs using functions, arrays, pointers, and structures. - Apply file handling and dynamic memory allocation techniques to solve real-world programming problems. - Analyze and implement efficient solutions for mathematical and engineering applications with C.				
Text Books				
1.	J.R. Hanly and E.B. Koffman, <i>Problem Solving and Program Design in C</i> , Pearson Education, 2016.			
2.	B.W. Kernighan and D.M. Ritchie, <i>The C Programming Language</i> , Pearson Education, 1988.			
Reference books				

1.	Dromey R.G., How to solve it by computer, Prentice-Hall International, 1982.
2.	B.S. Gottfried, <i>Programming with C</i> , McGraw-Hill Education, 2018.
3.	E. Balagurusamy, <i>Programming in ANSI C</i> , McGraw Hill Education, 2019.
4.	P. Deitel and H. Deitel, <i>C How to Program</i> , Pearson Education, 2016.

Mathematics II

COURSE OBJECTIVE(s)

This course aims to familiarize and equip the students with fundamental knowledge of Matrix, Differential Equations, Laplace Transforms and Fourier Series. The learned knowledge would enable the students to tackle standard engineering problems.

COURSE OUTCOMES

CO1	Develop skills in solving systems of linear equations and diagonalization techniques to engineering problems.
CO2	Gain proficiency in analyzing and solving various first- and higher-order ordinary differential equations and systems of ODEs.
CO3	Master the various concepts of Laplace Transform and their applications to differential equations.
CO4	Learn the various concepts of Fourier Series and Fourier analysis to represent periodic functions.

COURSE ASSESSMENT

The Course Assessment (culminating to the final grade), will be made up of the following three components;

S.No.	Component	Weightage
(a)	Internal assessment (based upon assignments, quizzes and attendance)	20%
(b)	Mid-term examination	30%
(c)	End Semester Examination	50%

Mathematics-II					
Prerequisite: None		L	T	P	C
Total hours: 28		2	1	0	3
Course Content					Hrs.
Unit 1	Matrix Algebra: Row echelon form, Rank of a matrix, Solution of linear simultaneous equations, Eigenvalues and Eigenvectors of a matrix, Cayley- Hamilton theorem (Statement only), Diagonalization of a matrix.				8
Unit 2	Ordinary Differential Equations: Exact differential equations, Solution of second and higher order linear differential equations with constant coefficients using operator method, Cauchy-Euler equations. Reduction of order, Method of variation of parameters, Matrix method for system of linear differential equations.				8
Unit 3	Fourier Series: Fourier series and its convergence, Fourier series of even and odd functions, Fourier half-range series.				4
Unit 4	Laplace Transform: Laplace and inverse Laplace transform of some standard functions, Shifting theorems, Laplace transform of				8

	derivatives and integrals, Convolution theorem, Heaviside unit step function and Dirac delta function, Applications of Laplace transform.	
Text Books		
1.	Kreyszig E., Advanced Engineering Mathematics, 10th Edition, Wiley, 2011.	
2.	Zill D. G. and Wright W. S., Advanced Engineering Mathematics, 4th Edition, Viva, 2011.	
Reference books		
1.	Jain R. K. and Iyengar S. R. K., Advanced Engineering Mathematics, 5th Edition, Narosa Publishing House, 2016.	
2.	Strang G., Linear Algebra and its Applications, 4 th edition, Cengage Learning, 2006.	
3.	O'Neil P. V., Advanced Engineering Mathematics, 8th Edition, Cengage Learning, 2017.	
4.	Grewal B.S., Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2021.	

Real Analysis					
Prerequisite:		L	T	P	C
Total hours: 42		3	1	0	4
Course Content					Hrs.
Unit 1	Bounded subsets of $\mathbb{R}$, infimum, supremum, concept of infinity, completeness axiom, Archimedean property, Intervals, Finite, countable and uncountable sets, decimal expansion.				8
Unit 2	Sequences of real numbers, Subsequences, Monotone sequences, monotone convergence theorem, Limit infimum, Limit Supremum, Bolzano-Weierstrass theorem, Cauchy sequence, and completeness. infinite series, absolute convergence, tests for convergence, Cauchy criterion.				8
Unit 3	Limit and continuity of functions, sequential criterion for limit, Continuity and compactness, Continuity and connectedness, uniform continuity, Lipschitz function, continuous extension theorem.				8
Unit 4	Derivative, mean value theorems and applications, L'Hopital rule, Taylor's theorem, Indian contribution to find the series of π and trigonometric functions, Riemann integral, fundamental theorem of calculus, Darboux integral, improper integral.				10
Unit 5	Sequence of functions, pointwise and uniform convergence, Interchange of limits, series of functions, test for uniform convergence, Weierstrass-M test, power series, Weierstrass approximation theorem.				8
Text Books					
1.	Ross K.A., Elementary Analysis, Springer-Verlag New York, 2nd ed. 2013.				
2.	Bartle R. G. & Sherbert D. R., Introduction to Real Analysis (IV ed.), Wiley publications, 2011.				
Reference books					
1.	Rudin W., Real and Complex Analysis, McGraw Hill Education (India), 2023.				
2.	Bali N. P., Real Analysis, New Age International Private Limited, 2nd Ed., 2023.				
3.	Ghorpade S.R. and Limaye B.V., A course in calculus and real analysis. Undergraduate Texts in Mathematics. Springer, New York, 2 nd Ed., 2018.				
4.	Carothers N. L., Real Analysis, Cambridge University Press, 2000.				
5.	Apostol T. M., Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.				

6.	Goldberg R.R., Methods of Real Analysis, Oxford & IBH Publishing Co. Pvt Ltd, 1970.
7.	Raju C. K., Cultural Foundations of Mathematics, Pearson Longman, 2007.

History of Mathematics and Computing						
Pre-requisite: None			L	T	P	C
Total hours: 14			1	0	0	1
Course Content						Hrs
Unit 1	Mathematics: Introduction to Indian Mathematics, place-value system. Clock and time calculation.					6
Unit 2	Śulba Sūtras, concept of Śūnya and Ananta, value of Pi, an introduction to geocentric astronomy and trigonometry, binary mathematics and combinatorial problems					8
Text Books						
1.	Plofker K., Mathematics in India, 500 BCE-1800 CE, Princeton University Press, New Jersey, 2009.					
2.	Raju C.K., Cultural Foundations of Mathematics: The Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe in the 16th CE, Pearson education, 2007					
3.	Williams M.R., A history of computing technology, John Wiley & Sons, 1997					
4.	Davis M., The universal computer: The road from Leibniz to Turing, AK Peters/CRC Press, 2018					
Reference books						
1.	Jhunjhunwala A., Indian Mathematics - An Introduction, New Age International (P) Ltd, 1993.					
2.	Gupta R., Ancient Indian Mathematics Historical and Cultural Highlights, NCERT, India, 1997.					
3.	Bhanu Murthy T.S., A Modern Introduction to Ancient Indian Mathematics, New Age International Pvt Ltd Publishers, 2009.					
4.	Datta B. and Singh A.N., History of Hindu Mathematics: A Source Book, Asia Publishing House, 1962.					

Data Structures and Algorithms					
Pre-requisite: None		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs.
Unit 1	Fundamentals of Data Structures, Memory Allocation, Abstract Data Types, Asymptotic Notations, Arrays, Lists Stack Implementation, Stack applications. Queue Implementation, Sequential, Circular, and Dequeue representation, Dynamic Queue implementation, Queue applications.				8
Unit 2	Searching and Sorting: Linear and Binary search, Bubble Sort, Selection Sort, Insertion Sort, Merge sort, Quick sort, Counting sort, Bucket sort, Radix sort, Heap sort, Comparisons of sorting algorithms.				8
Unit 3	Hashing and Hash Tables: Hash functions, Open and closed hashing, Dynamic and extendible hashing, Hash collision, chaining, Hash Tables and Probing Techniques.				8
Unit 4	Trees: Binary Tree and its representations, Tree traversal, Binary Search Tree, Threaded binary trees, Representing list as binary trees, Dynamic implementation of Binary tree and AVL tree, Tree applications, Interval tree, M-way search Tree, B-Tree and its variants, B+ Tree, Heaps and its applications.				10
Unit 5	Graphs Algorithms: DFS and BFS, Dijkstra and Prim's algorithms. Introduction to advanced data structures such as advanced lists, n-ary Tree, Self-Balancing BSTs, Trie Segment tree, Binary indexed tree, Suffix array and suffix tree, K-dimensional tree, Disjoint set and so on.				8
Course Outcomes • Develop a solid understanding of fundamental data structures such as arrays, linked lists, trees, and graphs, and their associated algorithms for insertion, deletion, and traversal. • Analyze and compare the time and space complexity of different data structures and algorithms, and make informed decisions for algorithm selection based on problem requirements. • Understand data structures and algorithms to solve computational problems efficiently, and design and implement algorithmic solutions for common programming tasks. • Collaborate with peers to solve programming challenges and algorithmic puzzles, and effectively communicate solutions and					

insights.	
Text Books	
1.	Cormen T., Lieserson C., Rivest R., and Stein C., Introductions to Algorithms, Prentice-Hall/India, 3rd edition, 2009
2.	Tenenbaum A.M, Langsam Y., Augenstein M.J., Data Structures Using C, 2019
Reference Books	
1.	Cormen T., Leiserson C., Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, PHI, 2nd Edition, 2023.
2.	Sahni S., Data Structures, Algorithms, And Applications in C++, Silicon Pr, 2004.
3.	Aho A.V., Hopcroft J.E., Ullman J.D., Data Structures and algorithms, Pearson, 1982.
4.	Anany L., Introduction to design & Analysis of Algorithms, 3 rd Edition, Pearson, 2017.

Data Structures and Algorithms Lab							
Pre-requisite: Basic Programming Skills				L	T	P	C
Total hours: 24				0	0	2	1
Course Content							Hrs.
The following topics are broad areas. The instructor offering the course in consultation with the theory offered can adopt further variations in tune with concerned theory courses.							
1.	Arrays and Linked List: Creation of arrays, singly, double and circular linked list and performing various operations on them (updating/adding/deletion an element in the begin/middle/end of the list).						2
2.	Stack and Queue: Programs involving implementations and applications of stacks and queues (array and linked list implementations, Dynamic Queue implementation, applications like balanced brackets problem, infix to postfix conversion).						2
3.	Searching: Linear Search, Binary Search, Median Search, Hash Table.						2
4.	Sorting: Bubble, Merge, Quick, Radix, Bucket, and Count; Time and Space, creation of heap from the given list of elements, conversion of min heap to max heap (and vice versa), heap-sort						4
5.	Complexity analysis of searching and sorting algorithms.						4
6.	Non-Linear Data Structure: Binary Tree, K-ary Tree, Binary Search Tree, Threaded Tree, AVL Tree, B Tree, B+ Tree, Priority Queue using Binary Heap.						6
7.	Graph: Adjacency Matrix and List; Graph Traversal using DFS and BFS						4
Course Outcomes							
- Gain practical experience in implementing data structures and algorithms through hands-on laboratory exercises and programming assignments. - Implement and analyze the performance of fundamental data structures such as arrays, linked lists, stacks, queues, trees, and graphs, using programming languages. - Design and implement algorithmic solutions to various computational problems, and evaluate their efficiency and correctness through experimentation and analysis. - Demonstrate proficiency in implementing and evaluating data structures and algorithms using programming languages and development environments commonly used in the field.							
Text Books							
1.	Cormen T., Lieserson C., Rivest R., and Stein C., Introductions to Algorithms, Prentice-Hall/India, 3rd edition, 2009						

2.	Tenenbaum A.M., Langsam Y., Augenstein J.M., Data Structures Using C, 2019
Reference Books	
1.	Thomas H.C., Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, PHI, 2nd Edition, 2023
2.	Sahni S., Data Structures, Algorithms, And Applications In C++, Silicon Pr, 2004.
3.	Aho A.V., Hopcroft J.E., Ullman J.D., Data Structures and algorithms, Pearson, 1982

Semester-III

S. No.	Code	Course Title	L-T-P	Credits	Type
1.		Soft Skill Advanced Lab		1	IC
2.		Design thinking for Innovation		2	IC
3.		Linear Algebra	3-0-0	3	PC
4.		Graphs and Matrices	3-0-0	3	PC
5.		Linear Algebra Lab	0-0-2	1	PC
6.		Numerical Methods and Computations	3-0-0	3	PC
7.		Numerical Methods and Computations Lab	0-0-2	1	PC
8.		Design and Analysis of Algorithms	3-0-0	3	PC
9.		Design and Analysis of Algorithms Lab	0-0-2	1	PC
10.		Digital Systems and Computer Architecture	3-0-0	3	EAS
			Total Credits	21	

Semester-IV

S. No.	Code	Course Title	L-T-P	Credits	Type
1.		Engg. Economics		3	IC
2.		Probability and Stochastic Process	3-0-0	3	PC
3.		Complex Analysis	3-1-0	4	PC
4.		Differential Equations	3-1-0	4	PC
5.		Optimization Methods and Applications	3-0-0	3	PC
6.		Optimization Methods and Applications Lab	0-0-2	1	PC
7.		Theory of Computation	3-0-0	3	EAS
			Total Credits	21	

Linear Algebra						
Pre-requisite: None			L	T	P	C
Total hours: 42			3	0	0	3
Course Content						Hrs.
Unit 1	Introduction: Algebra in ancient India. Review of set theory and fields. Vector spaces and subspaces, linear independence and dependence, spanning set, basis and its existence, sums and direct sum of subspaces.					10
Unit 2	Linear transformations: Linear transformations and their basic properties, Rank-Nullity theorem and its consequences, ordered basis, coordinate matrix, change of basis, matrix representation of a linear transformation, vector space of linear transformations, linear functional.					8
Unit 3	Inner product spaces: Cauchy-Schwartz inequality, orthogonality, Gram-Schmidt orthogonalization, orthonormal basis, QR-factorization, least square approximation, best approximation, orthogonal complement, Adjoint of an operator, Hermitian, unitary and normal operators.					12
Unit 4	Eigenvalues and Eigenvectors of a linear operator: Characteristic polynomials, minimal polynomials, Cayley Hamilton's theorem for operators, Schur's theorem (Statement Only), diagonalizability, Spectral theorem for normal operators, Singular Value Decomposition.					12
Course Outcomes - Understand the concepts of vector spaces, subspaces, bases, dimension and their properties. - Relate matrices and linear transformations, compute Eigen values and Eigen vectors of linear transformations and use these notions in diagonalization. - Learn properties of inner product spaces and properties of some special operators on such spaces. - Learn to apply geometric and algebraic notions of linear algebra to determine best approximations in vector spaces.						
Text Books						
1.	Axler S., Linear Algebra Done Right, Springer UTM, 1997.					
2.	Anton H., Rorres C., Elementary Linear Algebra: Applications, 11th edition, Wiley, 2013.					
Reference Books						
1.	Strang G., Linear Algebra and Its Applications, 4 th edition, Cengage Learning,					

	2006.
2.	Hoffman K. and Kunze R., Linear Algebra, 2 nd edition, PHI Learning, 2009.
3.	Lang S., Introduction to Linear Algebra, 2 nd Edition, Springer India, 2005.
4.	Kumaresan S., Linear Algebra: A Geometric Approach, PHI Learning, 2000.
5.	VaradarajanV. S., Algebra in ancient and modern times, American Mathematical Soc., 1998

Graphs and Matrices						
Prerequisite: Mathematics II			L	T	P	C
Total hours: 42			3	0	0	3
Course Content					Hrs	.
Unit 1	Graphs: Vertex degrees, isolated/pendant vertices, and the Handshaking Lemma, walks, trails, Paths, Cycles, connectivity, special types of graphs, subgraphs, isomorphism, trees and their properties, Spanning tree and minimum number of spanning trees, Eulerian and Hamiltonian graphs					12
Unit 2	Matrices: Eigenvalues of symmetric matrices, Generalized Inverse, Moore Penrose Inverse, Schur Complement, Interlacing Inequality, Weyl's Inequality, Positive Definite and Positive Semi-Definite Matrices					6
Unit 3	Representation of graphs: Incidence matrix, Matchings in bipartite graphs, Adjacency Matrix, Eigenvalues of some special graphs, Determinant, Bounds, Energy of a graph, Anti-Adjacency matrix of a directed graph, Non-singular trees					8
Unit 4	Laplacian matrix: Basic properties, Computing Laplacian Eigenvalues, Matrix-tree theorem, Bounds of Laplacian spectral radius, Signless Laplacian matrix, Regular graphs, strongly regular graphs, and the friendship theorem, Graph with maximum Energy					8
Unit 5	Algebraic connectivity: Classification of trees, Monotonicity properties of Fielder vector, Bounds of algebraic connectivity. Distance matrix of a graph, Distance and Laplacian matrix of a tree.					8
Text Books						
1.	R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory, Springer, 2000.					
2.	R. A. Horn and C. R. Johnson, Matrix Analysis, Second Edition, Cambridge University Press, 2012.					
3.	R. Bapat, Graphs and Matrices, Text and Readings in Mathematics, Second Edition, Hindustan Book Agency, New Delhi, 2014.					
Reference books						
1.	J. M. Aldous. Graphs and Applications. Springer, LPE, 2007.					
2.	J. A. Bondy and U. S. R. Murty. Graph Theory with Applications. North-Holland, 1976.					
3.	West D. B., Introduction to Graph Theory, Second Edition, Pearson, 2001.					
4.	R. J. Wilson, Introduction to Graph Theory, Fourth Edition, Prentice Hall, 1996.					
5.	D. R. Cvetkovic, S. Simic, An introduction to the theory of Graph Spectra, First Edition, Cambridge University press, 2010.					

6.	N. Biggs, Algebraic Graph Theory, Second Edition, Cambridge University press, 1993.
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Linear Algebra Lab						
Prerequisite: Nil			L	T	P	C
Total hours: 24			0	0	2	1
Lab	Lab Session Topic					Hrs.
1	Introduction to programming language setup; matrix operations and norms.					4
2	Solving $AX = B$; normal forms					2
3	Encoding through matrices: Inverse and determinants					2
4	Linear transforms from R^n to R^m and computer graphics					2
5	Coordinates and Matrix representation of a linear transformation					2
6	Introductory Image processing through matrices					2
7	Inner product spaces, orthogonality and Gram-Schmidt					2
8	Eigenvalues and Eigenvectors: Applications					2
9	Diagonalisation and Quadratic forms					2
10	Singular Value Decomposition and its applications					2
12	Adjacency matrices					2
Course Outcomes: • Apply matrix operations and solve systems of linear equations using appropriate matrix methods. • Analyze linear transformations, vector spaces, and orthogonality in computational problems. • Compute eigenvalues, eigenvectors, diagonalization, and singular value decomposition for practical applications. • Apply linear algebra concepts to computer graphics, image processing, data representation, and graph modeling.						
Text Books						
1.	Axler S., Linear Algebra Done Right, Springer UTM, 1997.					
2.	Anton H., Rorres C., Elementary Linear Algebra: Applications, 11th edition, Wiley, 2013.					
Reference Books						
1.	Strang G., Linear Algebra and Its Applications, 4 th edition, Cengage Learning, 2006.					
2.	Hoffman K. and Kunze R., Linear Algebra, 2 nd edition, PHI Learning, 2009.					

3.	Lang S., Introduction to Linear Algebra, 2 nd Edition, Springer India, 2005.
4.	Kumaresan S., Linear Algebra: A Geometric Approach, PHI Learning, 2000.
5.	VaradarajanV. S., Algebra in ancient and modern times, American Mathematical Soc., 1998

Numerical Methods and Computations						
Prerequisite: Mathematics - II, Real Analysis			L	T	P	C
Total hours: 42			3	0	0	3
Course Content					Hrs	
Unit 1	Errors in Numerical Computations: Representation of numbers in computers and their accuracy, floating point arithmetic, Machine epsilon, errors in computations, types of errors, propagation of errors, conditioning and stability of numerical computations, approximations of functions: Taylor's series.					6
Unit 2	Solution of Simultaneous Linear Equations: Direct methods: Gauss and Gauss-Jordan elimination method, Pivoting strategies, LU-decomposition, Operations count. Iterative methods: Jacobi and Gauss-Seidel iteration methods. Review of vector and matrix norms, condition number, and convergence analysis.					8
Unit 3	Numerical Solution of Algebraic and Transcendental Equations: Iterative algorithms: Ancient Indian Algorithms for Square Root Computation, Bisection method, Secant method, Newton-Raphson method, and Fixed-point iteration, Convergence and error analysis, Multiple Roots. Solution of a system of nonlinear equations using Newton's method.					8
Unit 4	Numerical Interpolation: Forward, backward and central differences operators, Second difference approximations in Ancient Indian Astronomy, Newton's forward and backward difference interpolation formulae. Central difference formulae: Gauss, Stirling, and Bessel's formula. Lagrange's and Newton's divided difference interpolation formulae, Error in polynomial interpolation. Hermite and Cubic-spline interpolation.					11
Unit 5	Numerical Differentiation and Integration: Numerical differentiation through an interpolating polynomial, the Method of Undetermined Coefficients. Numerical integration: Newton-Cotes formulae, Error estimates. Romberg integration and Gaussian quadrature. Extension to multiple integrals.					9
Course Outcomes:						
• Understanding of fundamental numerical methods for solving mathematical problems (linear and nonlinear equations) approximately. • Demonstrate proficiency in applying numerical techniques to analyze and approximate tabulated functions. • Ability to examine the accuracy and efficiency of numerical algorithms and						

computations. • Utilize numerical methods to evaluate numerical differentiation and integration of functions	
Text Books	
1.	Burden R. L. and Faires J. D., Numerical Analysis, 9th Edition, Cengage Learning, 2011.
2.	Jain M.K., Iyengar S.R.K., and Jain R.K., Numerical Methods for Scientific and Engineering Computation, Wiley Eastern Limited, 2012.
Reference books	
1.	Gerald C.F and Wheatly P.O., Applied Numerical Analysis, Seventh Edition, Pearson Addison-Wesley Pub. Co, 1985.
2.	Kincaid D.R. and Cheney W., Numerical Analysis: Mathematics of Scientific Computing, Third Edition, AMS, Providence, Rhode Island, 2002.
3.	Sastry S.S., Introductory Methods of Numerical Analysis, Prentice Hall of India, 2012.
4.	Sharma J.N., Numerical methods for Engineers and Scientists, 2nd edition, Narosa Publishing House, New Delhi, 2008.
5.	Divakaran P. P., The Mathematics of India: Concepts, Methods and Connections, Springer (with Hindustan Book Agency, New Delhi), 2018.

Numerical Methods and Computations Lab						
Prerequisite: Mathematics-II, Real Analysis			L	T	P	C
Total hours: 24			0	0	2	1
Course Content					Hrs.	
Exp. 1	Introduction to Programming Language/Package.					4
Exp. 2	Comparing root-finding algorithms through programming.					4
Exp. 3	Rounding-off errors in direct solvers for linear system of equations.					2
Exp. 4	Exploring convergence of iterative methods for solving linear systems.					2
Exp. 5	Analyzing interpolation through finite differences.					2
Exp. 6	Analyzing interpolation through finite differences: Equi-spaced data.					2
Exp. 7	Cubic spline interpolation.					4
Exp. 8	Numerical approximation of derivatives using finite differences.					2
Exp. 9	Numerical methods for approximating integrals.					2
Note: The course coordinator may decide upon programming language/package and may provide a list of experiments at the start of the semester based on the above list.						
Course Outcomes: • Demonstrate proficiency in implementing and testing numerical algorithms using computational software. • Analyze numerical errors and assess the accuracy of computational solutions. • Utilize iterative techniques to solve linear and nonlinear equations. • Apply numerical methods to solve a variety of mathematical problems, including interpolation, numerical differentiation and integration						
Reference Books						
1.	Chapra S., Applied Numerical Methods with MATLAB for Engineers and Scientists, 7th edition, McGraw Hill publications, 2019.					
2.	Vetterling W.T., Flannery B.P., Press W.H., Teukolsky S., Numerical Recipes in C: The Art of Scientific Computing, 3 rd Edition, Cambridge University Press, 2007.					
3.	Pratap R., Getting Started with MATLAB: A Quick Introduction for Scientists and Engineers, 7th edition, 2016.					
4.	Lindfield G., and Penny J., Numerical Methods Using MATLAB, 4th edition, Academic Press, 2019.					
5.	Bayen A., Kong Q., and Siau T., Python Programming and Numerical Methods:					

	A Guide for Engineers and Scientists,
6.	Solomon J., Numerical Algorithms: Methods for Computer Vision, Machine Learning, and Graphics, CRC Press, 2015.

Design and Analysis of Algorithms						
Prerequisite: Data Structures and Algorithms			L	T	P	C
Total hours: 42			3	0	0	3
Course Content						Hrs
Unit 1	Algorithm Analysis: Asymptotic notation, model of computation, time and space complexities, average and worst-case analysis, Master's Theorem, solving recurrence equations- iteration method, substitution, recursion tree, master method. Amortised Analysis. Linear Search, Insertion Sort, Euclid's Algorithm for finding GCD (Lame's Theorem): Correctness, Best-Case, Average-Case and the Worst-Case Running Time Analysis. Permutation Model for Average-Case Analysis of an Algorithm for Finding the Maximum Element in an Array.					12
Unit 2	Divide and Conquer: General recurrence and methods for obtaining bounds on given recurrence. Binary Search, Merge Sort, and Maximum Subarray Sum Problem. Quick-sort: Correctness, Running Time Analysis, Order statistics - finding median and Worst-case Linear Time Algorithm for Selection Problem. Max-Min problem, Strassen's Algorithm for Matrix Multiplication, Karatsuba's Algorithm for Large Integer Multiplication.					6
Unit 3	Dynamic Programming Approach: Introduction to dynamic programming - principal of optimality, Optimal substructure. Matrix Chain Multiplication Problem, Optimal Binary Search Tree Problem, Longest Common Subsequence Problem, 0/1 Knapsack Problem. Greedy Approach: Elements of Greedy Strategy - Greedy choice property, optimal substructure. Example Problems - Activity Selection Problem, Fractional Knapsack Problem, Huffman codes, Travelling Salesman Problem.					8
Unit 4	Graph Algorithms: Graph Traversal Algorithms (BFS, DFS), Shortest path algorithms (Bellman-Ford, Dijkstra's, Transitive-Closure, Floyd-Warshall), minimum spanning tree algorithms (Kruskal, Prim), Network-flow (Ford-Fulkerson), applications of DFS:- biconnectivity, topological sort, strongly-connected components, Articulation point.					8
Unit 5	Backtracking: Introduction to Backtracking, Enumerating Independent Sets of a Graph, Graph Colouring Problem and N-Queens Problem. Complexity Classes: P, NP, NP-Hard and NP-Complete. NP-Complete. Examples with Reductions, Satisfiability, Clique, Independent Set, Vertex Cover, Graph Colouring, Dominating Set.					6
Course Outcomes:						

• Develop a comprehensive understanding of algorithm design paradigms such as divide and conquer, dynamic programming, and greedy algorithms. • Analyze the time and space complexity of algorithms using mathematical techniques such as running time analysis. • Apply algorithm design techniques to solve computational problems across various domains. • Design and implement algorithms for optimization problems, graph algorithms, and backtracking.	
Text Books	
1.	Cormen T.H., Leiserson C.E., Ronald L. Rivest and Clifford Stein, Introduction to Algorithms, Third Edition, PHI, 2009.
2.	Horowitz E., Sahni S. and Rajasekaran S., Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2011.
Reference books	
1.	Goodrich M.T. and Tamassia R., Algorithm Design: Foundations, Analysis and Internet Examples, Second Edition, Wiley-India, 2006.
2.	Michael R. and David S., Computers and Intractability: A Guide the theory of NP Incompleteness, W.H. Freeman & Co., 1979.
3.	Herbert S. Wilf, Algorithms and Complexity, AK Peters Ltd., 2003.
4.	Kleinberg J. and Tardos E., Algorithm Design. Addison-Wesley Longman Publishing Co., Inc., USA, 2005.

Design and Analysis of Algorithms Lab					
Pre-requisite: Data Structures and Algorithms		L	T	P	C
Total hours: 40		0	0	4	2
Course Content					
1.	Implementation of various sorting and searching algorithms (Revision), Implement quick sort with three different positions of pivot element- first, last, random Implement Tree traversal, and graph traversal (recursive algorithms), Implement deterministic and randomized selection problem Implement maximum subarray sum problem Implement Karatsuba`s Algorithm for Large Integer Multiplication Implement matrix chain multiplication, longest common sub-sequences, 0/1 knapsack A program to obtain the topological ordering of vertices in a given digraph. Implement travelling salesman problem. Print all the nodes reachable from a given starting node in a digraph using BFS method. Check whether a given graph is connected or not using DFS method. Find minimum cost spanning tree of a given undirected path using a Prim`s algorithm. From a given vertex in a weighted connected graph, find shortest paths to other vertices using Dijkstra`s algorithm.				
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Course Outcomes					
- Gain practical experience in designing and analyzing algorithms through laboratory exercises and programming assignments. - Implement and evaluate algorithmic solutions to various computational problems using programming languages. - Analyze the time and space complexity of algorithms through empirical analysis and theoretical calculations, and compare different algorithmic approaches. - Collaborate with peers to design and implement algorithmic solutions to programming challenges and real-world problems, and communicate findings and insights effectively.					
Text Books					

1.	Cormen T.H., Leiserson E., Rivest R.L. and Stein C., Introduction to Algorithms, Third Edition, PHI, 2009.
2.	Horowitz E., Sahni S. and Rajasekaran S., Fundamentals of Computer Algorithms, Second Edition, Universities Press, 2011.
Reference Books	
1.	Goodrich M.T. and Tamassia R., Algorithm Design: Foundations, Analysis and Internet Examples, Second Edition, Wiley-India, 2006.

Digital Systems and Computer Architecture					
Pre-requisite: None		L	T	P	C
Total hours: 40		3	1	0	4
Course Content					Hrs.
Unit 1	Boolean Algebra and Logic Gates: Basic definition, Axiomatic Definition, Basic theorem and Properties of Boolean Algebra, Minterms and Maxterms, Logic Operations, Digital logic gates IC, digital logic families.				6
Unit 2	Simplification of Boolean functions: Different types map method, product of sum simplification, NAND or NOR implementation, Don't care condition, Tabulation method, Adder, subtractor, Code Conversion, Universal Gates.				6
Unit 3	Sequential Logic: Flip-flops, Triggering of Flip-flops, Analysis of clocked sequential circuits, State reduction and Assignment, Flip-flop excitation, Design of counters, Design with state equations.				6
Unit 4	Basic Computer Organization and Design: Instruction codes, Computer registers, Computer instructions, Addressing modes, Timing and Control, Instruction cycle, Memory-Reference Instructions, Input-output and interrupt. Design of Basic computer, Design of Accumulator Unit.				8
Unit 5	Programming the Basic Computer: Introduction, Machine Language, Assembly Language, the Assembler. Programming Arithmetic and logic operations. Subroutines. I-O Programming.				7
Unit 6	Central Processing Unit: Introduction, General Register Organization, Stack Organization, Instruction format. Addressing Modes, Data transfer and manipulation. Program Control, Reduced Instruction Set Computer (RISC). Pipelining, Parallel Processing.				7
Course Outcomes					
- Understand the fundamental principles of digital systems and computer architecture, including sequential logic, Boolean algebra, and basic of computer organization and design. - Analyze and design digital systems using combinational and sequential logic components, and understand their role in modern computer architecture. - Explore advanced topics in computer architecture, such as pipelining, addressing modes, and parallel processing, and their impact on system performance and efficiency.					

Design and implement computer architecture components such as processors, memory subsystems, and I/O programming.	
Text Books	
1.	Mano, Morris M., Computer system architecture. Prentice-Hall, Inc., 1993.
2.	Mano, Morris M., Digital logic and computer design, PHI, 2004
Reference Books	
1.	Tanenbaum A.S., Structured Computer Organization, 2016.
2.	Stallings, Computer Organization, Computer Organization & Architecture 7e, 2008.
3.	Hayes J., Computer Architecture and Organization, 2007.
4.	Hwang K., Advanced Computer Architecture, 2003.

Probability and Stochastic Processes						
Pre-requisite: None			L	T	P	C
Total hours: 42			3	0	0	3
Course Content						Hrs
Unit 1	Historical development of probability: Early concepts of counting, chance and uncertainty; combinatorial foundations in Pingala's Chandashastra, Meru Prastara (Pascal's Triangle), Hemachandra sequence, and Narayana Pandita's combinatorial methods; emergence of probability theory through the correspondence between Pascal and Fermat, leading to Kolmogorov's axiomatic framework. Probability: Classical and axiomatic definitions of probability, addition rule, conditional probability, multiplication rule, total probability, and Bayes' theorem.					7
Unit 2	Random Variables: Discrete, continuous, and mixed random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments, and moment generating function,					7
Unit 3	Special Distributions: Discrete: uniform, binomial, negative binomial, hypergeometric, Poisson. Continuous: Uniform, Exponential, Weibull, Normal. Historical evolution of probability distributions and statistical thinking, including Indian contributions to combinatorial enumeration and the emergence of probability models in science and engineering.					10
Unit 4	Pairs of Random Variables: Joint Cumulative Distribution Function, Joint Probability Mass Function(PMF), Marginal PMF, Joint Probability Density Function, Marginal PDF, Functions of two random variables, expected values, Conditioning by an event, and conditioning by Random Variables.					8
Unit 5	Stochastic Process: Classification and properties of stochastic processes, Stationary process, Markov process, Poisson process, Birth and death process, The Brownian motion process, Expected value and Correlation.					10
Course Outcomes						
- Understand and analyze the theoretical and practical aspects of the theoretical distributions of random variables. - Identify an appropriate theoretical distribution to fit the empirical data and find out the properties of the data. - Understand and apply the concept of stationarity to the stochastic processes in						

various contexts.	
Text Books	
1.	Ross S.M., Introduction to Probability and Statistics for Engineers and Scientists, Academic Press, 2014.
2.	Papoulis A. and Pillai S.U., Probability, Random Variables and Stochastic Processes, 4th edition, McGraw-Hill, 2002.
Reference books	
1.	Medhi J., Stochastic Processes, New Age International Publishers, 2009.
2.	Chung K.L. and Ait Sahlia F., Elementary Probability theory: With Stochastic Processes and an Introduction to Mathematical Finance, Springer, 2010.
3.	Gupta S. C. and Kapoor V. K., Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2014.
4.	Veerajan T., Probability, Statistics and Random Processes, Tata McGraw-Hill, 2017.
5.	Raju C.K., Cultural Foundations of Mathematics, Pearson Longman, 2007.
6.	Montgomery D. C. and Runger G. C., Applied Statistics and Probability for Engineers, 7th Ed., John Wiley & Sons, 2018.

Complex Analysis						
Pre-requisite: Real analysis			L	T	P	C
Total hours: 42			3	1	0	4
Course Content						Hrs
Unit 1	Historical development of complex analysis: Contributions of Brahmagupta and Bhāskara II to algebra and the theory of equations; transmission of methods for solving polynomial equations from India to Arabia and Europe; evolution of complex numbers through Cardano, Bombelli, Euler, and Gauss, leading to the development of the complex plane and its applications. Complex numbers and elementary properties, polar representation, stereographic projection, functions of a complex variable, graphical representation, single-valued and multi-valued functions, elementary complex functions and inverse functions, topology of the complex plane, and completeness.					8
Unit 2	Limits, continuity and differentiation, Cauchy-Riemann equations, holomorphic and harmonic functions, harmonic conjugate, analytic functions, power series, holomorphicity of power series, Line Integrals, and Green's Theorem.					8
Unit 3	ML-inequality, Cauchy-Goursat theorem, Cauchy's integral formula, Taylor series, Morera's theorem, Liouville's theorem, mean value property, maximum modulus principle,. Historical evolution of complex function theory.					8
Unit 4	Zeros of analytic functions, Fundamental theorem of algebra, classification of singularities, Laurent series, residues, Cauchy's Residue theorem and applications in solving improper real integrals, application to inverse Laplace transform, Rouché's theorem (statement only) and argument principle (statement only).					10
Unit 5	Conformal maps, standard transformations, bilinear transformations, group properties, automorphism, cross-ratio theorem, fixed points, simple bilinear transformations, Riemann mapping theorem (statement only), Schwarz-Christoffel transformation, Poisson integral for circle and plane, Dirichlet problem.					8
Course Outcomes						
- Represent complex numbers algebraically and geometrically - Analyze limit, continuity and differentiation of functions of complex variables.						

• Understand Cauchy-Riemann equations, analytic functions and various properties of analytic functions. • Understand Cauchy theorem and Cauchy integral formulas and apply these to evaluate complex contour integrals. • Represent functions as Taylor and Laurent series; classify singularities and poles; find residues and evaluate complex integrals using the residue theorem. • Understand conformal mapping and apply the techniques regarding conformal mappings to various fields.	
Text Books	
1.	Ponnusamy S., Silverman H., Complex Variable with Applications, Birkhauser, 2006.
2.	Brown J. W. and Churchill R. V., Complex Variables and Applications, 7th Ed., Mc-Graw Hill, 2004.
Reference books	
1.	Conway, J. B. Functions of One Complex Variable I. 2nd ed. Graduate Texts in Mathematics, Vol. 11. New York: Springer-Verlag, 1995. ISBN: 978-0-387-94234-6.
2.	Kasana H.S., Complex Variables: Theory and Application, PHI Intl Ltd, 2nd Edition, 2017.
3.	Zills, D. G., and Shanahan, P. D., A First Course in Complex Analysis with Applications. Jones & Bartlett Publishers, Inc., 2003.
4.	Raju C.K, Cultural Foundations of Mathematics: The Nature of Mathematical Proof and the Transmission of the Calculus from India to Europe in the 16th Century, Pearson Longman, 2007.
5.	Spiegel, M. R., Lipschutz, S., Schiller, J. J., & Spellman, D. Schaum's Outline of Complex Variables. 2nd ed. New York: McGraw-Hill Professional, 2009.

Differential Equations						
Prerequisite: Basic knowledge of Real Analysis			L	T	P	C
Total hours: 42			3	1	0	4
Course Content						Hrs.
Unit 1	Overview of the contributions of Indian mathematicians to mathematical astronomy and modern differential equations. First-order non-linear differential equations: Existence and Uniqueness problem, fixed-point theorem(statement only), Picard existence and uniqueness theorem.					10
Unit 2	Linear dependence and Wronskian, Dimensionality of space of solutions, Abel-Liouville formula, Method of Undetermined coefficients for linear differential equations of constant coefficients, Series solutions of linear differential equations, System of linear differential equations. Two-point boundary value problems of the Sturm-Liouville type, Sturm Separation Theorem (statement only), Sturm Comparison Theorem (statement only), Green's functions.					12
Unit 3	Introduction to PDE and the classification of PDEs (Linear, Nonlinear, Semi-linear, Quasi-linear), Formation of partial differential equations, Integral surfaces passing through a given curve, Method of characteristics. Classification of second-order PDEs (elliptic, parabolic, hyperbolic) and reduction to canonical form and their solutions.					8
Unit 4	Cauchy's problem for second-order PDEs, Characteristic equations and characteristic curves of second-order PDEs, Review of Fourier Series, Method of separation of variables: Solution of Wave equation, Heat equation, and Laplace equation.					12
Course Outcomes: - Analyze the existence, uniqueness, and continuity of solutions of first-order ordinary differential equations. - Explain the fundamental concepts of ordinary differential equations, including linear dependence, Wronskians, and the Abel-Liouville formula. - Apply power series methods to solve linear differential equations and solve systems of linear differential equations. - Classify second-order partial differential equations and identify their canonical forms.						

• Apply the method of separation of variables to solve classical partial differential equations such as the wave, heat, and Laplace equations.	
Text Books	
1.	Simmons G.F. and Krantz S.G., Differential Equations Theory, Techniques and Practice, McGraw Hill, 2006.
2.	Ross, S. L., Differential Equations, 3rd edition, Wiley 1984.
3.	Rao, K. Sankara, Introduction to Partial Differential Equations, PHI Learning Pvt. Ltd., 2010
Reference books	
1.	Deo S. G, Raghvendra V., Kar R. and Lakshmikantham V., Textbook of Ordinary Differential Equations, McGraw-Hill Education, 2018.
2.	Coddington E.A. and Levinson N., Theory of Ordinary Differential Equations, McGraw Hill, 2017.
3.	Zill D. and Wright W., Advanced Engineering Mathematics, Fourth Edition, Jones and Bartlett Student Edition, 2011 (Indian Edition).
4.	O'Neil P., Advanced Engineering Mathematics, Seventh Edition, Cengage Learning, 2012 (Indian Edition).
5.	Plofker, K.. Indian Mathematics. Princeton University Press, 2009

Optimization Methods and Applications					
Pre-requisite: Linear Algebra		L	T	P	C
Total hours: 42		3	0	0	3
Course Content					Hrs
Unit 1	Introduction to Optimization: Historical development of optimization from geometric constructions in the Śulba Sūtras, algebraic and computational methods developed by Aryabhata, Brahmagupta, and Bhāskara II, including Bhāskara II's ideas related to maxima and minima, followed by the evolution of optimization through the works of Fermat, Euler, Lagrange, Kantorovich, and Dantzig, leading to modern linear programming. Linear Programming Problems (LPP): Formulation of LPP, notion of an optimal solution, graphical interpretation of optimality, convex sets and convex functions, applications of convexity in linear programming, extreme points, basic feasible solutions (BFS), Fundamental Theorem of Linear Programming (statement only), and the relationship between extreme points of the feasible region and basic feasible solutions.				8
Unit 2	Canonical form of LPP, initial BFS and a method of improving current BFS, simplex algorithm, artificial variable and its interpretation in the context of feasibility, case of unbounded LPP, two-phase method.				6
Unit 3	Introduction to duality, formulation of dual LPP, duality theorems and their interpretations. Complementary slackness theorem (statement only), economic interpretation and applications of duality, dual-simplex method.				6
Unit 4	Linear integer program and Gomory cut algorithm, Transportation programming problems (TPP), optimal solution of TPP, assignment problems and Hungarian Method. Introduction to Game Theory: Two-person zero-sum games, payoff matrix, pure and mixed strategies.				8
Unit 5	Applications of LPP to problems such as Network optimization problems like shortest path and Network flows, PERT-CPM. Historical evolution of optimization in transportation, logistics and scheduling with emphasis on ancient Indian trade-route optimization, architectural planning, and modern developments in Operations Research after World War II.				7
Unit 6	Non-linear Programming: Lagrange multipliers and Kuhn - Tucker conditions. Historical development of constrained optimization from geometric methods to Lagrange multipliers, Karush-Kuhn-Tucker				7

	theory and their role in modern Artificial Intelligence, Machine Learning and Engineering.	
Course Outcomes		
• Understand the theoretical foundations of nonlinear programming, including convex and non-convex optimization problems, and optimization algorithms. • Understand the fundamental principles and concepts of optimization techniques in various domains. • Analyze and formulate linear programming problems mathematically, identifying objective functions, constraints, and decision variables. • Understand the principles and methodologies of Duality, Critical Path Method (CPM), and Program Evaluation and Review Technique (PERT), and their applications in project management and resource allocation.		
Text Books		
1.	Taha H. A., Operations Research: An Introduction, 10th Ed., Pearson, 2017.	
2.	Rao S., Engineering optimization theory and practice, New Age International publishers, 2013.	
Reference books		
1.	Boyd S. and Vandenberghe L., Convex Optimization, Cambridge University Press, 2004.	
2.	Bertsimas D., Introduction to Linear Optimization, Athena Scientific, 1997.	
3.	Joseph G.G., The Crest of the Peacock: Non-European Roots of Mathematics, 3 rd Ed., Princeton University Press, 2011.	
4.	Raju C. K., Cultural Foundations of Mathematics, Pearson Longman, 2007.	
5.	Swarup K., Gupta P.K. and Man Mohan, Operations Research, Sultan Chand & Sons, Latest Edition.	

Optimization Methods and Applications Lab					
Pre-requisite: Linear Algebra		L	T	P	C
Total hours: 24		0	0	2	1
Course Content					Hrs.
	1. Introduction to the programming language/package and setting up a Data File 2. Setting up the problem and solving simple LP problems 3. Solution of Transportation programming problems (TPP) 4. Solution of Assignment problems, Hungarian Method. 5. Solution of Travelling Salesman Problem 6. Applications of LPP to Network optimization problems like shortest path and Network flows 7. Linear Integer program and Gomory cut algorithm 8. Project Planning: PERT 9. Project Planning: CPM 10. Solution of shortest path problem 11. Solution of resource allocation problem Note: The concerned Course Coordinator will prepare the actual list of experiments/problems at the start of the semester based on the above generic list.				24
Course Outcomes					
• Gain hands-on experience in implementing optimization algorithms discussed in theory classes, including linear programming, and nonlinear programming techniques. • Develop proficiency in using computational tools and software packages or commercial optimization software to solve optimization problems efficiently. • Acquire skills in formulating optimization problems, defining objective functions, constraints, and decision variables, and translating them into code for algorithm implementation. • Develop critical thinking and problem-solving skills by troubleshooting algorithm implementations, debugging code, and refining optimization strategies.					
Text Books					

1.	Hamdy A. Taha, Operations research: An introduction, Pearson Education, 2006
2	Rao S., Engineering optimization theory and practice, New Age International publishers, 2013.
Reference book	
1.	Boyd S. and Vandenberghe L., Convex Optimization, Cambridge University Press, 2004.
2.	Bertsimas D., Introduction to Linear Optimization, Athena Scientific, 1997.
3.	Vanderbei R., Linear Programming: foundations and extension, Springer, 2001.
4.	Srinivasan G., Operations research principles and applications, PHI Learning Private Limited, 2010.
5.	Chvatal V., Linear Programming, W. H. Freeman Publishers, 1983.

Theory of Computations						
Prerequisite: None			L	T	P	C
Total hours: 42			3	0	0	3
Course Content						Hrs.
Unit 1	Basic foundation: Review of Set Theory, Automata Theory, Alphabet, Power of Alphabet, Kleen Closure, Positive Closure, String, Empty String, Concatenation, Language. Finite Automata (FA): Introduction, Deterministic Finite Automata (DFA) -Formal Definition, Simpler Notations (State Transition Diagram, Transition Table), Language of A DFA. Nondeterministic Finite Automata (NFA)- Definition of NFA, Language of an NFA, Equivalence of Deterministic and Nondeterministic Finite Automata, Applications of Finite Automata, Finite Automata with Epsilon Transitions, Eliminating Epsilon Transitions, Minimization of Deterministic Finite Automata, Finite Automata with Output (Moore and Mealy Machines) and Inter Conversion.					10
Unit 2	Regular Expressions (RE): Introduction, Identities of Regular Expressions, Finite Automata and Regular Expressions- Converting from DFA's to Regular Expressions, Converting Regular Expressions to Automata, Minimization of Finite Automata, Applications of Regular Expressions. Regular grammars: Chomsky Classification of Languages, Regular Grammars and FA, FA for Regular Grammar, Regular Grammar for FA. Proving Languages to be Non-Regular -Pumping Lemma, Applications, Closure Properties of Regular Languages.					8
Unit 3	Context free grammar (cfg): Derivation Trees, Sentential Forms, Rightmost and Leftmost Derivations of Strings. Ambiguity in CFGs, Minimization of CFGs, Normal Forms (CNF, GNF), Pumping Lemma for CFLs.					8
Unit 4	Pushdown automata theory: Push Down Automata, Deterministic and Nondeterministic PDA, PDA And Languages, Construction of PDA, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty Stack and its Equivalence, Equivalence of CFG and PDA. Turing machines (tm): formal Definition and Behaviour, Languages of a TM, TM as Accepters, TM as a Computer of Integer Functions,					8

	TM with Storage in its State, TM as Subroutine, Minsky's Theorem, Types of TMs, Multitrack, Multitape, Nondeterministic TM, Encoding of TM, Computability and Acceptability.	
Unit 5	Recursive and Recursively Enumerable Languages (REL): Properties of Recursive and Recursively Enumerable Languages. Undecidability and undecidable problems: Post's Correspondence Problem (PCP), Universal Turing Machine, The Halting Problem, Undecidable Problems about TMs. Context Sensitive Language and Linear Bounded Automata (LBA), Chomsky Hierarchy, Decidability.	8
Course Outcomes: • Develop a solid understanding of the theoretical foundations of computation, including formal languages and automata theory. • Analyze and classify computational problems using formal models such as finite automata, regular expressions, and context-free grammars. • Explore advanced topics in the theory of computation, such as Recursive and Recursively Enumerable Languages and Chomsky Hierarchy. • Apply theoretical concepts to solve computational problems and analyze the computational complexity of algorithms, and understand the limits of computation.		
Text Books		
1.	Hopcroft J.E., Motwani R., Ullman J.D., Introduction to Automata Theory, Languages and Computation, Pearson Education, India, 2007	
2.	Cohen, D. I. A. Introduction to Computer Theory. 2nd ed. New York: John Wiley & Sons, 1997.	
Reference books		
1.	Martin J.C., Introduction to Languages and the Theory of Computation. 4th ed., McGraw-Hill, 2010	
2.	Lewis H. R., & Papadimitriou, C. H. Elements of the Theory of Computation. 2nd ed., Prentice Hall, 1998	
3.	Linz P. An Introduction to Formal Languages and Automata. Jones & Barlett Learning, 2016.	

4.	Sipser, M. Introduction to the Theory of Computation. 3rd ed., Cengage Learning, 2013.
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Malaviya National Institute of Technology Jaipur
Department of Mechanical Engineering

I year scheme -2026

Course Category	Sub-Cat	Course Name	Sem I Credits	Sem II Credits
Institute Core	BSC	Mathematics I	3	
		Mathematics II		3
		Classical Physics (IC bucket*)		3
		Engineering Chemistry (IC bucket*)	3	
	ESC	Python Programming And Lab (IC bucket*)		3
		Makers Lab (ME+EE+ECE)	6	
		Data Analytics	2	
		Environmental Science		1
	HSSC	Soft Skills Foundational Lab		1
		Ethics And Human Values		1
	Labs	Classical Physics Lab		1
		Engineering Chemistry Lab	1	
		Engg. Drawing and Sketching Lab		1
Program Core	(PC)	Material Science and Engineering		3
		Engineering Mechanics		3
		Engineering Thermodynamics	4	
		Experiential Engineering	1	
		Total	20	20
Total Institute Core (IC)			11 – 15	10 – 14
Program Core (PC) (11–14) + 3 in case Engg. Eco.			5 – 10	5 – 10
Total Number of Courses			7	10

DEPARTMENT OF MECHANICAL ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Scheme/Specialization : B.Tech. (Mechanical Engineering)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical
xxx	Engineering Thermodynamics	4	3	1	0

PREREQUISITE

Nil

COURSE OBJECTIVE(S)

This course aims to provide students with a fundamental understanding of the principles of engineering thermodynamics and their applications to engineering systems. It develops the ability to analyze thermodynamic systems, properties, and processes using the First and Second Laws of Thermodynamics, evaluate the properties of pure substances and ideal gases, and analyze the performance of common engineering devices and basic power and refrigeration cycles. The course also prepares students for advanced thermal engineering subjects such as Heat Transfer, Internal Combustion Engines, Power Plant Engineering, and Refrigeration & Air Conditioning.

COURSE OUTCOMES

CO	Description
CO1	Explain thermodynamic concepts, systems, properties and processes.
CO2	Apply the First and Second Laws to engineering systems.
CO3	Analyze energy conversion devices using thermodynamic principles.
CO4	Evaluate the performance of gas power, vapour power and refrigeration cycles.

COURSE ASSESSMENT

Component	Weightage
Assignments	10%
Quiz(s)	10%
Mid Semester Examination	30%
End Semester Examination	50%

COURSE CONTENTS

Unit I (7 Hours): Fundamentals of Thermodynamics: systems, properties, equilibrium, Zeroth Law, temperature, pressure, heat, work, forms of energy.

Unit II (7 Hours): Properties of Pure Substances: phase change, property diagrams, steam tables, ideal gas equation, specific heats, compressibility factor.

Unit III (10 Hours): First Law of Thermodynamics: closed systems, boundary work, enthalpy, SFEE, applications to nozzles, turbines, compressors, pumps, heat exchangers and throttling devices.

Unit IV (11 Hours): Second Law of Thermodynamics: heat engines, refrigerators, Carnot cycle, entropy, reversible and irreversible processes, Clausius inequality.

Unit V (6 Hours): Gas Power Cycles: Otto, Diesel, Dual and Brayton cycles, thermal efficiency and mean effective pressure.

Unit VI (4 Hours): Vapour Power and Refrigeration Cycles: Rankine cycle, vapour compression refrigeration cycle, COP.

TEXT BOOKS / REFERENCE BOOKS

1. Y. A. Çengel and M. A. Boles, Thermodynamics: An Engineering Approach.
2. P. K. Nag, Engineering Thermodynamics.
3. Moran, Shapiro, Boettner and Bailey, Fundamentals of Engineering Thermodynamics.
4. Sonntag, Borgnakke and Van Wylen, Fundamentals of Thermodynamics.

ONLINE/E-RESOURCES

NPTEL courses, MIT OpenCourseWare

**DEPARTMENT OF MECHANICAL ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR**

B.Tech. (Mechanical Engineering)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical
26-xxxx	Experiential Learning Lab	1	0	0	2

PREREQUISITE

Nil

COURSE OBJECTIVE(S)

- Develop engineering thinking through systematic disassembly and reassembly of mechanical products.
- Understand product construction, material selection and working principles.
- Develop the ability to critically evaluate existing designs and recommend improvements.
- Promote experiential learning and design-oriented thinking through disassembling and assembling .

COURSE OUTCOMES

CO	Description
CO1	Demonstrate safe engineering practices while using appropriate tools for assembly, disassembly and reassembly of engineering products.
CO2	Investigate engineering products to identify components, materials, manufacturing processes and prepare a Bill of Materials (BOM).
CO3	Analyze the construction, working principle and interaction of components in mechanical and mechatronic systems.
CO4	Evaluate engineering products from functional, manufacturing and maintenance perspectives, and recommend feasible design improvements.

COURSE ASSESSMENT

Component	Weightage
PRS (Continuous Laboratory Performance)	60%
PRM (Laboratory Manual & Viva)	20%
PRE (End Semester Practical Examination)	20%

COURSE CONTENTS

Module 1: Engineering Observation and Experiential Learning

1. Introduction to experiential learning in engineering.
2. Engineering observation and product-function relationship.
3. Laboratory safety practices.
4. Identification and safe use of engineering hand tools.
5. Engineering documentation, systematic disassembly, inspection, reassembly and functional validation.

Module 2: Experiential Learning through Basic Mechanical Assemblies and Everyday Engineering Products (8 Activities)

Engineering Products under this module for Assembly, Disassembly and Functional Analysis

1. Bicycle (DIY Type)
2. Pull Back Car
3. Electric Iron
4. Pedestal Fan with Swing Mechanism
5. Mechanical Odometer
6. WC Flushing Mechanism
7. Differential Mechanism
8. Water Meter

Activities Objectives for Each Engineering Product

- Observe and document the product architecture.
- Identify individual components and prepare the Bill of Materials (BOM).
- Identify engineering materials and manufacturing processes used for major components.
- Study component interactions and power/motion transmission.
- Safely disassemble and reassemble the product.

- Explain the working principle.
- Evaluate the design from functionality, manufacturability and maintainability perspectives.

Module 3: Experiential Learning through Intermediate Mechanical and Mechatronic Systems (4 Activities)

Engineering Products under this module for Assembly, Disassembly and Functional Analysis

1. Bicycle Gear-Shifting Mechanism and Planetary Mechanism in EV Hub Motor
2. Sphygmomanometer (Manual and Automatic)
3. Automotive Air-Conditioning Compressor
4. Window Air Conditioner

Activities Objectives for Each Engineering Product

- Identify mechanical, electrical and control elements.
- Study subsystem integration and functional relationships.
- Analyze motion, force, power or fluid flow paths.
- Identify sensors, actuators and transmission mechanisms wherever applicable.
- Evaluate design choices considering efficiency, reliability and maintenance.

Module 4: Experiential Learning through Multi-Subsystem Engineering Products (2 Activities)

Engineering Products under this module for Assembly, Disassembly and Functional Analysis

1. Four-Stroke Internal Combustion Engine
2. Semi-Automatic Washing Machine

Learning Activities for Each Engineering Product

- Identify major subsystems and their interactions.
- Study energy conversion and power transmission mechanisms.
- Analyze assembly hierarchy and functional dependencies.

- Identify materials, manufacturing methods and standard components.
- Evaluate design with respect to performance, safety, sustainability and ease of maintenance.
- Recommend feasible engineering improvements.

Module 5: Experiential Learning Design Challenge

Students shall investigate an unfamiliar engineering product/system and demonstrate their understanding through engineering analysis.

The activity shall include:

- Functional decomposition of the product.
- Preparation of Bill of Materials (BOM).
- Identification of engineering materials and manufacturing processes.
- Identification of tools and assembly sequence.
- Explanation of the working principle.
- Evaluation of the existing design.
- Recommendation of engineering improvements.
- Reassembly and functional demonstration.

Laboratory Deliverables

For Each activities students shall submit a brief laboratory report containing:

1. Product Name
2. Functional Decomposition
3. Bill of Materials (BOM)
4. Material Identification
5. Manufacturing Processes involved
6. Tools Used
7. Principle of Operation
8. Merits and Demerits of the Design
9. Recommendations for Improved Design

TEXT/REFERENCE BOOKS

1. Otto & Wood, Product Design: Techniques in Reverse Engineering and New Product Development.

ONLINE/E-RESOURCES

Manufacturer service manuals, product datasheets

Note: The mentioned engineering products or systems of comparable complexity may be revised with time by taking proper approvals from DFB

DEPARTMENT OF MECHANICAL ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR

Scheme/Specialization: B.Tech. (Mechanical Engineering)

DETAILS OF THE COURSE

Course Code	Course Title	Category	Credits	Lecture	Tutorial	Practical
XXXX	Materials Science and Engineering	PC	3	3	0	0

Pre-requisite(s): Nil

Course Objectives: This course enables the students to:

1. Understand the classification of engineering metals and alloys, crystal geometries, and the structure of solids, and explain the structure–property relationship in engineering metals and alloys.
2. Apply the concepts of diffusion, nucleation, phase diagrams, and phase transformation mechanisms to explain heat treatment processes and predict microstructural evolution in engineering metals and alloys.
3. Analyse the influence of crystal defects and imperfections on the mechanical behaviour of engineering metals and alloys.
4. Understand the various strengthening mechanisms and annealing used to improve the mechanical behaviour of engineering metals and alloys.
5. Apply standard mechanical testing methods to determine and evaluate the mechanical properties and behaviour of engineering metals and alloys.

Course Outcomes (COs): After completion of this course, students will be able to:

CO No.	Course Outcome
CO1:	Explain the classification of engineering metals and alloys, crystallography, crystal structures, and the structure–property relationships of metallic materials.
CO2:	Apply the principles of diffusion, alloy formation, phase diagrams, and phase transformations to interpret microstructural evolution and heat treatment of steels.
CO3:	Analyse the influence of crystal defects, strengthening mechanisms, and microstructure on the mechanical behaviour of engineering metals and alloys.
CO4:	Evaluate the suitability of heat treatment processes and hardening techniques to achieve the desired microstructure and mechanical properties of steels.
CO5:	Apply standard mechanical testing and non-destructive testing methods to determine and evaluate the mechanical behaviour and properties of engineering metals and alloys.
CO6:	

COURSE ASSESSMENT: The Course Assessment will be made up of the following three components:

S. No.	Assessment Tools	Marks
1	Mid-Term Examination (MTE)	30 %
2	Class Work Sessionals (Assignments, self-study and activity-based)	20 %
3	End-Term Examination (ETE)	50 %
	Total (Marks) =	100

Syllabus:

Net Lectures = 40 hrs	
Course Content	hrs
Unit-1: Introduction to Engineering Materials: Historical development of engineering materials; materials engineering paradigm (processing–structure–properties–performance relationship); challenges and factors influencing material selection; classification of engineering materials. Crystallography of Solids: Crystal systems and Bravais lattices (2D and 3D); crystal structures of metals; crystallographic directions and planes; Miller and Miller–Bravais indices in cubic, tetragonal system, hexagonal systems, etc.; symmetry, interplanar spacing, linear and planar densities, Weiss Zone Law, and introduction to X-ray diffraction. Crystal Packing and Microstructure: Crystal packing in FCC, BCC, and HCP structures; atomic packing factor, coordination number, theoretical density, atomic radius–lattice parameter relationships, Triangular, tetrahedral, octahedral, and cubic voids in FCC/BCC/HCP packing and their positions; single crystals, polycrystalline materials, grain structure, microstructure, and amorphous solids.	7
Unit-2: Defects in Solids: Classification of crystal defects based on dimensionality; point defects (vacancies, interstitials, substitutional impurities, Frenkel and Schottky defects, etc.); line defects (edge, screw and mixed dislocations); surface defects (homophase like stacking fault, twin boundary, grain boundary, etc., and heterophase boundary like free surfaces, solid-liquid interface, phase boundary etc.); volume defects (voids, inclusions and second-phase particles, etc.); Dislocation density, Frank–Read source, slip systems in FCC, BCC and HCP crystal structures, and the role of crystal defects in plastic deformation and mechanical behaviour. Strengthening Mechanisms and Annealing of Metals: Plastic deformation and strain hardening; strengthening mechanisms including work (strain) hardening, solid solution strengthening, grain size strengthening (Hall–Petch relationship), and precipitation (age) hardening; annealing of cold-worked metals—recovery, recrystallization, and grain growth; effect of cold working and annealing on microstructure and mechanical properties.	10
Unit-3: Elastic and plastic deformation of metals; Tensile behaviour: stress–strain curve, mechanical properties, true stress–true strain, ductility and toughness; Hardness: principles and hardness testing methods (Brinell, Rockwell and Vickers); Impact behaviour (dynamic loading): ductile-to-brittle transition, Charpy and Izod impact tests; Fatigue behaviour (cyclic loading): fatigue mechanism, S–N curve, endurance limit, factors affecting fatigue life; Creep behaviour (time-dependent deformation): creep mechanism, creep curve, stages of creep, factors affecting creep resistance; Fracture behaviour (failure): ductile and brittle fracture, fracture mechanisms, fracture surface characteristics; Introduction to non-destructive testing (NDT): principles and applications of visual inspection, liquid penetrant, magnetic particle, ultrasonic and radiographic testing	8
Unit-4: Structure of Alloys: Formation of alloys; solid solutions and intermetallic compounds; interstitial and substitutional solid solutions; Hume–Rothery rules for substitutional solid solubility; random and ordered substitutional solid solutions; primary and intermediate phases. Phase Diagrams: Concept and classification of phase diagrams; Gibbs phase rule and its application; binary alloy phase diagrams including isomorphous (Cu–Ni), eutectic (Pb–Sn), eutectoid, and Fe–Fe ₃ C systems; interpretation of phase diagrams and lever rule; microstructural evolution during solidification and cooling; classification and	15

microstructures of ferrous alloys including hypo-eutectoid, eutectoid, and hyper-eutectoid steels, and cast irons.

Phase Transformations and Heat Treatment of Steels: Phase transformations in solids; nucleation and growth mechanisms; Time–Temperature–Transformation (TTT) diagrams and microstructural evolution; TTT diagram of eutectoid steel and its application in heat treatment; heat treatment processes including annealing, normalizing, quenching, tempering, and austempering; overview of TTT diagrams for hypo-eutectoid, hyper-eutectoid, and alloy steels; concept of hardenability, difference between hardness and hardenability, factors affecting hardenability, and the effect of alloying elements.

Diffusion in Solids: Fundamentals of atomic diffusion; Fick's first and second laws; steady-state and non-steady-state diffusion; interstitial and substitutional diffusion; atomic diffusion mechanisms; lattice, grain boundary, surface, and dislocation diffusion; factors affecting diffusion; applications in heat treatment and case hardening processes.

Recommended Learning Resources

Text Books:

1. Materials Science, GK Narula, KS Narula, and VK Gupta, Mc Graw Hill Education (India) Private Ltd.
2. Engineering Materials: Polymers, Ceramics and Composites, AK Bhargava, PHI Learning Private Ltd.
3. Mechanical Behaviour of Materials, Thomas H Courtney, Mc Graw Hill Education (India) Private Ltd.
4. Mechanical Behaviour and Testing of Materials, AK Bhargav and CP Sharma, PHI Learning Private Ltd.
5. Materials Science and Engineering: An Introduction, William D. Callister Jr. and David G. Rethwisch, 11th Edition, Wiley, 2020.
6. Foundations of Materials Science and Engineering, William F. Smith and Javad Hashemi, 6th Edition, McGraw-Hill Education, 2021.
7. The Science and Engineering of Materials, Donald R. Askeland and Wendelin J. Wright, 8th Edition, Cengage Learning, 2022.
8. Materials Science and Engineering, V. Raghavan, 7th Edition, Prentice Hall India (PHI).
9. Mechanical Metallurgy, George E. Dieter, 3rd Edition, McGraw-Hill.

Research Papers / Standards / Databases:

1. Recent SCI/Scopus papers (last 5 years)
2. ASTM / ISO / BIS standards
3. Materials Science and Engineering A, Materials Characterization, etc.

MOOCs / Digital Resources: NPTEL / SWAYAM / Coursera / edX

Details of the Course

Course Code	Course Title	Credits	L	T	P	Studio
	Engineering Mechanics	3	2	1	0	0

Prerequisite:

None

Course Objective:

This course aims to develop a strong foundation in engineering mechanics by introducing the fundamental principles governing the equilibrium and motion of particles and rigid bodies. It enables students to analyze force systems, engineering structures, and mechanical components using the principles of statics, virtual work, and energy methods, while providing an introduction to the kinematics and dynamics of rigid bodies for solving practical engineering problems.

Course Outcomes: At the end of the course, students should be able to

CO1	Explain the fundamental concepts, laws, and principles of engineering mechanics.
CO2	Apply the principles of equilibrium and free-body diagrams to analyze particles and rigid bodies.
CO3	Analyze engineering structures, beams, and trusses to determine reactions and internal forces.
CO4	Evaluate the stability and equilibrium of engineering systems using virtual work and energy methods.

Course Assessment:

S.NO	Component	Weightage
1	CWS (Assignment/Quiz/Project/Presentation)	20-30 %
2	Mid Term Examination	20-40 %
3	End Term Examination	30-50 %

Course Contents:

Introduction to Mechanics and Laws of Mechanics. Statics of Particles: Forces in a Plane- Force on a Particle, Resultant of Two Forces, Resultant of Several Concurrent Forces, Resolution of a Force. Equilibrium of a Particle, Free-Body Diagrams. Forces in Space – Rectangular Components of a Force in Space, Force Defined by Its Magnitude and Two Points on Its Line of Action. Concurrent Forces, Equilibrium of a Particle in Space.

Rigid Bodies: Equivalent Systems of Forces: Principle of Transmissibility. Equivalent Forces, Moment of a Force about a Point, Varignon's Theorem, Moment of a Force about a Given Axis, Moment of a Couple, Equivalent Couples, Resolution of a Given Force into a Force and a Couple, Reduction of a System of Forces to One

Malaviya National Institute of Technology Jaipur

Force and one Couple, Equivalent Systems of Forces, Reduction of a System of Forces to a Wrench.

Equilibrium of Rigid Bodies: Introduction, Free-Body Diagram, Equilibrium in Two Dimensions, Reactions at Supports and Connections for a Two-Dimensional Structure, Equilibrium of a Rigid Body in Two Dimensions, Statically Indeterminate Reactions. Partial, Constraints, Equilibrium of a Two-Force Body, Equilibrium of a Three-Force Body, Equilibrium in Three Dimensions, Equilibrium of a Rigid Body in Three Dimensions, Reactions at Supports and Connections for a Three-Dimensional Structure.

Force Analysis of Rigid Bodies Structures: Plane Trusses, Methods of Joints, Method of Section, Space Trusses, Frames and Machines, Internal Forces Developed in various Structural Members (such as rod, beam, shaft), Shear and Moment Equations and Diagrams (SFD and BMD), Relations between Distributed Load, Shear, and Moment.

Distributed Forces: Centroids and Center of Gravity: Moments of Inertia of Areas, Second Moment, or Moment of Inertia, of an Area, Determination of the Moment of Inertia of an Area by Integration, Polar Moment of Inertia, Radius of Gyration of an Area, Parallel-Axis Theorem, Moments of Inertia of Composite Areas, Product of Inertia, Principal Axes and Principal Moments of Inertia, Mohr's Circle for Moments and Products of Inertia, Moments of Inertia of a Mass Moment of Inertia of a Mass, Moments of Inertia of Thin Plates, Determination of the Moment of Inertia of a Three-Dimensional Body by Integration, Moments of Inertia of Composite Bodies, Moment of Inertia of a Body with Respect to an Arbitrary Axis through O, Mass Products of Inertia.

Methods of Virtual Work and Total Potential Energy: Work- Work of a Force and Couple, Virtual Work- Principle of Virtual Work for a Particle and Rigid Bodies, Potential Energy and Stability.

Kinematics and Dynamics of Rigid Bodies: General plane motion.

Text Books/ Reference Books

1. Vector Mechanics for Engineers: Statics and Dynamics, Ferdinand P. Beer, E. Russell Johnston, David Mazurek, Phillip J. Cornwell, Brian Self. McGraw Hill Education, 13th Edition, 2026
2. Engineering Mechanics: Statics & Dynamics, Hibbeler, R.C., Pearson Education Asia Pvt. Ltd., 15th Edition, 2025
3. Engineering Mechanics – Statics and Dynamics, Irving H. Shames, Pearson Education Asia Pvt. Ltd., 2005.
4. Engineering Mechanics: Statics and Dynamics, Meriam, J. L., Kraige, L. G., & Bolton, J. N., Wiley-India, 9th Edition, 2021.

MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
Curriculum structure of B.Tech Programme

Semester I

S. N.	Course Code	Course Title	Category	L	T	P	Credits	Contact Hrs
1		Data Science	IC	2	0	0	2	2
2		Makers Lab (ME+EE+ECE)	IC	0	0	6	6	12
3		Chemistry Lab	IC	0	0	2	1	2
4		Chemistry	IC	3	0	0	3	3
5		Mathematics II	IC	3	0	0	3	3
6		Introduction to Engineering Materials	PC	3	0	0	3	3
7		Fuels, Furnaces and Refractories	PC	3	0	0	3	3
			Total				21	

Semester II

S. N.	Course Code	Course Title	Category	L	T	P	Credits	Contact Hrs
1		Environmental Science	IC	2	0	0	1	2
2		Python Programming and Lab	IC	2	0	1	3	2
4		Physics Lab	IC	0	0	2	1	2
5		Classical Physics	IC	3	0	0	3	3
6		Soft skill foundation Lab	IC	0	0	2	1	2
7		Ethics and Human values	IC	0	0	2	1	2
8		Engineering Drawing and Sketching Lab	IC	0	0	2	1	2
9		Mathematics I	IC	3	0	0	3	2
10		Mineral Processing	PC	3	0	0	3	3
11		Mineral Processing Lab	PC	0	0	2	1	2
12		Fuel, Furnaces and Refractories Lab	PC	0	0	2	1	2
			Total				19	

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SEMESTER I

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
Scheme/Specialization: B.Tech. (Metallurgical and Materials Engineering)

DETAILS OF THE COURSE:

Course Code	Course Title	Credits	Lecture	Tutorial	Practical
	Introduction to Engineering Materials	3	3	0	0

PREREQUISITE: Basic Knowledge of Physics, Chemistry & Mathematics

COURSE OBJECTIVES:

1. Provide a fundamental understanding of the evolution, classification, and importance of engineering materials.
2. Introduce different classes of engineering and advanced materials along with their structure–property relationships.
3. Enable students to understand the selection and application of materials in real-world engineering systems.

COURSE OUTCOMES:

CO1	Explain the historical development, atomic structure, and bonding mechanisms in different classes of materials.
CO2	Classify engineering materials and explain the fundamentals of metals, ceramics, polymers, composites, and advanced materials.
CO3	Develop the knowledge of fundamental principles related to materials structure, properties and engineering applications.

COURSE ASSESSMENT:

The course assessment (culminating in the final grade) will be made up of the following three components.

S. No.	Evaluation Component	Weightage
a)	Mid- term examination	30%
b)	End Semester Examination	50%
c)	Weekly Submissions/assignments/Quizzes	20%

COURSE CONTENTS:

Unit 01 Introduction: History of materials, Atomic structure. Atomic bonding in solids: bonding forces and energies, primary interatomic bonds, secondary bonding with examples of metals, ceramics and polymers.

(No. of lectures – 04)

Unit 02 Structures of Crystalline Solids: Crystal structure and Bravais lattice, Unit cell and Miller indices, Crystal system, coordination number and packing fraction. Polymorphism and allotropy. Crystallographic directions and planes. Crystalline materials: single crystals, polycrystalline materials. Non- crystalline materials, Imperfection in solids (point defects, line defects, surface defects and volume defects). Level of Structures: macrostructure, microstructure, substructure, crystal structure, electronic structure, nuclear structure.

(No. of lectures – 10)

Unit 03 Engineering Materials: Classification of engineering materials: Metals and alloys, Ceramics and Glasses, Polymers, and Composites. Structure, Fundamentals of Advanced Materials: Superalloys, High Entropy Alloys (HEA), Shape Memory Alloys (SMA), Biomaterials, Nanomaterials, etc.

(No. of lectures – 10)

Unit 04 Properties of Materials: Physical Properties, Chemical Properties, Electrical Properties, Mechanical Properties, Magnetic Properties, Optical Properties, and Thermal Properties.

(No. of lectures – 12)

Unit 05 Applications: Applications of metals, polymers, ceramics, composites, and advanced materials.

(No. of lectures – 04)

TEXTBOOKS/ REFERENCE BOOKS:

1. V. Randle and O. Engler, Introduction to Texture Analysis: Macrotexture, Microtexture and orientation mapping, Gordon and Breach Science Publishers.
2. F.J. Humphreys and M. Hatherly, Recrystallisation and Related Phenomenon, Pergamon Press.
3. S. Suwas and R. K. Ray, Crystallographic texture of materials, Springer London Heidelberg New York Dordrecht.
4. Texture and Anisotropy, U.F. Cocks, C.N. Tome and H.-R. Wenk, Cambridge University Press.

ONLINE RESOURCES: nptel.ac.in

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
Scheme/Specialization: B.Tech. (Metallurgical and Materials Engineering)

DETAILS OF THE COURSE:

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
	Fuels, Furnaces & Refractories	3	3	0	0	0

PREREQUISITE: Basic Science (10+2 level)

COURSE OBJECTIVE:

To familiarize and equip the students with basic knowledge about different types of fuels, furnaces, and refractories used in metallurgical industries

COURSE OUTCOMES:

CO1	Understand about various solid, liquid, and gaseous fuels and their importance in metallurgical industries.
CO2	Gain knowledge about different manufacturing processes of various fuels having industrial significance.
CO3	Analyze the use of stoichiometry for evaluating combustion performances.
CO4	Understand different constructional and working principles of different types of furnaces and refractories

COURSE ASSESSMENT:

The course assessment (culminating to the final grade), will be made up of the following components.

S. No.	Component	Weightage
a)	Mid- term examination	30%
b)	End Semester Examination	50%
c)	Weekly submissions/assignments/Quiz	20%

COURSE CONTENTS:

Unit I Fuels: Definition, their importance in human life (historical background). Comparative study of solid, liquid, and gaseous fuels. Primary and Secondary fuels. Constitution, classification and grading of coal. Characterization of Coal: Proximate analysis, Ultimate analysis, Calorific value. Coal washing. Coal blending and its importance in metallurgical industries.

(No. of lectures - 7)

Unit II Carbonization of coal: Caking, Coking and Non- coking Coals. Metallurgical coke preparation, Testing and properties of coke. Formed coke, Dry quenching of coke. Manufacturing, properties and uses of Producer gas and Water gas. Properties and uses of Blast furnace gas and Coke oven gas.

(No. of lectures - 7)

Unit III Combustion Stoichiometry: Estimation of minimum amount of air required for a fuel of known composition, theoretical and actual combustion processes - Air fuel ratio, estimation of dry flue gases for

known fuel composition, calculation of the composition of fuel and excess air supplied from exhaust gas analysis.

(No. of lectures - 6)

Unit IV Furnaces: Definition and Classification of Furnaces, Major furnace components. Furnace atmosphere. Natural, forced, induced, and balanced draft. Chimney height. Heat losses in furnaces and minimization. Waste heat recovery. Flue gas cleaning systems. Various types of heating elements and Electric Furnaces viz. Resistance, Arc, and Induction furnaces

(No. of lectures - 12)

Unit V Refractories: Desirable properties of refractories. Methods of classification. Modes of failure of refractories in service and their prevention. Manufacturing methods and properties of Fireclay, Silica, Magnesite, and Chrome- Refractories. Metallic Refractories. Testing of Refractories. Applications of refractories in the metallurgical industries.

(No. of lectures - 8)

TEXT BOOKS/ REFERENCE BOOKS (Title, Authors, Publisher & Year):

1. Fuels, furnaces and refractories, R. C. Gupta, 1st Edition, PHI Learning Pvt. Ltd. Delhi, 2016.
2. Fuels, furnaces, refractories and pyrometry, A.V.K. Suryanarayana, 2nd edition, B.S. Publication. 2015.
3. Elements of fuels, furnaces & refractories O.P. Gupta, 6th Edition, Khanna Publishers, 2014.
4. Elements of Refractory Technology, O.P. Gupta, 1st edition, Khanna Book Publishing Co. Ltd., 2017.
5. Industrial Furnaces, W. Trinks, M.H. Mawhinney, R.A. Shannon, R.J. Reed, and J.R. Garvey, 6th edition, John Wiley and Sons, 2003.
6. Fuels, furnaces and refractories, J. D. Gilchrist, Pergamon Press, 1977.

ONLINE/E RESOURCES: <https://nptel.ac.in>

Meta.

SEMESTER II

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
Scheme/Specialization: B.Tech. (Metallurgical and Materials Engineering)

DETAILS OF THE COURSE

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
	Mineral Processing	3	3	0	0	0

PREREQUISITE: Course: (10+2) Science

COURSE OBJECTIVE:

To familiarize the students with different mineral dressing processes, practices and equipment.

COURSE OUTCOMES:

CO1	Understand different types of comminution operations.
CO2	Distinguish the importance of sizing and classification.
CO3	Understand various types of concentration methods.
CO4	Analyze different ways of separating solids from fluids.
CO5	Understand different coal washing methods.

COURSE ASSESSMENT:

The course assessment (culminating to the final grade), will be made up of the following four components.

S. No.	Component	Weightage
a)	Mid- term examination	30%
b)	End Semester Examination	50%
c)	Weekly submissions/assignments/Quiz	20%

COURSE CONTENTS:

Unit I: Importance of mineral processing, Comminution and liberation, Jaw crushers, Gyratory crushers, Cone crushers, Roll crushers, Ball Mill, Rod mill, Tube mill, Sizing and classification: Laboratory methods of sizing and interpretation, Industrial screening.

(No. of lectures - 15)

Unit II: Laws of settling of solids in fluids, Type of classifiers, Gravity concentration by Wilfley table, Spiral shaking tables, Jigging, Heavy media separation, Froth flotation, function of various reagents. Filtration. Electromagnetic, Electrostatic, Amalgamation techniques of concentration, Separation of solids from fluids: dewatering, thickening, filtration, dust elimination, drying.

(No. of lectures - 15)

Unit III: Quantifying Concentration Operations: Material balances in Mineral Processing Operations, Ratio of Concentrate, Recovery, Grade, and Selectivity Index.

(No. of lectures - 5)

Unit IV: Recent advances and practices of mineral processing used in industries.

(No. of lectures - 5)

TEXT BOOKS/ REFERENCE BOOKS (Title, Authors, Publisher & Year):

1. A.M. Gaudin, Principles of Mineral processing, McGraw- Hill Inc., US, 1939.
2. S.K. Jain, Mineral Processing, CBS, 2nd Edition, 2001.
3. Wills' Mineral Processing Technology seventh edition, Barry A. Wills, Willey, 2006.

OTHER REFERENCES:

1. Recent journal papers
2. Expert lecture from industry persons

ONLINE RESOURCES: <https://nptel.ac.in>

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
Scheme/Specialization: B.Tech. (Metallurgical and Materials Engineering)

DETAILS OF THE COURSE:

Course Code	Course Title	Credits	Lecture	Tutorial	Practical	Studio
	Mineral processing lab	1	0	0	2	0

PREREQUISITE: Principles of Mineral Processing

COURSE OBJECTIVE:

To familiarize the students with different mineral dressing processes and equipment.

COURSE OUTCOMES:

CO1	Distinguish different types of crushers.
CO2	Contrast on sizing and classification.
CO3	Analyse various types of concentration methods.
CO4	Analyze different ways of separating solids from fluids.

COURSE ASSESSMENT:

The course assessment (culminating to the final grade), will be made up of the following four components.

S. No.	Component	Weightage
a)	Mid- term examination	30%
b)	End Semester Examination	50%
c)	Weekly submissions/assignments/Quiz	20%

COURSE CONTENTS:

1. Study of various minerals and ores.
2. To study the construction and operation of Blake type jaw crusher, and to find its reduction ratio and production capacity.
3. To study the construction and operation of roll crusher and to find out its reduction ratio, angle of nip and production capacity.
4. To study the construction and operation of disc pulverizer and to find the grindability index of given feed.
5. To study the construction and operation of ball mill and find the grindability index of the given feed.

6. To study the construction and operation of rod mill and find the grindability index of the given feed.
7. To study the single deck and double deck vibrating screens and to find screen efficiency.
8. To find the percentage of iron scrap present in a given feed using magnetic separator.
9. To study the construction and operation of froth floatation cell.
10. To study the construction and operation of mineral jig.
11. To study the construction and operation of pneumatic classifier.
12. To study the construction and operation of spiral classifier.
13. To study the construction and operation of Wilfley table, Richard hindered settling classifier and thickener.

TEXT BOOKS/ REFERENCE BOOKS (Title, Authors, Publisher & Year):

1. Mineral processing laboratory manual

DEPARTMENT OF METALLURGICAL AND MATERIALS ENGINEERING
MALAVIYA NATIONAL INSTITUTE OF TECHNOLOGY JAIPUR
Scheme/Specialization: B.Tech. (Metallurgical and Materials Engineering)

DETAILS OF THE COURSE:

Course Code	Course Title	Credit	Lecture	Tutorial	Practical	Studio
	Fuel, furnaces and Refractories Lab	1	0	0	2	0

PREREQUISITE: Basics of fuel, furnaces and refractories

COURSE OBJECTIVE:

To familiarize and equip the students with basic knowledge about characterization and testing of fuels, furnaces, and refractories used in various metallurgical industries.

COURSE OUTCOMES:

CO1	Analyze the estimation of various properties of fuels and oils.
CO2	Understand the working principles of thermocouples and their calibration.
CO3	Compare different heating elements used in industrial furnaces.
CO4	Understand the constructional and working principles of different types of furnaces.
CO5	Understand the method of making and testing the refractory products.

COURSE ASSESSMENT:

The Course assessment (culminating to the final grade), will be made up of the following four components.

S. No.	Component	Weightage
a)	Mid- term examination	30%
b)	End Semester Examination	50%
c)	Weekly submissions/assignments/Quiz	20%

COURSE CONTENTS:

1. To determine the viscosity of the given fuel oil by using the Redwood and Engler's viscometer.
2. To determine the flash point and fire point of the given fuel oil using the Abel, Pensky-Martens, and Cleveland's apparatus.
3. To determine the proximate analysis of the given coal sample.
4. To determine the Sulphur content of the given coal sample.
5. To determine the calorific value of the given fuel using the Bomb's calorimeter.

6. To study about different thermocouples and their calibration.
7. To study about various heating elements including measure of resistance.
8. To study the variation of resistance with respect to temperature in Kanthal / Nichrome wire
9. To study about various parts of furnaces (Muffle, Induction, and Raising Hearth furnace)
10. To determine the packing density of refractory raw materials.
11. To study of effect of composition, forming pressure & firing temperature on some properties of refractory bodies.
12. To determine the spalling resistance (Thermal Resistance Shock Test) of refractory bodies.

TEXT BOOKS/ REFERENCE BOOKS (Title, Authors, Publisher & Year):

1. Elements of fuels, furnaces & refractories O.P. Gupta, 6th edition, Khanna Publishers, 2014.
2. Fuels, furnaces and refractories, R. C. Gupta, 1st edition, PHI Learning Pvt. Ltd. Delhi, 2016.
3. Industrial Furnaces, 6th Edition, W. Trinks, M. H. Mawhinney, R. A. Shannon, R. J. Reed, J. R. Garvey, Willey, 2003.

ONLINE/E RESOURCES: <https://nptel.ac.in>