INDIAN INSTITUTE OF TECHNOLOGY MANDI

KAMAND, DISTT. MANDI – 175075 (HIMACHAL PRADESH)

MINUTES OF 37TH BOARD OF ACADEMICS MEETING

VENUE : A-4(SC) and GUEST HOUSE (NC) CONFERENCE ROOM, KAMAND

DATE : 29TH OCTOBER, 2020 (THURSDAY)

TIME : 04:00 P.M.

Following members attended the meeting

Sl. No	Responsibilities	Name
1	Dean Academics	Dr. Pradeep Parameswaran
2	Associate Dean (Courses)	Dr. Anil K Sao
3	Chairman Library Advisory Committee	Dr. Astrid Kiehn
4	Chairman Course Proposal Committee	Dr. Kunal Ghosh
5	Course Coordinator (IC Courses)	Dr. Aniruddha Chakraborty
6	Course Coordinator (B.Tech.-CSE)	Dr. Dileep A D
7	Course Coordinator (B.Tech.-ME)	Dr. Gaurav Bhutani
8	Course Coordinator (B.Tech.-DSE)	Dr. Manoj Thakur
9	Course Coordinator (B.Tech.-EP)	Dr. Pradeep Kumar (SBS)
10	Course Coordinator (B.Tech.-M.Tech. Integrated Dual Degree in Bio-Engg.)	Dr. Shubhajit Roy Chowdhury
11	Course Coordinator (M.Tech.- (Energy Engg. (Materials))	Dr. Sumit Sinha Ray
12	Course Coordinator (M.Tech.-(Structural Engg.))	Dr. Sandip Kumar Saha
13	Course Coordinator (M.Tech.-(Communication and Signal Processing))	Dr. Siddartha Sarma
14	Course Coordinator (M.Tech.-Biotechnology)	Dr. Shyam K Masakapalli
15	Course Coordinator (M.Sc.-Physics) + (I-Ph.D. (Physics))	Dr. Ajay Soni
16	Nominee-1: School of Engineering	Dr. Gaurav Bhutani
17	Nominee-1: School of Computing & Electrical Engineering	Dr. Srikant Srinivasan
18	Nominee-2: School of Computing & Electrical Engineering	Dr. Manas Thakur
19	Nominee-1: School of Basic Sciences	Dr. Nitu Kumari
20	Nominee-2: School of Basic Sciences	Dr. C.S.Yadav
21	Nominee-1: School of Humanities & Social Sciences	Dr. Devika Sethi
22	Academic Affairs Secretary	Mr. Arnav Prasad
23	Research Affairs Secretary	Mr. Pawan Kumar Mandal
24	Assistant Registrar (Academics): Secretary	Mr. Vivek Tiwari

Following members could not attend the meeting

Sl. No.		Name	
1	Associate Dean (Research)	Dr. Rahul Vaish	Member
2	Course Coordinator (HSS Courses)	Dr. Suman Sigroha	Member
3	Course Coordinator (B.Tech.-EE)	Dr. Rahul Shrestha	Member
4	Course Coordinator (B.Tech.-CE)	Dr. Maheshreddy Gade	Member
5	Course Coordinator (M.Tech.-(Mechanical Engg. (Energy Systems))	Dr. Pradeep Kumar	Member
6	Course Coordinator (M.Tech.-(VLSI))	Dr. Hitesh Shrimali	Member
7	Course Coordinator (M.Tech.-(Power Electronics and Drives))	Dr. Narsa Reddy Tummuru	Member
8	Course Coordinator M.Sc. (Chemistry)	Dr. Chayan K Nandi	Member
9	Course Coordinator (M.Sc.-Applied Maths)	Dr. Rajendra K Ray	Member
10	Course Coordinator (MA Dev.Studies)	Dr. Shyamasree Dasgupta	Member
11	Nominee-2: School of Engineering	Dr. Subhamoy Sen	Member
12	Nominee-2: School of Humanities & Social Sciences	Dr. Puran Singh	Member
13	Industry Member – 1	Dr. Nadeem Akhtar	Member

Special Invitee

Sl. No.	Name	
1.	Dr. Sunny Zafar	Advisor, CnP Cell
2.	Dr. Varun Dutt	Assoc. Prof., SCEE
3.	Dr. Pratim Kundu	Asst. Prof., SCEE
4.	Dr. Jinesh Machchar	Asst. Prof., SCEE
5.	Dr. Himanshu Pathak	Asst. Prof., SE
6.	Dr. Parmod Kumar	Asst. Prof., SE

PART-A

(Issues discussed by the Board of Academics when the Student Members were present)

37.1 Confirmation of the minutes of 36th meeting of Board of Academics:

The minutes of the 36th Board of Academics meeting held on 30th September, 2020 were confirmed.

37.2 To consider award of Ph.D., M.S. (by Research), M.Tech, M.Sc., M.A. and B.Tech degree:

The 8th Convocation of IIT Mandi may be organized in the month of December, 2020. There are three programmes for which degree will be conferred for the first time:

(a) Master of Arts in Development Studies
(b) Master of Technology in Structural Engineering
(c) Master of Technology in VLSI

The Board recommended the following number of students, who have completed all the academic requirements for award of mentioned degrees during the 8th Convocation scheduled to be held in the month of December 2020 at Kamand campus for Senate approval. The detailed list is placed as Annexure – A. The award of the degree would be subject to clearance of all the dues and no pending disciplinary action against the student.

The summary information with regard to the various degrees is placed as **Annexure – A**.

Sr. No.	Programme	No. of students
1	Doctor of Philosophy	35
2	Master of Science (by Research)	9
3	M.Tech. in Biotechnology	10
4	M.Tech. in Communication and Signal Processing	10
5	M.Tech. in Energy Engineering with specialization in Materials	14
6	M.Tech. in Mechanical Engineering with specialization in Energy Systems	22 + 1 (2016 batch)
7	M.Tech. in Power Electronics and Drives	14
8	M.Tech. in Structural Engineering	17
9	M.Tech. in VLSI	9
10	Master of Science in Chemistry	26
11	Master of Science in Applied Mathematics	28 + 1 (2017 batch)
12	Master of Science in Physics	22
13	Master of Arts in Development Studies	12
14	B.Tech. in Civil Engineering	19
15	B.Tech. in Computer Science Engineering	59
16	B.Tech. in Electrical Engineering	40 + 1 (2014 batch)
17	B.Tech. in Mechanical Engineering	25
	Total	**374**

The BoA also noted that Thesis/Answer sheets of a few students are under evaluation. If the requirements for the programme are completed before the 8th Convocation, their names may be included in the list of degree recipients.

37.3 One Time Approval (OTA) of the courses already taken by the graduating students through Semester Exchange:

A list of courses taken by graduating students during the semester exchange requires One Time Approval (OTA) of the Senate. The BoA discussed on the course descriptions, etc. and recommended it to Chairman, Senate for approval. The list is placed as **Annexure - B**
A list of courses taken at IIT Mandi by the graduating students are given below:

Sl. No.	Course Code	Credit	Course Title	Semester/Faculty
1	HS-461	3	Consumer Behaviour	Feb-June 2020 (Dr. Saumya Dixit)
2	CS-594	4	Introduction to Computer Graphics and Design	Feb-June 2020 (Dr. Jinesh Machchar)

A list of courses taken by the graduating students during semester exchange visits at different abroad Universities are given below:

Sl. No	Course Code	Credit	Name	University
1	1212311	4	Introduction to Computational Differentiation	RWTH Aachen University, Germany
2	1215720	4	High-Performance Computing	RWTH Aachen University, Germany
3	1215725	4	Parallel Programming	RWTH Aachen University, Germany
4	1216861	4	Introduction to Data Science	RWTH Aachen University, Germany
5	IN2073	2.67	Cloud Computing	Technical University Munich (TUM), Germany
6	IN2107	3.33	Seminar Course Recent Advances in 3D Computer Vision	Technical University Munich (TUM), Germany
7	IN2346	4	Introduction to Deep Learning	Technical University Munich (TUM), Germany
8	WI000231	4	Asset Management	Technical University Munich (TUM), Germany
9	WI000739	4	Consumer Behavior	Technical University Munich (TUM), Germany
10	WI001121	4	International Management & Organizational Behavior	Technical University Munich (TUM), Germany

37.4 To consider the modification in Core Course list for B.Tech in Engineering Physics Curriculum:

Dr. Pradeep Kumar, Course Coordinator for B.Tech. Engineering Physics, proposed modification in the Core Course list of Engineering Physics Curriculum. The Board deliberated and suggested a few minor changes. The modified and final Core Course list is placed as **Annexure - C** and is recommended for consideration of the Senate for approval.

37.5 To consider the proposal for six months Internship option in the B.Tech. program::

Dr. Sunny Zafar, Advisor of Career and Placement Cell, presented a proposal for providing an option to do six months internship in the B.Tech. program.

After brief discussion, the BoA decided to constitute a sub-committee of the following to deliberate further and submit recommendations during the subsequent meeting of the BoA:

Dr. Sunny Zafar, CnP Cell Advisor (Chair)
Dr. Varun Dutt, Associate Professor
Dr. Kunal Ghosh, Associate Professor
Student Academic Affairs Secretary

37.6 To consider approval of courses presented by the Course Proposal Committee (CPC)

The Chairperson, Course Proposal Committee (CPC) presented fourteen courses for consideration and approval of the BoA. After due deliberations, the BoA recommended nine courses with minor modifications for consideration of the Senate and its approval, which is placed as **Annexure - D**:

Sl.No.	Course No.	Course Title	Credits (L-T-P-C)
1	CS 550	Computer Graphics and Geometric Design	2-0-2-3
2	CS 611	Program Analysis	3-1-0-4
3	CS 662	Mobile Virtual Reality and Artificial Intelligence	3-0-0-3
4	EE 583	Smart Grids	3-0-0-3
5	EE 584	Power System Protection	3-0-0-3
6	EE 630	HVDC Transmission and Flexible AC Transmission Systems	3-0-0-3
7	EP 401P	Engineering of Instrumentation	1-0-5-4
8	EP 402P	Engineering Physics Practicum	1-0-5-4
9	PH 606	Quantum Field Theory	3-0-0-3

The following five courses were deferred by the BoA:

Sl.No.	Course No.	Course Title	Credits (L-T-P-C)
1	ME 514	Fundamentals of Multiphase Flow	3-0-0-3
2	ME 516	Polymer Technology for Engineers	3-0-0-3
3	ME 627	Mesh Independent Computational Techniques	3-0-0-3
4	ME 628	Impact Mechanics	3-0-0-3
5	ME 310	System Dynamics & Controls	3-0-0-3

37.7 Any other item with the permission of the Chair.

-NIL-

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

Secretary, Board of Academics

Chairman, Board of Academics

PART-B

(Issues discussed by the BoA without the Student Members being present)

-NIL-

ANNEXURE-A

35 Ph.D., 9 M.S. (by Research), 97 M.Tech (including 96 from 2018, 01 from 2016), 26 M.Sc. (Chemistry), 29 M.Sc. (Applied Mathematics) (including 28 from 2018, 01 from 2017), 22 M.Sc. (Physics), 12 M.A. (Development Studies) and 144 B.Tech (including 143 from 2016, 01 from 2014) which includes 02 B.Tech. (Honours) students, 56 B.Tech with Minor students, who fulfilled all the requirement for the award of the degree are as under:

a) Doctor of Philosophy (Ph.D.)

The following 35 Ph.D. scholars have completed all the requirements for the award of the degree of "Doctor of Philosophy' including submission of the final approved thesis.

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Guide	Thesis Title	Viva- Voce Board	Thesis Examiners
1	Ajay (D13010)	DoJ: 29-07-2013 DoC: 05-11-2019 (6 Years, 4 months)	Dr. Samar	Device-To-Device Multicast in Underlay Cellular Networks	Dr. Bharat Singh Rajpurohit (Chair) Dr. Samar (Guide) Prof. Adrish Banerjee (Thesis Examiner) Dr. Satyajit Thakor (Subject Expert)	Prof. Adrish Banerjee (IIT Kanpur) Prof. Lajos Hanzo (University of Southampton, UK)
2	Karan Singh (D14021)	DoJ: 15-12-2014 DoC: 16-12-2019 (5 Years)	Dr. Kaustav Mukherjee	Magnetic, Thermodynamic and Electrical Transport Properties of Ce-based Intermetallics: $Ce_{1-x}La_xGe$ (x = 0.0-0.76), $Ce_{1-x}Y_xNiGe_2$ (x = 0.0-0.4) and CeAlGe	Dr. Pradeep Kumar (Chair) Dr. Kaustav Mukherjee (Guide) Dr. Ravi P. Singh (Thesis Examiner) Dr. Sharath Chandra LS (Subject Expert)	Dr. Ravi P Singh (IISER, Bhopal) Prof. Filip Ronning (Institute for Material Science, USA)
3	Sumeet Kumar Sharma (D14037)	DoJ: 13-02-2015 DoC: 13-01-2020 (5 Years)	Dr. Vishal Singh Chauhan (Guide) Prof. S.C. Jain (Co-guide)	Electromagnetic Radiation Detection from Ferroelectric Ceramics for Wireless Sensing Applications	Dr. Viswanath Balakrishnan (Chair) Dr. Vishal Singh Chauhan (Guide) Prof. S.C.Jain (Co-guide) Prof. B. N. Singh (Thesis Examiner) Dr. Mohit Pant (Subject Expert)	Prof. B.N.Singh (IIT Kharagpur) Prof. Arch. Giuseppe Lacidogna (Politecnico di Torino, Turin, Italy)
4	Vibha Gupta (D13009)	DoJ: 29-07-2013 DoC: 19-02-2020 (6 Years, 7 months)	Dr. Arnav Bhavsar	Ensemble and Deep Learning based Approaches for Microscopy Image Analysis	Dr. Samar (Chair) Dr. Arnav Bhavsar (Guide) Prof. Anubha Gupta (Thesis Examiner) Dr. Narayanan Krishnan (Subject Expert)	Prof. Anubha Gupta (IIIT Delhi) Dr. Gennaro Percannella (University of Salerno, Italy)
5	Surender Lal (D13018)	DoJ: 10-02-2014 DoC: 28-02-2020 (6 Years)	Dr. C.S.Yadav (Guide) Dr. Kaustav Mukherjee (Co-guide)	Structural, Magnetic, Dielectric and Thermodynamic Studies of Layered Perovskite $LnBaCuFeO_5$ (Ln = Rare-earth element) and its Derivatives	Dr. Suman K Pal (Chair) Dr. C.S.Yadav (Guide) Dr. Kaustav Mukherjee (Co-guide) Prof. Preeti Bhobhe (Thesis Examiner) Dr. Jayita Naik (Subject Expert)	Dr. Preeti Bhobe (IIT Indore) Dr. Ashutosh Tiwari (University of Utah, US)
6	Anshul Thakur (D14003)	DoJ: 01-08-2014 DoC: 13-03-2020 (5 years, 6 months)	Dr. Padmanabhan Rajan (Guide)	Automatic Pattern Analysis of Bioacoustic Signals: Exploring Shallow and Deep Learning Frameworks	Dr. Anil K Sao (Chair) Dr. Padmanabhan Rajan (Guide) Prof. Ram Bilas Pachori (Thesis Examiner) Dr. Philemon Daniel (Subject Expert)	Prof. Ram Bilas Pachori (IIT Indore) Dr. Saikat Chatterjee (Royal Institute of Technology, KTH, Sweden)

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Guide	Thesis Title	Viva- Voce Board	Thesis Examiners
7	Manu Shree (D15022)	DoJ: 27-07-2015 DoC: 18-03-2020 (4 years, 8 months)	Dr. Shyam K Masakapalli	Mapping Central Carbon Metabolism of Xanthomonas Oryzae and Xanthomonas Campestris by Integrating Metabolic Systems Biology approaches	Dr. Amit Jaiswal (Chair) Dr. Shyam K Masakapalli (Guide) Dr. Smita Srivastava (Thesis Examiner) Dr. Debabrata Sircar (Subject Expert)	Dr. Smita Srivastava (IIT Madras) Dr. Fabienne Vailleau (ENSAT-LIPM, France)
8	Shaifu Gupta (D14002)	DoJ: 01-08-2014 DoC: 29-05-2020 (5 years, 9 months)	Dr. Dileep A D (Guide) Prof. T.A.Gonsalves (Co-Guide)	Online Resource Usage Prediction and Failure-Aware System for Resource Provisioning in Cloud Datacenters	Dr. Samar Agnihotri (Chair) Dr. Dileep A D (Guide) Prof. T.A.Gonsalves (Co-guide) Prof. Shalabh Bhatnagar (Thesis Examiner) Dr. Sanasam Ranbir Singh (Subject Expert) Dr. Rajeev Kumar (Special Nominee of Chairman, Senate)	Dr. Shalabh Bhatnagar (IISc, Bangalore) Dr. Melody Moh (San Jose State University, California)
9	Naina Arora (D15025)	DoJ: 27-07-2015 DoC: 02-06-2020 (4 years, 11 months)	Dr. Amit Prasad (Guide)	Immuno-Proteomic Profiling of Excretory-Secretory Proteins of Taenia Solium Metacestode	Dr. Syed Abbas (Chair) Dr. Amit Prasad (Guide) Dr. Shailendra Saxena (Thesis Examiner) Dr. Rajavasisth Tripathi (Subject Expert) Dr. Rahul Vaish (Special Nominee of Chairman, Senate)	Dr. Shailendra Saxena (KGMU, Lucknow) Dr. Siddappa N. Byrareddy (University of Nebraska Medical Center, Omaha, NE)
10	Indu Yadav (D14030)	DoJ: 02-02-2015 DoC: 04-06-2020 (5 years, 4 months)	Dr. Hitesh Shrimali (Guide)	Design and Analysis of Front-End Electronics for CMOS Pixel Detectors	Dr. Samar Agnihotri (Chair) Dr. Hitesh Shrimali (Guide) Dr. Rohit Y Sharma (Thesis Examiner) Prof. Santosh K Vishvakarma (Subject Expert) Dr. Suman Kalyan Pal (Special Nominee of Chairman, Senate)	Dr. Rohit Y Sharma (IIT Ropar) Prof. Daniel Durini (INAOE, Mexico)
11	Adil Usman (D15042)	DoJ: 18-8-2015 DoC: 11-06-2020 (4 years, 10 months)	Dr. Bharat Singh Rajpurohit (Guide)	Fault Diagnosis in Brushless Permanent Magnet Synchronous Motor Drive	Dr. Samar Agnihotri (Chair) Dr. Bharat Singh Rajpurohit (Guide) Prof. Naran Pindoriya (Thesis Examiner) Prof. Ravindra Arora (Subject Expert)	Prof. Naran Pindoriya (IIT Gandhinagar) Dr. Francisco M Gonzalez-Longatt (University of South Eastern Norway)
12	Joshi Ashish Shirish (D14029)	DoJ: 19-01-2015 DoC: 16-06-2020 (5 years, 5 months)	Dr. Satinder Kumar Sharma (Guide) Dr. Hitesh Shrimali (Co-Guide)	Multivalent Energy-Efficient CMOS Amplifiers and Data Converters for Signal Processing Applications	Dr. Samar Agnihotri (Chair) Dr. Satinder Kumar Sharma (Guide) Dr. Hitesh Shrimali (Co-Guide) Prof. Sudeb Dasgupta (Thesis Examiner) Prof. S.C.Bose (Subject Expert) Dr. Suman Kalyan Pal (Special Nominee of Chairman, Senate)	Prof. Sudeb Dasgupta (IIT Roorkee) Prof. Trond Ytterdal (Norwegian University of Science and Technology, Norway)

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Guide	Thesis Title	Viva- Voce Board	Thesis Examiners
13	Gadhave Kundlik Bhagwan (D16070)	DoJ: 01-02-2017 DoC: 26-06-2020 (3 years, 4 months)	Dr. Rajanish Giri (Guide)	The Dark Side of Alzheimer's Disease and Amyloid Formation by Signal Peptide of Amyloid Precursor Protein	Dr. Syed Abbas (Chair) Dr. Rajanish Giri (Guide) Dr. Pankaj Trivedi (Thesis Examiner) Dr. Bishwajit Kundu (Subject Expert) Dr. Bharat S Rajpurohit (Special Nominee of Chairman, Senate)	Dr. Bishwajit Kundu (IIT Delhi) Dr. Pankaj Trivedi (La Sapienza University of Rome, Italy)
14	Deepak Kumar (D15017)	DoJ: 27-07-2015 DoC: 29-06-2020 (4 years, 11 months)	Dr. Rajanish Giri (Guide)	Zika Virus Helicase: From Biophysics to Drug Discovery of a Moving Target	Dr. Syed Abbas (Chair) Dr. Rajanish Giri (Guide) Dr. Pankaj Trivedi (Thesis Examiner) Prof. Arvind Mohan Kayastha (Subject Expert) Dr. Bharat S Rajpurohit (Special Nominee of Chairman, Senate)	Dr. Arvind M. Kayastha (BHU, Varanasi) Dr. Pankaj Trivedi (La Sapienza University of Rome, Italy)
15	Subrata Mondal (D15007)	DoJ: 27-07-2015 DoC: 29-06-2020 (4 years, 11 months)	Dr. Rajesh Ghosh (Guide)	Biomechanical Analysis and Design Considerations of Tibial Component for Total Ankle Replacement	Dr. Viswanath Balakrishnan (Chair) Dr. Rajesh Ghosh (Guide) Prof. Debabrata Chakraborty (Thesis Examiner) Dr. Kaushik Mukherjee (Subject Expert) Dr. Anil K Sao (Special Nominee of Chairman, Senate)	Prof. Debabrata Chakraborty (IIT Guwahati) Dr. Abolfazl Zahedi (De Montfort University, UK)
16	Navneet Chandra Verma (D14009)	DoJ: 01-08-2014 DoC: 20-03-2020 (5 years, 7 months)	Dr. Chayan Kanti Nandi (Guide)	Single Molecule Blinking and Localization Based Superresolution Microscopy of Carbogenic Fluorescent NanoDots	Dr. Subrata Ghosh (Chair) Dr. Chayan Kanti Nandi (Guide) Dr. Sameer Sapre (Thesis Examiner) Dr. Arijit Kumar De (Subject Expert)	Dr. Sameer Sapra (IIT Delhi) Dr. Philip Tinnefeld (LMU, Munchen, Butenandtstr)
17	Rajesh Dhayal (D15026)	DoJ: 27-07-2015 DoC: 15-07-2020 (5 years)	Dr. Muslim Malik (Guide) Dr. Syed Abbas (Co-guide)	Study of Deterministic and Stochastic Differential Equations with Applications in Control Problems	Dr. Manoj Thakur (Chair) Dr. Muslim Malik (Guide) Dr. Syed Abbas (Co-guide) Prof. N. Sukavanam (Thesis Examiner) Dr. Arabind K Gupta (Subject Expert) Dr. Satinder K Sharma (Special Nominee of Chairman, Senate)	Prof. N. Sukavanam (IIT Roorkee) Prof. Ghana Bhaskar Tenali (Florida Institute of Technology, Melbourne, USA)
18	Shekhar Singh (D15027)	DoJ: 27-07-2015 DoC: 15-07-2020 (5 years)	Dr. Syed Abbas (Guide) Dr. Muslim Malik (Co-guide)	Study of Dynamic Equations on Time Scale with Applications	Dr. Manoj Thakur (Chair) Dr. Syed Abbas (Guide) Dr. Muslim Malik (Co-guide) Prof. Swaroop Nandan Bora (Thesis Examiner) Dr. S.C. Martha (Subject Expert) Dr. Rajeev Kumar (Special Nominee of Chairman, Senate)	Prof. Swaroop Nandan Bora (IIT Guwahati) Prof. Ioannis K Argyros (Cameron University, USA)

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Guide	Thesis Title	Viva- Voce Board	Thesis Examiners
19	Medha Kumar (D13015)	DoJ: 23-01-2014 DoC: 15-07-2020 (6 years, 6 months)	Dr. Varun Dutt (Guide)	Understanding and Improving Human Decisions Against Climate Change via Computer Simulation Tools	Dr. Samar Agnihotri (Chair) Dr. Varun Dutt (Guide) Dr. Harish Karnick (Thesis Examiner) Dr. Joachim Funke (Subject Expert) Dr. Chayan K Nandi (Special Nominee of Chairman, Senate)	Prof. Harish Karnick (IIT Kanpur) Prof. Joachim Funke (University of Heidelberg, Germany)
20	Shikha Gupta (D15068)	DoJ: 01-08-2014 (in M.S. by Research) DoJ; 16-03-2016 DoC: 24-07-2020 (6 years)	Dr. Dileep A D (Guide)	Dynamic Kernels and Semantic Representations for Recognition of Varying Size Scene Images	Dr. Samar Agnihotri (Chair) Dr. Dileep A D (Guide) Prof. C. Krishna Mohan (Thesis Examiner) Dr. Surya Prakash (Subject Expert) Dr. Prosenjit Mondal (Special Nominee of Chairman, Senate)	Prof. C. Krishna Mohan (IIT Hyderabad) Prof. Weiyao Lin (Shanghai Jiao Tong University Shanghai)
21	Bandhana Devi (D15035)	DoJ: 27-07-2015 DoC: 31-07-2020 (5 years)	Dr. Aditi Halder (Guide) Dr. Rik Rani Koner (Co-guide)	Metal Organic Materials Derived Nanostructures for Energy Conversion and Storage Applications	Dr. Syed Abbas (Chair) Dr. Aditi Halder (Guide) Dr. Rik Rani Koner (Co-guide) Dr. Debabrata Pradhan (Thesis Examiner) Dr. Debashish Adhikari (Subject Expert) Dr. Rajeev Kumar (Special Nominee of Chairman, Senate)	Dr. Debabrata Pradhan (IIT Kharagpur) Prof. David Zitoun (Bar-IIan University, Israel)
22	Shivani (D14024)	DoJ: 19-01-2015 DoC: 05-08-2020 (5 years, 6 months)	Dr. Hitesh Shrimali (Guide) Dr. Satinder Kumar Sharma (Co-guide)	High-κ Gate Dielectrics for Two-Dimensional Multilayer Hafnium Disulfide based Interdigitated Electrodes-Field-Effect Transistors: Next-Generation Technology	Dr. Samar Agnihotri (Chair) Dr. Hitesh Shrimali (Guide) Dr. Satinder Kumar Sharma (Co-guide) Dr. Santanu Mahapatra (Thesis Examiner) Prof. Ramesh Chandra (Subject Expert) Dr. Aditi Halder (Special Nominee of Chairman, Senate)	Dr. Santanu Mahapatra (IIsc Bangalore) Dr. Ashok Srivastava (Louisiana State University, USA)
23	Imran Ahamed (D14012)	DoJ: 01-08-2014 DoC: 20-08-2020 (6 years)	Dr. Arti Kashyap (Guide)	Ab-initio studies of exotic properties of ϵ-Fe_2O_3: A rare polymorph of iron oxide	Dr. Syed Abbas (Chair) Dr. Arti Kashyap (Guide) Prof. Yogesh Chauhan (Thesis Examiner) Dr. Bindu Radhamany (Subject Expert) Dr. Viswanath Balakrishnan (Special Nominee of Chairman, Senate)	Prof. Yogesh Chauhan (IIT Kanpur) Prof. Rajeev Ahuja (Uppsala University, Sweden)
24	Rohit Pathak (D14016)	DoJ: 13-08-2014 DoC: 25-08-2020 (6 years)	Dr. Arti Kashyap (Guide)	First Principles Investigation of Some Rare-Earth Free Permanent Magnets	Dr. Syed Abbas (Chair) Dr. Arti Kashyap (Guide) Prof. Yogesh Chauhan (Thesis Examiner) Dr. Sudhir Kumar Pandey (Subject Expert) Dr. Arpan Gupta (Special Nominee of Chairman, Senate)	Prof. Yogesh Chauhan (IIT Kanpur) Prof. Rajeev Ahuja (Uppsala University, Sweden)

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Guide	Thesis Title	Viva- Voce Board	Thesis Examiners
25	Pravat Kumar Jena (D14034)	DoJ: 06-02-2015 DoC: 01-09-2020 (5 years, 6 months)	Dr. Sarita Azad (Guide)	Observed and Projected Changes in Indian Monsoon Rainfall Extremes Under Changing Climate RCP8.5 Scenario	Dr. Syed Abbas (Chair) Dr. Sarita Azad (Guide) Prof. Govindan Rangarajan (Thesis Examiner) Prof. Mrinal Biswas (Subject Expert) Dr. Mohammad Talha (Special Nominee of Chairman, Senate)	Prof. Gocindan Rangarajan (IISc, Bangalore) Prof. Mrinal Biswas (NCAR, USA)
26	Nitin Sharma (D15018)	DoJ: 27-07-2015 DoC: 01-09-2020 (5 years, 1 month)	Dr. Rajanish Giri (Guide)	Zika Virus: Role of Envelope Protein in Entry and Therapeutics	Dr. Syed Abbas (Chair) Dr. Rajanish Giri (Guide) Dr. Pankaj Trivedi (Thesis Examiner) Prof. Vikas Kumar Dubey (Subject Expert) Dr. Rik Rani Koner (Special Nominee of Chairman, Senate)	Prof. Vikas K Dubey (IIT Bhu) Dr. Pankaj Trivedi (La Sapienza University of Rome, Italy)
27	Abhilash M (D14007)	DoJ: 05-08-2014 DoC: 04-09-2020 (5 years, 1 month)	Dr. Manu V Devadevan (Guide)	Land Regime, Agricultural Production and the Politics of Credit Money in Eighteenth Century Malabar	Dr. Suman Sigroha (Chair) Dr. Manu V Devadevan (Guide) Prof. Amar Farooqui (Thesis Examiner) Dr. John Thomas (Subject Expert) Dr. Ajay Soni (Special Nominee of Chairman, Senate)	Prof. Rila Mukherjee (University of Hyderabad) Prof. Amar Farooqui (University of Delhi) Prof. Dilip M Menon (University of Witwatersrand)
28	Sandeep Kumar Shukla (D14015)	DoJ: 12-08-2014 DoC: 24-09-2020 (6 years, 1 month)	Dr. Satvasheel Powar (Guide) Dr. Rahul Vaish (Co-guide)	$BaTiO_3$ Based Ferroelectric Ceramics for Bacterial Remediation in Aqueous Systems	Dr. Viswanath Balakrishnan (Chair) Dr. Satvasheel Powar (Guide) Dr. Rahul Vaish (Co-guide) Dr. Raman Suri (Thesis Examiner) Dr. Vijayendra Bhalla (Subject Expert) Dr. Hari Varma (Special Nominee of Chairman, Senate)	Prof. Raman Suri (IIT Ropar) Prof. Christopher Rhys Bowen (University of Bath)
29	Abhimanyu (D15014)	DoJ: 27-07-2015 DoC: 24-09-2020 (5 years, 2 months)	Dr. Deepak Swami (Guide)	Fate and Transport Study of contaminant through Saturated Porous Media	Dr. Viswanath Balakrishnan (Chair) Dr. Deepak Swami (Guide) Prof. T.I. Eldho (Thesis Examiner) Dr. Pramod Kumar Sharma (Subject Expert) Dr. Hitesh Shrimali (Special Nominee of Chairman, Senate)	Prof. T. I. Eldho (IIT Bombay) Prof. Jiri Simunek (University of California Riverside, USA)

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Guide	Thesis Title	Viva- Voce Board	Thesis Examiners
30	Pindoriya Rajesh Manjibhai (D15041)	DoJ: 18-08-2015 DoC: 06-10-2020 (5 years, 2 months)	Dr. Bharat Singh Rajpurohit (Guide) Dr. Rajeev Kumar (Co-guide)	Experimental Investigation of Acoustic Noise and Vibration of High Performance PMSM Drive	Dr. Samar Agnihotri (Chair) Dr. Bharat Singh Rajpurohit (Guide) Dr. Rajeev Kumar (Co-guide) Prof. Ashwani Sharma (Thesis Examiner) Dr. Ranjana Sodhi (Subject Expert) Dr. Prem Felix Siril (Special Nominee of Chairman, Senate)	Prof. Ashwani Kumar (NIT Kurukshetra) Dr. Francisco M. Gonzalezlongatt (University of South-Eastern Norway)
31	Krishan Sharma (D14025)	DoJ: 19-01-2015 DoC: 06-10-2020 (5 years, 9 months)	Dr. Renu M. Rameshan (Guide)	Exploring Geometrical Structures in Image and Video Data for Classification: From Subspaces to Matrix Manifolds	Dr. Samar Agnihotri (Chair) Dr. Renu M Rameshan (Guide) Prof. C. Chandra Sekhar (Thesis Examiner) Prof. Suyash Awate (Subject Expert) Dr. Kaustav Mukherjee (Special Nominee of Chairman, Senate)	Prof. C. Chandra Sekhar (IIT Madras) Prof. Brian C. Lovell (The University of Queensland, Australia)
32	Harmanpreet Singh (D12067)	DoJ: 25-06-2012 DoC: 06-10-2020 (8 years, 4 months)	Dr. Pradyumna Pathak (Guide)	Phonon Assisted Non-Linear Interaction and Quantum Entanglement in Semiconductor Cavity Quantum Electro Dynamics	Dr. Syed Abbas (Chair) Dr. Pradyumna Pathak (Guide) Dr. Subhashish Banerjee (Thesis Examiner) Dr. Subhrangshu Dasgupta (Subject Expert) Dr. Satinder Kumar Sharma (Special Nominee of Chairman, Senate)	Dr. Subhashish Banerjee (IIT Jodhpur) Prof. Alessio Serafini (University College London)
33	Manoj Das (D12066)	DoJ: 25-06-2012 DoC: 08-10-2020 (8 years, 4 months)	Dr. Pradyumna Pathak (Guide)	Study of Hybrid Optomechanical Systems	Dr. Syed Abbas (Chair) Dr. Pradyumna Pathak (Guide) Dr. Harshwardhan Wanare (Thesis Examiner) Dr. Asoka Biswas (Subject Expert) Dr. Dileep A D (Special Nominee of Chairman, Senate)	Dr. Harshwardhan Wanare (IIT Kanpur) Dr. Yuri Rostovtsev (University of North Texas, USA)
34	Juhi Pandey (D14020)	DoJ: 15-12-2014 DoC: 23-10-2020 (5 years, 10 months)	Dr. Ajay Soni (Guide)	Light Matter Interactions in Metal Chalcogenides Investigated by Optical Spectroscopy	Dr. Syed Abbas (Chair) Dr. Ajay Soni (Guide) Prof. Mandar Deshmukh (Thesis Examiner) Dr. Surajit Saha (Subject Expert) Dr. Padmanabhan Rajan (Special Nominee of Chairman Senate)	Prof. Mandar Deshmukh (Tata Institute of Fundamental Research, Mumbai) Prof. Radha Boya (University of Manchester, UK)
35	Piyush Kumar Avasthi (D15011)	DoJ: 27-07-2015 DoC: 28-10-2020 (5 years, 3 months)	Dr. Viswanath Balakrishnan (Guide)	Surface Engineering of CVD Grown Carbon Nanostructures for Supercapacitor Electrode Applications	Dr. Rajeev Kumar (Chair) Dr. Viswanath Balakrishnan (Guide) Dr. Sudakar Chandran (Thesis Examiner) Dr. C. Subramaniam (Subject Expert) Dr. Prem Felix Siril (Special Nominee of Chairman Senate)	Prof. S. Sudhakar (IIT Madras) Prof. Sebastian Pattinson (University of Cambridge)

b) Master of Science (MS.(by Research))

The following 9 M.S. scholars have completed all the requirements for the award of the degree of Master of Science (M.S. (by Research)) including submission of the final approved thesis.

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Thesis Title	Guide	Academic Progress Committee	External Examiners
1	Prakash Pratik (S15003)	DoJ: 20-07-2015 DoC:16-12-2019 (4 years 5 months)	Modelling and Analysis of Thermal Profile of Photovoltaic Module Installed on Rooftop	Dr. Kunal Ghosh	Dr. Anil K Sao (Chair) Dr. Kunal Ghosh (Guide) Dr. Hitesh Shrimali Dr. Satvasheel Powar	Dr. Himanshu Tyagi (IIT Ropar) Dr. Suneet Singh (IIT Bombay)
2	Seema Kumari (PTS1501)	DoJ: 29-04-2016 DoC:16-12-2019 (3 years 8 months)	Learning Based Depth Map Estimation: Considering Noise and Scene Categories	Dr. Arnav Bhavsar	Dr. Anil K Sao (Chair) Dr. Arnav Bhavsar (Guide) Dr. Aditya Nigam Dr. Syed Abbas	Dr. Chetan Arora (IIT Delhi) Dr. Balasubramanian Raman (IIT Roorkee)
3	Akash K Rao (S19018)	DoJ: 18-02-2016 in Ph.D.) Converted to M.S. (16-08-2019) DoC: 04-03-2020 (4 years)	Evaluation of Human Performance in Indirect Visual Displays and Virtual Reality	Dr. Varun Dutt	Dr. Renu Rameshan (Chair) Dr. Varun Dutt (Guide) Dr. Dileep A D Dr. Deepak Swami	Prof. Harish C Karnick (IIT Kanpur) Dr. Rina Maiti (IISc, Bangalore)
4	Bharat Vardani (S17009)	DoJ: 01-02-2018 DoC: 30-04-2020 (2 years, 2 months)	A Single Stage Inductive Wireless Power Transfer Using Matrix Converter for an Electric Vehicle Application	Dr. Narsa Reddy Tummuru	Dr. Bharat Singh Rajpurohit (Chair) Dr. Narsa Reddy Tummuru (Guide) Dr. Tushar Jain Dr. Rik Rani Koner	Dr. Siva Kumar K (IIT Hyderabad) Dr. Srinivas K Bhaskar (IIT Bhubaneswar)
5	Tejinder Thakur (S17006)	DoJ: 21-08-2017 DoC: 24-07-2020 (2 years, 11 months)	Study on the Factor Contribution of Micropile Pullout Resistance	Dr. Kala Venkata Uday	Dr. Sandip Saha (Chair) Dr. Kala Venkata Uday (Guide) Dr. Mousumi Mukharjee Dr. Maheshreddy Gade Dr. Manoj Thakur	Dr. Ayothiraman R. (IIT Delhi) Prof. G L Sivakumar Babu (IISc, Bangalore)
6	Chandni (S17003)	DoJ: 03-08-2017 DoC: 07-08-2020 (3 years)	Modelling of Solute Transport through Saturated Porous Media: Experimental and Numerical Approach	Dr. Deepak Swami	Dr. Rajeev Kumar (Chair) Dr. Deepak Swami (Guide) Dr. Kala Venkata Uday Dr. Manoj Thakur	Dr. Suresh Kartha (IIT Guwahati) Dr. Munish Chandel (IIT Bombay)
7	Bodhayan Nandi (S16002)	DoJ: 25-07-2016 DoC: 20-08-2020 (4 years, 1 month)	Closed Loop Control of Blood Glucose Level through Simultaneous Estimation of Blood Insulin and Glucose	Dr. Shubhajit Roy Chowdhury	Dr. Samar Agnihotri (Chair) Dr. Shubhajit Roy Chowdhury (Guide) Dr. Tushar Jain Dr. Hitesh Shrimali Dr. Prosenjit Mondal	Prof. Neeraj Sharma (IIT Bhubaneswar) Dr. Debjani Paul (IIT Bombay)

Sl. No	Name & Roll No.	Date of Joining/ Date of Completion	Thesis Title	Guide	Academic Progress Committee	External Examiners
8	Nayan Pundhir (S16009)	DoJ: 01-02-2017 DoC: 28-08-2020 (3 years, 6 months)	Impact Behaviour of Microwave-Assisted Compression Moulded HDPE/Kenaf and HDPE/MWCNT Composites	Dr. Sunny Zafar (Guide) Dr. Himanshu Pathak (Co-guide)	Dr. Viswanath Balakrishnan (Chair) Dr. Sunny Zafar (Guide) Dr. Himanshu Pathak (Co-guide) Dr. Mohammad Talha Dr. Gopi Shrikanth Reddy Dr. Satvasheel Powar	Prof. Apurbba Kumar Sharma (IIT Roorkee) Prof. Navin Kumar (IIT Ropar)
9	Shete Snehal Dilip (S16014)	DoJ: 14-02-2017 DoC: 07-09-2020 (3 years, 6 month)	Image Analysis and Synthesis for Maize Phenotyping	Prof. T. A. Gonsalves & Dr. Srikant Srinivasan (Guide)	Dr. Samar Agnihotri (Chair) Prof. T. A. Gonsalves (Guide) Dr. Srikant Srinivasan (Guide) Dr. Anil K Sao Dr. Shyamashree Dasgupta	Dr. S.R. Mahadeva Prasanna (IIT Dharwad) Dr. Sumantra Dutta Roy (IIT Delhi)

c) Master of Science in Chemistry (M.Sc. (Chemistry))

The following 26 students have completed all the requirements for the award of the degree of Master of Science (M.Sc. (Chemistry)). Their names and Roll Nos. are as given below:

Sl. No.	Roll.No.	STUDENT NAME
1	V18031	AKHIL BHARDWAJ
2	V18032	CHANJOT KAUR
3	V18033	ABHISHEK JAIN
4	V18034	KRITI KOCHAR
5	V18035	RITU
6	V18036	PAVITRA SRIVASTAVA
7	V18037	ANJALI NEGI
8	V18038	AASTHA JAIN
9	V18039	POOJA SHARMA
10	V18040	DEEKSHA SHARMA
11	V18041	SRISHTI GUPTA
12	V18042	ADITYA PRASUN
13	V18043	PARUL SHARMA
14	V18044	GULNAAZ
15	V18045	RAJDIP SONI
16	V18046	RAJAT SAINI
17	V18047	SHRIYA RAWAL
18	V18048	KRITI SHAKYA
19	V18049	MOHAMMAD ZEESHAN ALAM
20	V18050	ANKIT PATEL

21	V18051	HIMANSHU SAINI
22	V18052	SUNIDHI
23	V18053	NISHCHAL CHAUHAN
24	V18054	SANIYA
25	V18056	NEHA
26	V18057	BHOLA NATH GUPTA

d) Master of Science in Applied Mathematics (M.Sc. (Mathematics))

The following 29 students have completed all the requirements for the award of the degree of Master of Science (M.Sc. (Applied Mathematics)). Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	V18001	SANTOSH
2	V18002	ARISHI ORRA
3	V18003	NISHA
4	V18004	MONIKA NANDAL
5	V18005	DIVYA AGRAWAL
6	V18006	ANURAG TIWARI
7	V18008	ALKA SINGH CHAUHAN
8	V18009	NAMRATA MANI TRIPATHI
9	V18010	SONU
10	V18011	HIMANSHU CHOUDHARY
11	V18012	POONAM
12	V18013	VIKASH KUMAR POONIYA
13	V18014	RISHABH SAINI
14	V18015	AMIT KUMAR YADAV
15	V18016	SANJAY
16	V18017	AWANDKAR ASHISH NANDKISHOR
17	V18018	MAHESH KUMAR OLA
18	V18019	PAYAL
19	V18020	KM YATNESH
20	V18022	NAWANG THAKUR
21	V18023	MOHIT KAPOOR
22	V18024	MANTU PRASAD GUPTA
23	V18025	SIDHARTHA SANKAR PRADHAN

24	V18026	RAHUL
25	V18027	VISHNU SHARMA
26	V18028	YASH KUMAR
27	V18029	ANJU BAWRA
28	V18030	VIMAL KUMAR
29	V17043	NIKHIL RAGHAV

e) Master of Science in Physics (M.Sc. (Physics))

The following 22 students have completed all the requirements for the award of the degree of Master of Science (M.Sc. (Physics)). Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	V18061	AKASH
2	V18062	PANKAJ KUMAR
3	V18063	SAGAR REWADIA
4	V18065	JAGRITI AHUJA
5	V18066	SHUMILE AHMED SIDDIQUI
6	V18067	POOJA MANRAL
7	V18068	SARDAR DILBAG SINGH KHALSA
8	V18069	MONU MEHTA
9	V18070	YOGESH YADAV
10	V18071	ARSHAD
11	V18072	NIKESH KUMAR
12	V18073	ANURAG KUMAR
13	V18074	EKTA KUMARI
14	V18076	RAHUL DHANKHAR
15	V18077	SANTOSH KUMAR SAHU
16	V18078	DEENBANDHU SHARMA
17	V18079	BHISMA NARAYAN MAHANTY
18	V18080	SONU KUMAR KULDEEP
19	V18081	RAHUL SHARMA
20	V18082	GOURAV
21	V18083	KIRTI
22	V18084	SUNITA TAREI

f) Master of Technology in Mechanical Engineering with specialization in Energy Systems (MES)

The following 23 students have completed all the requirements for the award of the degree of Master of Technology in MES. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18121	SUBHAV CHAUHAN
2	T18122	RENU TEWARI
3	T18123	PAWAN SINGH BISHT
4	T18125	AMIT KUMAR CHOUDHARY
5	T18127	VAGISH KUMAR
6	T18128	JAIPRAKASH ANAND
7	T18129	SANDEEP YADAV
8	T18130	AMAN KUMAR SONI
9	T18131	KARAN
10	T18132	SONU KUMAR
11	T18133	DIVANSHU GUPTA
12	T18134	VIJAY TIWARI
13	T18135	SATYAM SINGH THAKUR
14	T18136	TARUN PRATAP SINGH
15	T18137	MAN MOHAN SINGH PATEL
16	T18138	KUNWAR PRATAP SINGH YADAV
17	T18140	GAIKWAD DEEPAK GANGADHAR
18	T18141	ANSHUL MEHROTRA
19	T18142	VARUN KUMAR
20	T18143	RAMEEZ RAJA KHAN
21	T18144	SAMANVAY ANAND
22	T18145	PRAKASH GIRI
23	T16002	ASHUTOSH RAINJAN DEV

g) Master of Technology in Energy Engineering with specialization in Materials (EEM)

The following 14 students have completed all the requirements for the award of the degree of Master of Technology in EEM. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18151	MOHIT BARTHWAL
2	T18152	ANKIT JOSHI

3	T18153	ABHISHEK GOEL
4	T18154	DHARMENDER KUMAR
5	T18163	HARSH ARORA
6	T18168	GAURAV KUMAR
7	T18169	KAWADE SAYALI MARUTI
8	T18175	CHHAIL BIHARI SONI
9	T18176	MARUTI NANDAN TRIPATHI
10	T18177	SHOBHIT NIGAM
11	T18178	RAHUL SINGH
12	T18179	MOHD UZAIR KHALIDI
13	T18180	VAIBHAV KUMAR MITTAL
14	T18181	VIKRAM BISHT

h) Master of Technology in Structural Engineering (SE)

The following 17 students have completed all the requirements for the award of the degree of Master of Technology in Structural Engineering. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18101	VARUN SHARMA
2	T18102	AJENDRA SINGH
3	T18103	HIMANSHU SINGH GANGWAR
4	T18105	MD MASIBUL
5	T18106	ANAND SHAW
6	T18107	GANESH JAISWAL
7	T18108	SAURABH KUMAR
8	T18109	MAHIPAL KULARIYA
9	T18110	SUMIT KUMAR
10	T18111	GEETHESH N
11	T18112	NAVEEN BHARTI
12	T18113	SHAILENDRA KUMAR SINGH
13	T18114	GURPREET SINGH
14	T18115	SAURKAR ATHARV ANANT
15	T18116	KSHITIJ TANDON
16	T18117	MOHAMMAD TALAHA SIDDIQUI
17	T18118	BHAG CHAND MEENA

i) Master of Technology in VLSI:

The following 9 students have completed all the requirements for the award of the degree of Master of Technology in VLSI. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18001	SANDEEP PAREEK
2	T18002	MONU
3	T18004	SASWATH T
4	T18005	SHAKTI SINGH
5	T18006	NISHANT SINGH
6	T18009	PRASHANT SHARMA
7	T18010	ASHISH TIWARI
8	T18011	KANCHAN SINGH RANA
9	T18013	SHUBHAM MISHRA

j) Master of Technology in Power Electronics and Drives (PED)

The following 14 students have completed all the requirements for the award of the degree of Master of Technology in PED. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18062	RAJIV
2	T18064	VISHNU PRASAD J
3	T18067	ABHINAV SINGH KASHYAP
4	T18068	DEEPAL GUPTA
5	T18069	PATEL PARTH HASMUKHBHAI
6	T18071	KARTIK SHARMA
7	T18072	VIVEK KUMAR SHARMA
8	T18073	LALWANI ROHAN RAJKUMAR
9	T18074	CHANDAN BHARTI
10	T18077	MAYANK GUPTA
11	T18078	MD IRSHAD ANSARI
12	T18079	ABHISHEK KUMAR
13	T18080	AJEET KUMAR YADAV
14	T18081	POGULAGUNTLA RAVI TEJA

k) Master of Technology in Communications and Signal Processing (CSP)

The following 10 students have completed all the requirements for the award of the degree of Master of Technology in CSP. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18031	SUPRIYO BANERJEE
2	T18032	PUSHAP DEEP SINGH
3	T18033	ANKIT CHAKRABORTY
4	T18034	NILESH KUMAR SHUKLA
5	T18035	MAHESH KUMAR GUPTA
6	T18036	HIMANSHI THAKKAR
7	T18037	RISHABH RANJAN
8	T18038	SOUVIK MITRA
9	T18039	SOMPAL SINGH
10	T18040	SUBHANSHU SAHU

l) Master of Technology in Biotechnology:

The following 10 students have completed all the requirements for the award of the degree of Master of Technology in Biotechnology. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	T18201	ANIRBAN BANDYOPADHYAY
2	T18202	VIKAS KUMAR SINHA
3	T18203	DEEPANSHU VERMA
4	T18204	ANKUR KUMAR
5	T18205	GUDIVADA JAYANTHLAL
6	T18206	ASHUTOSH KUMAR SINGH
7	T18207	PREM CHAND
8	T18208	NIKITA DESHWAL
9	T18209	MEENAKSHI APPASAHEB SHEGANE
10	T18210	GEHI BHUVANESHWARI RAJENDRAKUMAR

m) Master of Arts in Development Studies:

The following 12 students have completed all the requirements for the award of the degree of Master of Arts in Development Studies. Their names and Roll Nos. are as given below:

Sl. No.	Roll No.	STUDENT NAME
1	A18001	TAJ UD DIN MALIK
2	A18002	NAMALA SATYA KISHAN KUMAR
3	A18003	SRIVIDYA R
4	A18004	MRIDU BALA
5	A18005	NIKITA AGGARWAL
6	A18006	SHASHANK SHEKHAR
7	A18007	ANUPREET KAUR
8	A18008	RAJAT CHAUDHARY
9	A18009	SOURABH YADAV
10	A18011	ABBA ROHITH
11	A18012	PIYUSH KUMAR
12	A18013	MANISHA

n) Bachelor of Technology (B.Tech.) in Computer Science and Engineering

The following 59 students have completed all the requirements for the award of 'Bachelor of Technology' degree in Computer Science and Engineering. Their names and Roll. Nos. are as given below:

Sl. No.	Roll No.	Student Name	Sl. No.	Roll No.	Student Name
1	B16001	AASHISH KUMAR	31	B16033	SARTHAK SHEKHAWAT ***(With Minor in Management)***
2	B16002	ABHINANDAN ***(With Minor in Management)***	32	B16034	SHASHWAT GARG
3	B16003	ABHINAV DIXIT	33	B16035	SHUBHAM CHOUDHARY (***With Minor in Management)***
4	B16004	AJ R LADDHA (***With Minor in Management)***	34	B16036	SUJETTH RANGANNATH NELLUTLA
5	B16005	AKHILESH DEVRARI	35	B16037	SURYAVANSHI VIRENDRASINGH BASANTLAL(***With Minor in Management)***
6	B16006	AKUL GUPTA (***With Minor in Management)***	36	B16038	SYLVIA MITTAL ***(With Minor in Management)***
7	B16007	AMAN KHANDELWAL	37	B16039	VINAYAK KUTHIALA
8	B16009	AMIT RAJAIN	38	B16040	VISHAL ANAND

Sl. No.	Roll No.	Student Name	Sl. No.	Roll No.	Student Name
9	B16010	AMRENDRA SINGH (***With Minor in Management)***	39	B16041	VISHNU PRIYA JINDAL (***With Minor in Management)***
10	B16011	ANANT MISHRA	40	B16044	AMAN JAIN (***With Minor in Management)***
11	B16012	ANSHUL GUPTA	41	B16047	ARPIT BATRA (***With Minor in Management)***
12	B16014	ASHUTOSH JAMADARI	42	B16056	GAGANDEEP TOMAR (***With Minor in Management)***
13	B16015	BHARAT LODHI (***With Minor in German Language)& (With Minor in Management)***	43	B16060	LAKSHYA ARORA
14	B16016	BHAVYA BHATT	44	B16061	LOKESH KUMAR (***With Minor in Management)***
15	B16017	DHRUBODEEP BASUMATARY	45	B16065	NAVNEET SHARMA (***With Minor in Management)***
16	B16018	DILIP KUMAR CHAUHAN (***With Minor in Management)***	46	B16066	NIKHIL T R
17	B16019	HEMANT KUMAR (***With Minor in German Language)***	47	B16067	PALAK GUPTA (***With Minor in Management)***
18	B16020	KARAN KALRA	48	B16069	PRABHAKAR PRASAD (***With Minor in Management)***
19	B16021	KAUSTUBH VERMA	49	B16072	RAJAN BAJAJ (***With Minor in Management)***
20	B16022	NAVEEN KUMAR CHOUHAN (***With Minor in Management)***	50	B16077	SHIVAM VERMA (***With Minor in Management)***
21	B16023	NIKHIL GUPTA	51	B16082	ABHIGYAN KHAUND
22	B16024	NIRAJ YADAV	52	B16085	ADITYA SINGH (***With Minor in Management)***
23	B16025	PRASHANT SHEKHAR GUPTA	53	B16091	ANIRUDH PRASAD NISTALA
24	B16026	PRATYUSH GAURAV	54	B16092	ANMOL PASSI
25	B16027	PRIYANSHU KHANDELWAL	55	B16094	CHIRAG VASHIST **B.Tech (Honours)** ***with Minor in Management)***
26	B16028	ROHIT KAUSHAL (***With Minor in Management)***	56	B16097	HRITIK GUPTA (***With Minor in German Language)***
27	B16029	HRISHIKESH SAGAR	57	B16117	SURYAKANT BHARDWAJ
28	B16030	SAJAL BORIS (***With Minor in German Language)& (With Minor in Management)***	58	B16120	YASH AGRAWAL (***With Minor in Management)***
29	B16031	SAMMARTH KAPSE	59	B16124	ANAND RAMRAKHYANI
30	B16032	HRUSHIKESH SUDAM SARODE			

o) Bachelor of Technology (B.Tech.) in Electrical Engineering

The following 41 students have completed all the requirements for the award of 'Bachelor of Technology' degree in Electrical Engineering. Their names and Roll. Nos. are as given below:

Sl. No.	Roll No.	Student Name	Sl. No.	Roll No.	Student Name
1	B16042	AGRAWAL PARESH KISHANLAL	22	B16075	ROHAN AGRAWAL (***With Minor in Management)***
2	B16043	AJAY KUMAWAT	23	B16076	SHASHI MOHAN
3	B16045	ANAND KUMAR	24	B16078	SIRASALA VENKAT RAM
4	B16046	ANURAG MAURYA	25	B16079	SONALI JAGARWAL
5	B16048	ASHISH KUMAR MEENA	26	B16080	TIRUPATI MISHRA
6	B16049	AVINASH KUMAR ARYAN	27	B16081	VEDANT AGGARWAL (***With Minor in Management)***
7	B16050	BHAVESH KUMAR	28	B16008	AMAN ROHILLA
8	B16051	CHAHAK GODARA	29	B16103	MUKUL JANGID
9	B16052	DAKSH SAGAR	30	B16109	PATIL PIYUSH RAJENDRA
10	B16054	DEEPAK JARWAL	31	B16110	RITWIK SAHA
11	B16055	DEVASHISH SINGH	32	B16119	VIVEK SHARMA
12	B16057	GAURAV KUMAR (***With Minor in Management)***	33	B16125	ANKIT KUMAR
13	B16058	KADARU SAHITH (***With Minor in Management)***	34	B16127	AYUSH MEGHWANI (***With Minor in Management)***
14	B16062	M AMUDHAN	35	B16138	RAM LAKHAN (***With Minor in Management)***
15	B16063	MANISH SHARMA (***With Minor in Management)***	36	B16139	RANDHEER KUMAR
16	B16064	MOHD NADEEM	37	B16145	SHREYAS BAPAT (***With Minor in Management)***
17	B16068	PIYUSH (***With Minor in Management)***	38	B16146	SHUBHAM KUMAR
18	B16070	PURVESH CHHAJED	39	B16147	SIDDHARTH SINGH
19	B16071	RACHIT MAHESHWARI	40	B16148	SURENDER KUMAR
20	B16073	RAKSHIT MATTA (***With Minor in Management)***	41	B14222	NITESH KUMAR
21	B16074	RAKSHIT RAJ (***With Minor in Management)***			

p) Bachelor of Technology (B.Tech.) in Mechanical Engineering

The following 25 students have completed all the requirements for the award of 'Bachelor of Technology' degree in Mechanical Engineering. Their names and Roll. Nos. are as given below:

Sl. No.	Roll No.	Student Name	Sl. No.	Roll No.	Student Name
1	B16083	ABHIJEET RAJPUT	14	B16102	MOTHI KAILAASH S
2	B16084	ABHISHEK KUMAR BHASKAR	15	B16104	NAMAN CHAUDHARY (***With Minor in Management)***
3	B16086	AJAY KUMAR	16	B16105	NAVEEN KUMAR (***With Minor in Management)***
4	B16087	AKASH KUMAR	17	B16106	NEELOTPAL DUTTA **B.Tech (Honours)** ***with Minor in Management)***
5	B16088	AKKAPELLI AKHIL	18	B16107	NISHANT RANA
6	B16089	AMIRTH VARSHAN	19	B16111	SAQUIB RAZA
7	B16090	AMIT RANJAN (***With Minor in Management)***	20	B16112	SATPAL MEENA
8	B16093	BASUPALLY ROHITH	21	B16113	SHANTANU KAUSHIK (***With Minor in Management)***
9	B16095	GAGANDEEP SINGH	22	B16115	SHIVAM CHAUDHARY (***With Minor in Intelligent Systems)***
10	B16096	GARVIT MATHUR (***With Minor in Management)***	23	B16116	STANZIN TSOGNIS
11	B16098	KASHYAP PARAM PRABHAKAR (***With Minor in Management)***	24	B16118	VIKAS KUMAR MEHARDA
12	B16100	KULDEEP ANJANA (***With Minor in Management)***	25	B16144	SHISHIR ASTHANA (***With Minor in Management)***
13	B16101	KUMAR ABINASH MISHRA (***With Minor in Applied Physics)***			

q) Bachelor of Technology (B.Tech.) in Civil Engineering

The following 19 students have completed all the requirements for the award of 'Bachelor of Technology' degree in Civil Engineering. Their names and Roll. Nos. are as given below:

Sl. No.	Roll No.	Student Name
1	B16121	ABHAY KUMAR
2	B16122	AJAY KUMAR

3	B16126	ASHUTOSH KUMAR
4	B16128	BHANU SINGH
5	B16129	CHIRAG SINGH
6	B16130	GAURAV MEENA
7	B16131	HARDEEP MALIK (***With Minor in Management)***
8	B16132	HARSH GARG
9	B16133	MOHIT GOUNIYAL
10	B16134	NIDHIKA KADELA (***With Minor in Management)***
11	B16136	NIYUSH KATHERIA
12	B16137	PARIMAL KUMAR (***With Minor in Management)***
13	B16140	RIJUL
14	B16142	ROHIT KUMAR
15	B16143	SAURABH KUMAR
16	B16149	VIJAY KUMAR
17	B16150	VISHAL MAHAR
18	B16151	YOGESH MEERWAL
19	B16099	KIRTI JORWAL (***With Minor in Management)***

Annexure-B

Course Name	:	Consumer Behavior
Course Number	:	HS 461
Credits	:	3-0-0-3
Students intended for	:	B.Tech
Old Course/New Course	:	New Course **(Elective)**

Course Description

Consumer behavior focuses on *why* as *well* as *how* consumers make specific decision and behave in certain ways- what motivates them, what captures their attention, and what retains their lo yalty (i.e. whats turns customers in to "fans"of an organisation). Getting answers to question to questions about why prople buy and consume requires an examination of many different aspects of consumers and their behaviors, from their motivations, personalities, knowledge, and atti tudes to the process by which they make their purchase and consumption decisions. This examination also includes understanding things as far-reaching as the consumer's culture and macro-economic conditions as well as influences exerted by the consumer's peer and

family. You'll not only be able to apply this knowledge to nearly any carri er you choose, but also apply it to your personal decisions, making you a wiser consumer.

Course Content:

Part One: Introduction

1. Consumer Behaviour: Meeting Changes and Challenges
2. Consumer Research Process
3. Marketing Segmentation and Strategic Training

Part Two: The Consumer as an Individual

4. Consumer Motivation
5. Personality and Consumer Behaviour
6. Consumer Perception
7. Consumer Learning
8. Consumer Attitude Formation and Change
9. Communication and Consumer Behaviour

Part Three: Consumer in their Social and Cultural Settings

10. The Family and Social Class
11. Influence of Culture on Consumer Behaviour
12. Cross Cultural Consumer Behaviour: An International Perspective

Part Four: The Consumer's Decision Making Process and Ethical Dimensions

13. Consumer and the Diffusion of Innovations
14. Consumer Decision Making and Beyond
15. Marketing Ethics and Social Responsibility

Suggested Readings:

1. Schiffman,
   Leon G., Kanuk, L.L., & Kumar, S.Ramesh (2010). Consumer Behavior (10th Edition). Pearson Edu.
2. Blackwell,
   R.D., Miniard, P.W., & Engel, J.F. (2006). Consumer Behaviour. Cengage Learning.
3. Kumar, S. Ramesh (2013). Case Studies in Consumer Behaviour. Pearson Edu.

(2) *Course Name:* Introduction to Computer Graphics and Design

Course Number: CS594

Credits: 3-0-2-4

Prerequisites: Linear algebra or real-analysis or any entry-level course in Mathematics or approval of the instructor. Some experience with writing computer-code is expected.

Intended for: B.Tech. (CSE, EE and ME) II/III/IV year/ MS/M.Tech /PhD (any branch)

Distribution: Elective for B.Tech. II/III/IV year/ MS/M.Tech/PhD

Semester: Odd/Even

Preamble: This course is intended to introduce the graphics processing pipeline found in modern day computers. This pipeline has three main phases. Depending on the application domain, the first phase creates 2D/3D modeling data which is in either discrete or continuous format. The second phase converts this data into simpler discrete primitive forms such as points, line-segments and triangles. The final phase maps this data onto the pixels of the computer display. Topics from all the three phases will be discussed. The course will include assignments about using popular graphics software suites as well as programming assignments.

Learning outcome: After taking this course, students will

1. be familiar with the graphics processing pipeline.
2. understand in depth, the set of fundamental algorithms which drive modern graphics engines.
3. be able to choose between alternative graphics/geometry data-structures which best suit the target application.
4. get hands-on experience with graphics programming APIs such as OpenGL.
5. get familiarity with using 3D graphics software packages such as Blender.
6. be able to create realistic scenes and environments.
7. be able to choose between alternative light sources and object materials in order to achieve the desired visual effect.
8. be able to use design kernels such as Open Cascade for solid modeling.
9. be able to design simple video games.

Course modules:

1. *Introduction:* (3 lecture hours)
   Motivation; Use of computer graphics in different domains; Digital display technologies; Color; Graphics processing pipeline; OpenGL.

2. *Geometry representation:* (3 lecture hours)

Lines, triangles, polygons, meshes, point-clouds, polynomials, B-splines; Parametric v/s. implicit representation, boundary representation, volumetric representation.

3. *Rasterization:* (8 lecture hours)
   World and camera transformations; Orthogonal and perspective projections; Hidden-surface removal, Z-buffering; Bresenham's line drawing algorithm; Triangle drawing primitive; Flood-fill algorithm.

4. *Lighting, shaders and texture mapping:* (8 lecture hours)
   Radiometric concepts such as BRDF, BTDF, BSSRDF; Types of light sources such as point, spot, parallel; Texture mapping; Shading schemes such as Flat, Gouraud, Phong; Flattening of 3D surfaces; Bump maps, Normal maps, Displacement maps.

5. *Ray tracing and ray casting:* (5 lecture hours)
   Mechanism of tracing the path of light in order to generate realistic images from 3D scenes.

6. *Modeling with curves:* (8 lecture hours)
   Differential geometry of planar and space curves; Definition and basic properties of Bezier and B-spline curves; Weierstrass approximation theorem.

7. *Modeling with surfaces:* (7 lecture hours)
   Differential geometry of surfaces; Definition and basic properties of tensor-product Bezier surfaces.

Lab exercises:

Lab to be conducted on a 2-hour slot. It will be conducted in tandem with the theory course so the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course shall be appropriately sequenced for synchronization with the laboratory.

Lab1: Installation of Blender, familiarization of the GUI, simple exercises involving creation of primitive shapes. Installation of OpenGL, writing a 'Hello World' application. Draw a few parametric as well as implicitly defined curves.

Lab2-3: Implementation of Bresenham's line drawing algorithm. Implementation of flood-fill algorithm.

Lab4-6: Create a 3D scene in Blender and apply various models of light-interaction such as BRDF, BTDF, BSSRDF. Insert different types of light sources into the scene. Apply textures to 3D objects. Lighting and shading in OpenGL, Raytracing

Lab7-8: Implementation of ray-tracing.

Lab9-11: Installation of Open Cascade. Construct and plot Bezier curves. Plot the tangents and osculating circles at a few points. Plot the Frenet frame at a few sampled points. Construct and plot B-spline curves.

Lab12-13: Construct and plot tensor-product Bezier surfaces. Plot tangent-plane and curvature at sampled points. Extract iso-curves.

Textbooks:

1. Donald D. Hearn *et al., Computer Graphics with OpenGL,* 3rd edition, Pearson, 2013

Reference Books:

1. Steve Marschner et al., *Fundamentals of Computer Graphics,* 4th Edition, A K Peters/CRC Press, 2015
2. Gerald Farin, *Curves and Surfaces for CAGD,* 5th Edition, 2001
3. Dave Shreiner, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Versions 3.0 and 3.1 (7^{th} Edition)

Content Similarity Declaration with Existing Courses: N/A

Sr #	Course code	Similarity content	Approx. % of content
N/A	N/A	N/A	N/A

Justification for new course proposal if cumulative similarity content is > 30%: N.A.

Approvals:
Other Faculty who may be interested in teaching this course:

Proposed by Jinesh Machchhar School: SCEE

LIST OF COURSES TAKEN BY THE GRADUATING STUDENTS DURING SEMESTER EXCHANGE VISITS AT DIFFERENT ABRAOD UNIVERSITIES:

Course Code	1212311
Credit	4
Subject Title	Introduction to Computational Differentiation
Name of the Institute	RWTH Aachen University, Germany
Description	The availability of state-of-the-art numerical simulation software is an essential ingredient in the investigation of a large number of problems in science and engineering Simulation software is an enabeling technology in areas such as climate research/weather prediction, fluid dynamics for automobile and aircraft construction, chemistry and biology, or prediction of economical developments. Numerical simulation programs are often highly complex and their execution requires large computational resources. They are intended for use over long time periods to amortize development time and costs. Numerical codes are not static. Continued code development and optimization often require semantical transformations to ensure applicability of modern mathematical and computational methods. This lecture introduces the basics as well as a number of special techniques for the automatic source transformation of computer programs. An important application of these methods is the generation of efficient tangent-linear and adjoint codes by automatic differentation. The associated tutorial complements the content of the lecture with practical implementations.

Course Code	1215720
Credit	4
Subject Title	High-Performance Computing
Name of the Institute	RWTH Aachen University, Germany
Description	Parallel Computer Architectures, Network Topologies, Methods for Parallel Algorithms, Design of Parallelism (Speedup, Efficiency, Amdahl), Introduction to Parallel Programming. Simple Performance Modeling

Course Code	1215725
Credit	4
Subject Title	Parallel Programming
Name of the Institute	RWTH Aachen University, Germany
Description	This course teaches parallel programming for science and engineering. Emphasis is given to programming models predominantly used in high-performance computing - Parallel architectures - Principles of parallel performance - Processes and threads - MPI - OpenMP - Patterns of parallel programming Learning objectives:The students should be enabled to write correct and efficient parallel programs.

Course Code	1216861
Credit	4
Subject Title	Introduction to Data Science
Name of the Institute	RWTH Aachen University, Germany
Description	The course, Introduction to Data Science offered by the Chair of Process and Data Science (PADS) within the scope of the new programme, Master of Data Science" can now also officially be selected as a semi-elective module (Wahlpflichtfach) for the following Master Programmes: - Master Informatik - Master Software Systems Engineering (SSE) - Master Media Informatics. The module is currently added to the relevant exam regulations of the master programmes mentioned above.

Course Code	IN2073
Credit	2.67
Subject Title	Cloud Computing
Name of the Institute	Technical University Munich (TUM), Germany
Description	The students know the goals of Cloud and Grid computing. They can present application scenarios in different domains. They are familiar with the fundamental techniques in the areas security, application development and resource management. They can identify the differences and similarities between Cloud and Grid computing and distributed systems. They are able to participate in Cloud and Grid-related research projects. The lecture starts with an introduction and a presentation of the base technologies for Cloud and Grid computing. The layered architecture of Grids and the base services are presented. Cloud Computing is then introduced and the different models SaaS, PaaS, laaS. The list of base services is extended for Cloud Computing. The lecture also covers a discussion of legal issues. The concepts of Grid and Cloud Computing are introduced in the lecture. In the exercises, the student work on assignments that allow them to train the development of Cloud applications. References to current literature allow the students to deepen their understanding of the concepts.

Course Code	IN2107
Credit	3.33
Subject Title	Seminar Course Recent Advances in 3D Computer Vision
Name of the Institute	Technical University Munich (TUM), Germany
Description	Visual simultaneous localization and mapping (SLAM) or Structure from Motion (SM) is a classical problem in computer vision. It has wide applications in autonomous navigation, virtual/augmented reality, 3D scanning etc. In this seminar, we will start by reviewing the classical approaches in the literature and then proceed to the more recent methods for SLAM and SIM. In particular, topics will range from monocular to stereo and RGB-D cameras, from static methods to dynamic settings, and from low-level feature-based algorithms to high-level semantics-oriented approaches.

Course Code	IN2346
Credit	4
Subject Title	Introduction to Deep Learning
Name of the Institute	Technical University Munich (TUM), Germany
Description	- Introduction to Computer Vision and history of Deep Learning - Machine learning Basics 1: linear classification, maximum likelihood - Machine learning basics 2: logistic regression, perceptron - Introduction to neural networks and their optimization, SGD, Back-propagation - Training Neural Networks Part 1: regularization, activation functions, weight initialization, gradient flow, batch normalization, hyperparameter optimization - Training Neural Networks Part 2: parameter updates, ensembles, dropout - Convolutional Neural Networks - CNN for object detection (from MNIST to ImageNet). visualizing CNN (DeepDream) - Recurrent networks and LSTMS - Research 1: Prominent architectures, e.g. GoogleNet, ResNet - Research 2: Reinforcement learning - Research 3: Adversarial networks

Course Code	WI000231
Credit	4
Subject Title	Asset Management
Name of the Institute	Technical University Munich (TUM), Germany
Description	The target of the module is to familiarize students with the concept of Asset Management from a theoretical perspective. The module provides the theoretical foundation that is required to understand typical problems in Asset Management and illustrates how to solve these problems effectively by means of the appropriate tools (e.g. Excel Solver) The following contents are addressed: - Utility Theory and decisions under uncertainty - Theory and application of basic models of portfolio theory with a particular focus on portfolio optimization under various contraints in the Markowitz mean-variance framework - Theory and application of asset pricing models (e.g. Capital

	Asset Pricing Model, Arbitrage Pricing Theory) - Theory and application of conditional asset pricing - Portfolios Performance Measurement The module combines various learning methods: -Basic knowledge, theoretical concepts and practical examples will be provided through the lecture. - Controversial discussions and active participation in class are encouraged to deepen understanding of the concepts presented. - In the exercises, students will apply their theoretical knowledge to concrete - Demonstration of how to apply portfolio optimization on real-world data by using Excel - Students will get insights into practice via several guest lecture

Course Code	WI000739
Credit	4
Subject Title	Consumer Behavior
Name of the Institute	Technical University Munich (TUM), Germany
Description	Learning outcomes : At the end of the module the students will be able to understand types and trends in consumer behavior. They will be able to apply different theoretical approaches to consumer behavior and to analyze consumer behavior in different socio-economic contexts. Students will also be able to analyze the implications of market developments for consumer behavior. content : The objective of this module is to provide students with an understanding of consumer behavior and scientific approaches to consumer behavior research. The students get to know the main models of consumer behavior and the main determinants of consumer behavior in the cultural and socio-demographic background. The module also provides an understanding of how consumers make choices and which factors influence the process of decision-making. Teaching and learning method : The module consists of a lecture and an exercise. During the lecture the contents are delivered via presentation and talks. Exercises involve group discussions, case studies and discussion of scientific articles.

Course Code	WI001121
Credit	4
Subject Title	International Management & Organizational Behavior
Name of the Institute	Technical University Munich (TUM), Germany
Description	Grading is based on the performance in a 120min written examination. The examination consists of single-choice-questions, which aim at testing knowledge on different levels: Knowledge questions aim at the recall of the learned concepts, e.g. by reproducing different change management models; decision items aim at classifying or interpreting the module contents, e.g. by contrasting and comparative analysis of different strategies of multinational enterprises, application and scenario questions aim at testing the ability to transfer the learned concepts to real-life settings, e.g. by identifying solutions to short practical cases in conflict management. It is allowed to bring one hard-copy dictionary (English - first language) or English thesaurus. Furthermore, no aids such as lecture slides, personal notes, etc. are allowed.

ANNEXURE-C

Revised list of core courses for B.Tech. in Engineering Physics Program at IIT Mandi
Date: 17 Nov. 2020

The following two changes were made in the list of core courses for B.Tech. in Engineering Physics.

(1) EP 3XX (Computational Methods for Engineering) is replaced with ME 352 (Finite Element Methods in Engineering)
(2) Addition of course EP 403 (Physics of atoms and molecules).

List of Core courses for Engineering Physics Program

(Total Credits for discipline core = 33)

S. No.	Course Title	Lecture	Tutorial	Practical	Total Credit
1	Engineering Mathematics-2 (EP301)	3	1	0	4
2	Quantum Mechanics and Applications (PH301)	3	0	0	3
3	Introduction to Statistical Mechanics (PH302)	3	0	0	3
4	Solid State Physics (PH501)	3	0	0	3
5	Device Electronics for Integrated Circuits (EE311)	3	0	0	3
6	Finite Element Methods for Engineering (ME352)	2.5	0.5	0	3
7	Eng. Physics Practicum (EP402P)	1	0	5	4
8	Photonics (PH502)	3	0	0	3
9	Physics of atoms and molecules (EP403)	3	0	0	3
10	Eng. of Instrumentation (EP401P)	1	0	5	4

ANNEXURE-D

IIT Mandi
Proposal for a New Course

Course Name: Computer Graphics and Geometric Design

Course Number: CS550

Credits: 2-0-2-3

Prerequisites: IC111 Linear Algebra or similar course, IC250 Data Structure and Algorithms or similar course.

Intended for: B.Tech. (CSE, EE and ME) II/III/IV year/ MS/M.Tech /PhD (any branch)

Distribution: Elective for B.Tech. II/III/IV year/ MS/M.Tech/PhD

Preamble: This course is intended to introduce the graphics processing pipeline found in modern day computers. This pipeline has three main phases. Depending on the application domain, the first phase creates 2D/3D modeling data which is in either discrete or continuous format. The second phase converts this data into simpler discrete primitive forms such as points, line-segments and triangles. The final phase maps this data onto the pixels of the computer display. Topics from all the three phases will be discussed. The course will include assignments about using popular graphics software suites as well as programming assignments.

Learning outcome: After taking this course, students will

1. be familiar with the graphics processing pipeline.
2. understand in depth, the set of fundamental algorithms which drive modern graphics engines.
3. be able to choose between alternative graphics/geometry data-structures which best suit the target application.
4. get hands-on experience with graphics programming APIs such as OpenGL.
5. get familiarity with using 3D graphics software packages such as Blender.
6. be able to create realistic scenes and environments.
7. be able to choose between alternative light sources and object materials in order to achieve the desired visual effect.
8. be able to use design kernels such as Open Cascade for solid modeling.
9. be able to design simple video games.

Course modules:

1. *Introduction:* (2 hours)
   Motivation; Use of computer graphics in different domains; Digital display technologies; Color; Graphics processing pipeline; OpenGL.

2. *Geometry representation:* (2 hours)
   Lines, triangles, polygons, meshes, point-clouds, polynomials, B-splines; Parametric v/s. implicit representation, boundary representation, volumetric representation.

3. *Rasterization:* (6 hours)
   World and camera transformations; Orthogonal and perspective projections; Hidden-

surface removal, Z-buffering; Bresenham's line drawing algorithm; Triangle drawing primitive; Flood-fill algorithm.

4. *Lighting, shaders and texture mapping:* (6 hours)
   Radiometric concepts such as BRDF, BTDF, BSSRDF; Types of light sources such as point, spot, parallel; Texture mapping; Shading schemes such as Flat, Gouraud, Phong; Flattening of 3D surfaces; Bump maps, Normal maps, Displacement maps.

5. *Ray tracing and ray casting:* (3 hours)
   Mechanism of tracing the path of light in order to generate realistic images from 3D scenes.

6. *Modeling with curves:* (5 hours)
   Differential geometry of planar and space curves; Definition and basic properties of Bezier and B-spline curves; Weierstrass approximation theorem.

7. *Modeling with surfaces:* (4hours)
   Differential geometry of surfaces; Definition and basic properties of tensor-product Bezier surfaces.

Lab exercises:
Lab to be conducted on a 2-hour slot. It will be conducted in tandem with the theory course so the topics for problems given in the lab are already initiated in the theory class. The topics taught in the theory course shall be appropriately sequenced for synchronization with the laboratory.
Lab1: Installation of Blender, familiarization of the GUI, simple exercises involving creation of primitive shapes. Installation of OpenGL, writing a 'Hello World' application. Draw a few parametric as well as implicitly defined curves.
Lab2-4: Implementation of Bresenham's line drawing algorithm. Implementation of flood-fill algorithm.
Lab5-7: Create a 3D scene in Blender and apply various models of light-interaction such as BRDF, BTDF, BSSRDF. Insert different types of light sources into the scene. Apply textures to 3D objects. Lighting and shading in OpenGL, Raytracing
Lab8-10: Implementation of ray-tracing.
Lab11-12: Installation of Open Cascade. Construct and plot Bezier curves. Plot the tangents and osculating circles at a few points. Plot the Frenet frame at a few sampled points. Construct and plot B-spline curves.
Lab13-14: Construct and plot tensor-product Bezier surfaces. Plot tangent-plane and curvature at sampled points. Extract iso-curves.

Textbooks:
1. Donald D. Hearn *et al., Computer Graphics with OpenGL,* 3rd edition, Pearson, 2013

Reference Books:

1. Steve Marschner et al., *Fundamentals of Computer Graphics,* 4th Edition, A K Peters/CRC Press, 2015
2. Gerald Farin, *Curves and Surfaces for CAGD,* 5th Edition, 2001
3. Dave Shreiner, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Versions 3.0 and 3.1 (7^{th} Edition)

Content Similarity Declaration with Existing Courses: N/A

Sr #	Course code	Similarity content	Approx. % of content
1	CS451	Linear transforms, RGB space	5%

Justification for new course proposal if cumulative similarity content is > 30%: N.A.

Approvals:

Other Faculty who may be interested in teaching this course:

Proposed by Jinesh Machchhar School: SCEE

Signature: _____ Date_____

Recommended/Not Recommended, with Comments:

_____ Date: _____

Chairman, CPC

Approved / Not Approved

_____ Date: _____

Chairman, Senate

Reviewer comments and response:

1. The theory content of the course seems mostly fine. Texture mapping can be added to the course explicitly - without that bump, normal and displacement maps seem out of place.
Response: Texture mapping is now included in Module 4.

2. The lab content can be upgraded to include implementing lighting and shading in OpenGL for solids objects/surfaces, and an implementation of raytracing.
Response: Lighting and shading in OpenGL are now included in Lab4-6. Raytracing is now included in Lab7-8.

3. Also, if OpenGL 2.x is being taught then the reference book for it needs to be changed (the one listed is for OpenGL 4.3). If OpenGL 4.x is being taught, the learning curve is much steeper and students cannot get started on it in a single two hour lab, so plan accordingly.
Response: As a balance between availability of hardware and being up-to-date OpenGL 3 will be used. The reference book for the same is updated.

4. OpenGL 4.x needs some minimal GPU support so make sure the lab machines are equipped to handle it.
Response: See response to comment 3 above.

IIT Mandi
Proposal for a New Course

Course number	:	CS611
Course name	:	Program Analysis
Credits	:	3-1-0-4
Prerequisites	:	CS202: Data Structures and Algorithms or equivalent; CS208: Mathematical Foundations of Computer Science or equivalent; CS304: Formal Languages and Automata Theory or equivalent
Intended for	:	B.Tech., M.Tech., MS, PhD
Distribution	:	Discipline Elective for BTech CSE, Elective for others

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1. Preamble

Program analysis approximates the runtime behavior of a program by looking at its source code. The results of program analyses are used to drive a plethora of applications: performance-oriented optimizations, program understanding, verification, debugging, refactoring, finding vulnerabilities, test generation, parallelization, and so on. As a result, once an exclusive part of the back-end of optimizing compilers, now program analysis finds its applications in the development of a large number of tools in a programming language's ecosystem. The aim of this course is threefold: (i) to develop a thorough understanding of the theory behind the long studied discipline of analyzing programs; (ii) to explore modern strategies that balance the trade-offs between the precision of an analysis and the resources consumed therein; and (iii) to get introduced to various applications that benefit from the results of a precise-yet-efficient program analysis.

2. Learning outcomes

After taking this course, the students will:

- have a strong foundation in abstract interpretation, which is a way to soundly approximate the semantics of a computer program;
- have a thorough understanding of the various dimensions along which the precision of an analysis can be varied and the associated trade-offs;
- be able to make intelligent decisions concerning the abstraction used to represent program features and the data structures used to implement static analyses, with an understanding of the corresponding effects on analysis precision and efficiency;
- be able to appreciate the challenges imposed by various features of programming languages on designing the associated compiler technology;
- have hands-on experience with some of the modern tools and frameworks used to implement program analyses in production and research environments; and
- be excited to use program analyses to improve different aspects of a program and the overall programming language ecosystem.

3. Course modules

- *Introduction to static analysis.* Concrete versus abstract semantics. Abstract interpretation. Galois connection. Symbolic execution. Control-flow graphs. Iterative dataflow analysis. Lattices and monotonicity. Analysis dimensions. **[10 hours]**

- *Heap analysis.* Heap modeling. Points-to information. Andersen's and Steensgard's pointer analyses. Variations: alias analysis, null-check analysis, escape analysis. **[9 hours]**

- *Interprocedural analysis.* Call-graph construction. Context sensitivity: functional and call-string approaches. Various context abstractions: value and lsrv contexts, object and type sensitivity. Heap cloning. **[10 hours]**

- *Strategies for efficiency.* Demand-driven analysis. Program slicing. Analysis staging. Partial analysis. Efficient data structures. Heuristics and machine learning. **[9 hours]**

- *Language features and challenges.* Lexical and dynamic scoping. Eager and lazy evaluation. Call-backs and reflection. Concurrency and synchronization: may-happen-in-parallel analysis. Speculative optimizations and deoptimization. Dynamic analysis. **[10 hours]**

- *Sneak peek into applications.* Type checking. Bug detection. Program correctness. Program synthesis and repair. Software refactoring. **[8 hours]**

4. Tutorials and assignments

This course involves hands-on practice with writing different program analyses, implementing the techniques for efficiency, and learning various associated tools and language features. The classes will teach the theory, and tutorials would train the students on the various skill-sets required to finish take-home programming assignments.

It may be noted that as the course covers several recent topics related to designing analyses that are precise-yet-efficient, the classes will use one or two important analyses as running examples (examples being alias analysis and pointer analysis for resolving virtual calls). Hence, another aim of the tutorial hours would be to help students imbibe the concepts learnt by making them write specifications of different analyses and optimization strategies.

The take-home assignments will be based on implementing and understanding (a) intra- and inter-procedural analyses; (b) strategies for imparting efficiency; (c) examples of handling tricky language features; and (d) non-trivial applications such as parallelization, refactoring and security.

5. References

1. Flemming Nielson, Hanne Riis Nielson and Chris Hankin. "Principles of Program Analysis", Corrected Edition, Springer, 1999.
2. Uday P. Khedker, Amitabha Sanyal and Bageshri Karkare. "Data Flow Analysis: Theory and Practice", First Edition, CRC Press, 2009.
3. Y. N. Srikant and Priti Shankar. "The Compiler Design Handbook", Second Edition, CRC Press, 2007.
4. Various research papers related to the course content.

6. **Similarity content declaration with existing courses**: <10% (CS502 Compiler Design: Control-flow graphs, iterative dataflow analysis, type checking.)

7. **Justification of new course proposal if cumulative similarity content is >30%**: N/A

Approvals:

Other Faculty who may be interested in teaching this course:

Proposed by: Manas Thakur School: SCEE

Signature: _____ Date: 04.01.20

Recommended/Not Recommended, with Comments:

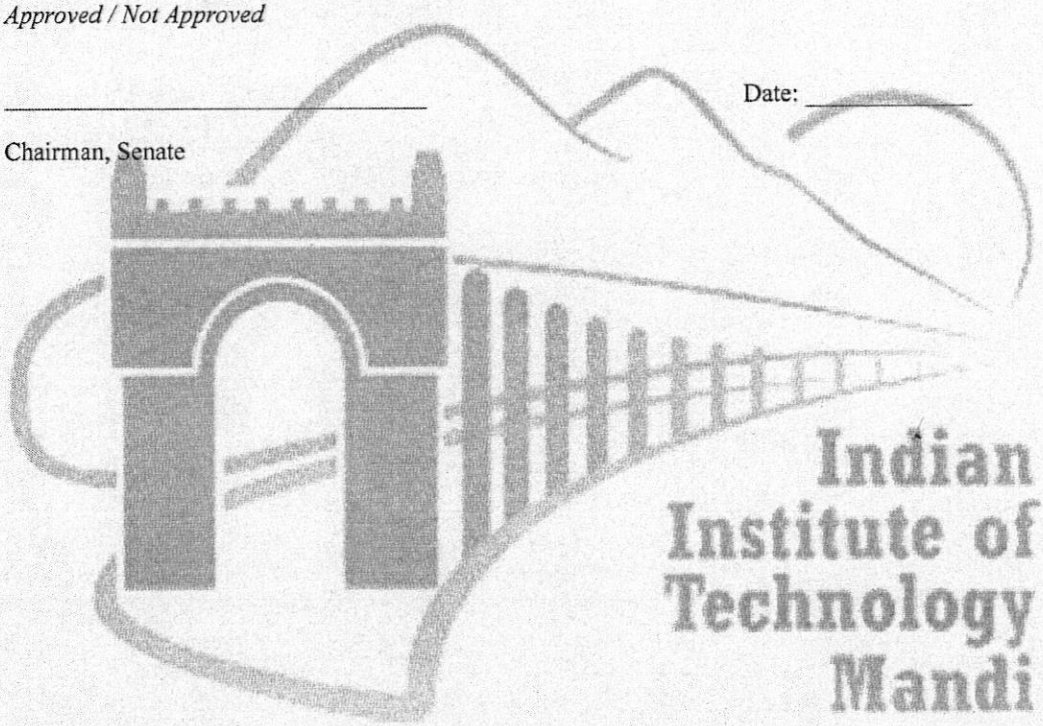
_____ Date: _____

Chairman, CPC

Approved / Not Approved

_____ Date: _____

Chairman, Senate



IIT Mandi
Proposal for a New Course

Course Number : CS662

Course Name : Mobile Virtual Reality and Artificial Intelligence

Credits : 3-0-0-3

Prerequisites : CS 660, CS 669, or an equivalent course in AI/ML area

Intended for : B. Tech./M. Tech./M.S./Ph.D. students

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1. Preamble:

The virtual reality (VR) industry is growing rapidly with applications in several domains. VR applications are revolutionizing how human-beings interact with computers and a number of companies in the human-computer interaction area are at the forefront of this technology with VR products. Although VR application development in industry is gaining popularity, finding human resource with VR skills is a challenge. This course addresses this challenge by training interested students in mobile VR application development that involves AI in VR. The primary objectives of this course include the following: To give students hands-on exposure to mobile virtual reality; to give students experience with basic AI in virtual reality; and, to provide students with fundamentals of application design in virtual reality. The course will use tools such as Unity to provide hands on experience to the students and the students will gain exposure to such tools.

2. Course modules with quantitative lecture hours:

Modules

Module 1: Introduction to VR and VR programming (12 hours)

Introduction to VR and its historical perspective (e.g., Sensorama simulator or Ivan Sutherland's Sword of Damocles), Introduction to software tools for VR, Moving a Cube, Lights, Particle Systems, Applying Physics, and Assets, VR Coding Introduction, Variables, Methods, If Blocks, Loops, Hello Mammoth, User Interaction, Inputs Introduction Preview, Key Presses, Moving a Player, Jumping, Moving Forward, Cycling Cameras, Prefabs Introduction, Instantiating Objects, Random Angles, Destroying Objects, Explosion Effects, Adding Explosion Effects.

Module 2: Building the first AI simulation (6 hours)

Developing a Pathfinding Game, How to Set Up a Project, Node, String Map, A* Algorithm Setup, A* Algorithm Loop, Auxiliary Methods, Finishing the Algorithm, Importing 2D Assets, Building a Level, From Console to Visual, Adding Tanks, Identifying Nodes, Moving the Tank, Visually Moving Tank, Smooth Movement, Smooth Rotation, Ordering Tank to Move, Speeding up Player, Spawning Logic, Crate Visuals, Adding Crates to Valid Positions, Collecting Crates, Score Counting, Game Interface, Starting the Game, Game Over Screen, Scoring, Sounds.

Module 3: Introduction to Virtual Reality and Blending (8 hours)

VR Introduction, Camera Changing Position, Triggering Events Interface, Blending and Introduction & Customizing Settings, Controlling Blender Camera, Emulate Numpad Camera, Manipulating Objects, Common Tools, Mirroring 1 Side of Object. Case Study: Flappy bird game in VR, First person shooter VR game, Kart VR game.

Module 4: Introduction to ML in VR (6 hours)

Introduction to Machine Learning, the need for ML in VR, different kinds of learnings, Neural Networks (NNs), Training a NN, Optimizer, Convolutional layers, Transfer learning, Imitation learning. Case study: Training the kart in kart game via IL and testing the kart drive.

Module 5: Reinforcement Learning (10 hours)

Introduction to Reinforcement Learning, Initial state, Training a policy, The PPO algorithm, Evolutional Strategies, Reward. Case study: Training a kart in the kart game with RL, Tensorboard analysis, Testing results.

3. Textbook:

Buttfield-Addison, P., Manning, J., Nugent, T. (2019). *Unity Game Development Cookbook: Essentials for Every Game.* O'Reilly Media.

4. Reference books:

Linowes, J., & Schoen, M. (2016). *Cardboard VR Projects for Android.* Packt Publishing Ltd.

Lanham, M. (2019). *Hands-On Deep Learning for Games: Leverage the power of neural networks and reinforcement learning to build intelligent games.* Packt Publishing Ltd.

Aversa, D., Kyaw, A. S., & Peters, C. (2018). *Unity Artificial Intelligence Programming: Add powerful, believable, and fun AI entities in your game with the power of Unity 2018!.* Packt Publishing Ltd.

4. Similarity Content declaration with existing courses:

S.No	Course Code	Similarity Content	Approximate %. Of Content
NA	NA	NA	NA

5. Justification for new course proposal if cumulative similarity content is >30%:

N.A.

Approvals:

Other faculty interested in teaching this course

Proposed by: Dr. Varun Dutt School: SCEE

Signature: Varun Dutt Date: 4th Jan 2021

Recommended/Not Recommended, with comments:

_____ Date:

Chairman, CPC_____

Approved/Not Approved

_____ Date:

_____

Chairman, Senate

Comments and responses on Mobile Virtual Reality and Artificial Intelligence

Dr. Samar Agnihotri, Associate Professor, IIT Mandi

My suggestion is to remove any mention of Unity from the title of the course on Mobile VR and AI, and from the description of the course modules. The course preamble and course outcomes may include a sentence to the effect that tools such as Unity will be used to provide hands on experience to the students and the students will gain exposure to such tools.

Response: Thank you for your kind comments. In agreement, we have now removed the mention of Unity from the title and from the description of course modules. In addition, we have now included a sentence in the preamble as per your kind suggestions.

Dr. Pradipta Biswas, Assistant Professor, IISc, Bangalore

I went through the course description. The course seemed to me has a focus on developing Unity VR applications. While such a course will have immense application for practitioners but I am wondering whether students will already have basic background in computer graphics, GPU architecture, event driven programming and interactive devices like head and hand tracking, haptic feedback and so on.

Response: Students will have an understanding about AI/ML and they would be introduced to some of these mentioned concepts throughout the course. For example, the course's module 1 is focused on exposing students to Unity environment and C# as the programming language. Module 2 and 3 will focus on the concepts computer graphics, event driven programming, and creating objects that address different modes of interaction (e.g., haptics and blender). Also, there is emphasis on learning by doing, where students will be exposed to the creation of a tank simulation, a flappy bird simulation, a first-person shooter simulation, and a Kart (driving) simulation.

As the prerequisite says AI/ML, I am assuming students already know A algorithm, Markov Decision Process and Reinforcement Learning.*

Response: Even for those who do not have this expertise, these concepts are covered across different modules. Specifically, modules 2, 4, and 5 cater to this need.

It would also be interesting to discuss historical VR projects like Sensorama simulator or Ivan Sutherland's Sword of Damocles. I am sharing my course website http://eamoum.net/course-2.php on similar topic.

Response: Thank you for your kind comments. Based upon your own course material at IISc, I have now included the introduction and historical VR perspective (e.g., Sensorama simulator or Ivan Sutherland's Sword of Damocles) under module 1.

Prof. Bapi Raju S, Professor, International Institute of Information Technology, Hyderabad

I went through the Course contents and comments of Dr. Pradipta Biswas. Overall, I find the course to be potentially useful and novel, quite topical and contemporary. The course focus is to give hands-on skills using Unity and incorporating AI and ML into games using Unity. To this end, the course contents are adequate.

Response: Thank you for your kind feedback and in positive comments on the course proposal.

I am not an expert on Unity so do not know its capabilities. Since there are now powerful algorithms developed in deep learning, including deep reinforcement learning using other tools such as Keras, Tensor Flow and other Python-based toolkits, it might be useful to learn how to incorporate deep models developed in other softwares into a Unity game.

Proposal for a New Course

Response: In particular, modules 4 and 5 provide hands-on exposure on how to include Python-based deep learning, machine learning, and reinforcement learning models in Unity.

Also as suggested by Dr. Pradipta the prerequisites could include familiarity with Computer Graphics, Event-driven programming as well as AI/ML concepts.

Response: Thank you for your kind feedback. Students will have an understanding about AI/ML through the prerequisites and they would be introduced to some of these mentioned concepts throughout the course. For example, the course's module 1 is focused on exposing students to Unity environment and C# as the programming language. Module 2 and 3 will focus on the concepts computer graphics, event driven programming, and creating objects that address different modes of interaction (e.g., haptics and blender). Also, there is emphasis on learning by doing, where students will be exposed to the creation of a tank simulation, a flappy bird simulation, a first-person shooter simulation, and a Kart (driving) simulation.

IIT Mandi
Proposal for a New Course

Course Number: EE583

Course Name: Smart Grids

Credits: 3-0-0-3

Prerequisites: EE-303 (Power systems)

Intended for: UG/PG

Distribution: Elective for B. Tech (EE), M.S., M. Tech. & Ph.D.

Preamble: The proposed course is designed to provide the concepts of modern power system operations and the challenges associated with them. The focus of the course is to enable the students acquire knowledge on smart grids which includes different architectural designs, sensors, measurement technology, renewable energy sources and storage integration.

Course Outline: This course provides overview of fundamentals, design tools, current research, and the critical issues in the development and deployment of smart grids. The application of smart grid technologies in different types of power sectors such as power generation, transmission and distribution will be taught with discussion on its applicability and advantages to the Indian power grid. The course will also emphasize on renewable energy source integration in present grids and explore issues in operation, analysis, management, control, protection and monitoring. In addition, there will be focus on sensing, metering and communication of smart grid data with cyber security aspects.

Course Modules with Quantitative lecture hours:

Introduction – 3 hours
Smart Grid: Concept, architecture, standards and protocols, Smart Grid in Indian Grid context.

Power System Operations – 6 hours
Load flow for smart grids, voltage stability assessment, and state estimation

Communication Infrastructure – 4 hours
Communication standards, requirements for data links, data quality, cyber security: state of the art, risks and mitigation

Wide Area Measurement Systems (WAMS) – 3 hours
Phasor measurement units (PMU), WAMS architecture, applications of WAMS for power system operation improvement: advantages and disadvantages

Integration of Renewable Energy Sources and Energy storage – 8 hours
Renewable energy sources, penetration and variability issues, environmental implications, demand response, electric vehicles, energy storage techniques: battery, pumped hydro, modelling of storage devices.

Smart Devices – 5 hours
FACTS, STATCOM, HVDC, fault current limiters

Protection and Security – 5 hours
Intelligent protection, contingency analysis and classification, security, outage management, remedial action schemes, special protections schemes

Meters and Sensors – 4 hours
Hardware, demand side integration, communication standards and protocols, smart meters, automatic meter reading (AMR), advanced metering infrastructure (AMI)

Microgrids – 3 hours
System operation, consumer energy management

Hardware in Loop (HIL) testing – 1 hours
HIL requirements, advantages and disadvantages.

Text book:

1. S. F. Bush, *Smart Grid: Communication-enabled intelligence for the electric power grid*, John Wiley and Sons, Ltd., 2014.
2. I. S. Jha, S. Sen, R. Kumar, D. P. Kothari, *Smart Grid Fundamentals & Applications*, New Age International Publishers, 2019.

References:

1. J. Momoh, *Smart Grid: Fundamentals of design and analysis*, John Wiley and Sons, Ltd., 2012.
2. B. M. Buchholz, Z. Styczynski, *Smart Grids – Fundamentals and Technologies in Electricity Networks*, Springer, 2014.
3. C. W. Jennings, *The Smart Grid: Enabling Energy Efficiency and Demand Response*, Fairmont Press Inc., 2009.
4. N. Hatziargyriou, *Microgrids: Architectures and Control*, John Wiley and Sons, Ltd., 2014.

Similarity Content Declaration with Existing Courses:

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	EE603	Renewable energy sources, penetration and variability issues,	6

Proposed by: **Pratim Kundu** School of Computing and Electrical Engineering

Pratim Kundu

IIT Mandi
Proposal for a New Course

Course Number: EE584
Course Name: Power System Protection
Credits: 3-0-0-3
Prerequisites: EE-303 (Power systems)
Intended for: UG/PG
Distribution: Elective for B. Tech (EE), M.S., M. Tech. & Ph.D.

Preamble: The proposed course is designed to provide the basic concepts of power system protection. System protection deals with detection of proximity of system to unstable operating region and consequent control actions to restore stable operating point and/or prevent damage to equipment. This course focusses on the protective relaying principles, settings and operation during fault condition in power system.

Course Outline: The course will discuss the role of main, back up and redundant relay protection scheme and identification of zones of protection for a given substation. The selection of proper instrument transformer inputs to the relaying schemes and analysis and calculation of currents in a system for various types of fault will be demonstrated. Introduction to the concept of both high impedance and low impedance protection relays to protect power system buses. In addition, protection of rotating machines and distribution networks will also be covered in the syllabus.

Course Modules with Quantitative lecture hours:

Introduction – 3 hours
Fundamentals of protection – Security, selectivity and reliability, measurement principles – unit and non-unit protection, legacy relays, solid state and numerical relays, standards in power system protection

Instrument Transformers – 4 hours
Working principle of current transformers (CT), voltage transformers (VT), dynamic response of CTs and capacitor coupled voltage transformer (CCVT) during faults and its effect on relaying

Fault Analysis using Symmetrical components – 4 hours
Sequence components, sequence modelling of power system components such as transformers, generators, transmission lines, fault analysis

Numerical Relaying – 4 hours
Sampling of analog values, analog to digital conversion, least square method for estimation of phasors, Fourier analysis, discrete Fourier transform: properties, phasor calculation, fast Fourier transform.

Directional Overcurrent Protection – 4 hours
Directional and overcurrent relay principles, directional relay coordination problem associated with multiple loop system.

Transmission line Protection – 6 hours
Distance and non-distance-based protection concepts. Zones of protection and back up protection, distance relay settings, pilot protection with distance relays

Power Swing – 2 hours
Power swing detection, stable and unstable swing, blocking and unblocking of distance relays during power swing, analysis of power swing in multi machine system, operation of relays during out of step condition.

Transformer protection – 3 hours
Inrush phenomenon, Inrush detection methods; Differential and over-excitation protection.
Bus Protection – 3 hours
Bus configurations; High and low impedance protection concepts. External Fault detection methods and remedial measures to account for CT saturation detection.

Rotating Machinery Protection – 4 hours
Motor and generator protection, generator construction and grounding methods, Detection of faults and abnormal operating conditions

Distribution system protection – 2 hours
Feeder protection philosophies, Coordination examples, Power system restoration concepts – Reclosing, Automatic sectionalizing.

Introduction to relay setups and Standards– 3 hours
Distance, overcurrent, over/under frequency relay set up demonstration. Discussion on standards for protection scheme in Indian power grid.

Text book:

1. S. Horowitz and A. G. Phadke, *Power System Relaying (4th ed.)*. Wiley, 2014.
2. A. G. Phadke and J. S. Thorpe, *Computer Relaying for Power Systems*, Wiley, 2009
3. Juan Gers, *Protection of Electricity Distribution Networks (3rd ed.)*, IET press, 2011.

References:

1. P. M. Anderson, *Power System Protection*, Wiley-IEEE press, 1999.
2. J. L. Blackburn, T. J. Domin, *Protection Relaying: Principles and Applications (3rd ed.)*, Taylor and Francis, 2006
3. J. D. Glover, M. S. Saema, T. J. Overbye. *Power System Analysis and Design (5th ed.)*, Cengage Learning, 2010.
4. Bhavesh Bhalja, R. P. Maheshwari and N. Chothani, *Protection and Switchgear*. Oxford University Press, 2nd Edition, New Delhi, India, 2019.

Similarity Content Declaration with Existing Courses:

S. No.	Course Code	Similarity Content	Approx. % of Content
1.	EE303	Sequence components, sequence modelling of power system components such as transformers, generators, transmission lines	7

Proposed by: **Pratim Kundu** School of Computing and Electrical Engineering

Pratim Kundu

IIT Mandi

Proposal for a New Course

Course Number: EE630
Course Name: HVDC Transmission and Flexible AC Transmission Systems
Credits: 3-0-0-3
Prerequisites: EE-303 (Power systems) and EE-309 (Power electronics)
Intended for: PG
Distribution: Elective for M.S., M. Tech. & Ph.D.

Preamble: The deregulation of the electricity market together with increasing constraints resulting from social opposition to the installation of new facilities brings great pressure to the operators of transmission and distribution systems. Large scale integration of renewable energy into power supply brings further pressure on how to operate and control future power networks. These new trends require the need for flexibility, power quality and increased availability of electricity transmission and distribution systems by using new devices which can be implemented with limited investments, short delivery times and short planning and decision-making horizons. FACTS (Flexible AC Transmission Systems) is a terminology to describe a whole family of concepts and devices for improved use and flexibility of electrical power systems. HVDC is used for long distance power delivery, interconnection of asynchronous AC systems and integration of large-scale renewable energy systems.

Course Outline: The course covers the basic concepts and operating principles for integration of HVDC system and FACTS devices to the existing power network. The students will be introduced to the evolution of HVDC systems, and comparison of HVAC and HVDC transmission systems. The components involved in HVDC transmission system, analysis of HVDC converters, and HVDC control will be taught. The course will also focus on FACTS devices and their use to improve the operation of power networks. Application of HVDC system and FACTS devices to existing power system in relation to integration of renewable energy will be covered. Also, the new developments in multi-terminal HVDC Grid will be discussed.

Course Modules with Quantitative lecture hours:

Introduction to HVDC – 5 hours
Introduction of DC power transmission technology, comparison of AC and DC transmission, limitation of HVDC transmission, reliability of HVDC systems, application of DC transmission, description of DC transmission system, planning for HVDC transmission, modern trends in DC transmission, advantages of HVDC.

Analysis of HVDC converters – 4 hours
Simple rectifier circuits, required features of rectification circuits for HVDC transmission, choice of converter configuration, converter bridge characteristics

Control of HVDC converter and systems: – 5 hours
Necessity of control of a DC link, rectifier control, compounding of rectifiers, power reversal of DC link, voltage dependent current order limit (VDCOL) characteristics of the

converter, inverter extinction angle control, pulse phase control, starting and stopping of DC link, constant power control, control scheme of HVDC converters.

Harmonics and filters: – 5 hours
Generation of harmonics by converters, characteristics of harmonics on DC side, characteristics of current harmonics, characteristic variation of harmonic currents with variation of firing angle and overlap angle, effect of control mode on harmonics, non-characteristic harmonic.

FACTS devices: – 5 hours
Introduction to FACTS; Compensation of transmission systems, Series and Shunt FACTS controllers - variable impedance type and switched converter type, Unified Power Flow Controller and other types of FACTS devices.

Load flow and stability analysis: – 5 hours
Component Models for the Analysis of AC DC Systems, Power flow analysis of AC-DC systems, Transient stability analysis, Dynamic stability analysis. Application of FACTS controllers in improvement of power system operation and stability.

Reactive power control: – 3 hours
Reactive power requirements in steady state, sources of reactive power, static VAR systems, reactive power control during transients

Fault and protection schemes in HVDC systems: – 5 hours
Nature and types of faults, faults on AC side of the converter stations, converter faults, fault on DC side of the systems, protection against over currents and over voltages, protection of filter units.

Multiterminal HVDC systems: – 5 hours
Types of multiterminal (MTDC) systems, parallel operation aspect of MTDC. Control of power in MTDC. Power upgrading and conversion of AC lines into DC lines, Parallel AC/DC systems, FACTS and HVDC system application in wind power generation- VSC based applications for wind power systems

Text book:

1. K. R. Padiyar, *HVDC Power Transmission Systems*. Wiley, 1990
2. J. Arrillaga, *High Voltage Direct Current Transmission.* The Institution of Electrical Engineers, London, UK, 1998.
3. N. G. Hingorani, *Understanding FACTS*, IEEE Press, 2001.

References:

1. K. R. Padiyar, *FACTS Controllers in Power Transmission and Distribution.* New age international (p) limited, 2007.
2. EW Kimbark, *Direct Current Transmission.* Wiley-Interscience. New York, 1971.
3. S N Singh, *Electric Power Generation, Transmission and Distribution.* PHI, New Delhi 2nd edition, 2008.
4. T J E Miller, *Reactive Power Control in Electric Systems*, Wiley, 1982

Similarity Content Declaration with Existing Courses:
NA

Proposed by: **Pratim Kundu** School of Computing and Electrical Engineering

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course Name : Engineering of Instrumentation
Course Number : EP401P
Credits : 1-0-5-4
Prerequisites : PH301 or PH513 and PH501 or PH523.
Intended for : B.Tech. in Engineering Physics
Distribution : Core course for B.Tech. in Engineering Physics.

Preamble: This course is aimed at giving instrumentation exposure to students by lectures on various techniques along with demonstration and hands on practices for small scale instruments with central focus on the working physics.

Modules:

1. Introduction to data Acquisition systems, Labview/open source (such as Python) programming (Interfacing and programming), Signal processing and Error analysis.
2. Automatic control (PID control, Feed forward control, Time delay and inverse response systems, Sequence control).
3. Cryogenics Instrumentation (Low temperature, Liquefaction of gases, Close Cycle Refrigerator, Temperature sensor). Vacuum pumps (Rotary, Dry scroll, Root pumps) with focus on role of valves, gauges etc.
4. Introduction to design and working of instruments (Electron microscope, Scanning Tunneling Microscopy, Atomic force microscope and Superconducting magnets)

Textbooks:

1. Transmission Electron Microscopy, by C. Barry Carter and David B. Williams, Springer, New York (2016).
2. Experimental Techniques in Condensed Matter Physics at Low Temperatures, by Robert C. Richardson and N. Smith ; CRC Press (2018).

References: *As advised by the course instructors.*

1. Similarity Content Declaration with Existing Courses

S.N.	Course Code	Similarity Content	Approx. % of Content
1			

2. Justification for new course proposal if cumulative similarity content is > 30%:

NA.

Proposed by: Course Interest Group **School:**
Signature: _____ **Date:** _____

Recommended/Not Recommended, with Comments:
_____ **Date:** _____
Chairman, CPC

Approved/Not Approved

_____ **Date:** _____

Chairman, Senate

Indian Institute of Technology Mandi

IIT Mandi
Proposal for a New Course

Course Name	: Eng. Physics Practicum
Course Number	: EP402P
Credits	: 1-0-5-4
Prerequisites	: PH301 or PH513 and PH501 or PH523.
Intended for	: B.Tech. in Engineering Physics
Distribution	: Core course for B.Tech. in Engineering Physics.

Preamble: This experimental course is expected to develop the art of experimentation and analysis skill, collaborative learning skills among students along with the hands-on training in making the devices.

Course Outline: The course content includes basic physics experiments from various modules of physics, the theory of which students have learnt during their core courses and basic training in device making.

Part A

1. Hall Effect in Semiconductor
Measure the resistivity and Hall voltage of a semiconductor sample as a function of temperature and magnetic field. The band gap, the specific conductivity, the type of charge carrier and the mobility of the charge carriers can be determined from the measurements.

2. Diffraction of ultrasonic waves
Fraunhofer and Fresnel diffraction and determine the wavelength of the ultrasound wave. Students may also develop their own sound wave generator and receiver and perform this experiment.

3. Geiger-Müller-Counter
To study random events. Determination of the half-life and radioactive equilibrium. Verification of the inverse-square law for beta and gamma radiation.

4. Dispersion and resolving power of a grating
Determination of the grating constant of a Rowland grating based on the diffraction angle (up to the third order) of the high intensity spectral lines. Determination of the angular dispersion and resolving power of a grating. Students may also design their own gratings and study that using this experimental technique.

04 Jan-21

Devices Fabrication Technologies

- **Basic clean room training and introduction to instruments**

Draw a comprehensive wafer clean process flow/cleaning of wafer and validate the hydrophobic and hydrophilic nature through contact angle measurements.

- **Metal-Semiconductor contact fabrications and characterizations**

Indian Institute of Technology Mandi

Design and fabricate basic metal semiconductor junction and do the characterization. Basic characterization may also be extended to thin films grown via spin coater or any other technique.

Textbooks:

1. R. A. Dunlop, Experimental Physics, Oxford University Press (2012).
2. S. K. Ghandhi, VLSI Fabrication Principles: Silicon and Gallium Arsenide, 2nd Edition. (2014)

References:

1. A. C. Melissinos, Experiments in Modern Physics, Academic Press (1996).
2. E. Hecht, Optics, Addison-Wesley; 4 edition (2011)
3. J. Varma, Nuclear Physics Experiments, New Age Publishers (2010)
4. B. L. Worsnop and H. T. Flint, Advanced Practical Physics for Students, Methusen& Go. (1950).
5. E. V. Smith, Manual for Experiments in Applied Physics. Butterworths (1970).
6. D. Malacara (ed), Methods of Experimental Physics, Series of Volumes, Academic Press Inc. (1988).
7. D. K. Schroder, Semiconductor Material and Device Characterization, 3rd Edition.

1. **Similarity Content Declaration with Existing Courses**

S.N.	Course Code	Similarity Content	Approx. % of Content
1	PH515P	Part of section A	20%

2. **Justification for new course proposal if cumulative similarity content is > 30%:**
NA.

Proposed by: Course Interest Group **School:**

Signature: _____ **Date:** _____ 04 Jan. 21

Recommended/Not Recommended, with Comments:

---------- **Date:** _____

Chairman, CPC

Approved/Not Approved

---------- **Date:** _____

Chairman, Senate

IIT Mandi
Proposal for a New Course

Course Name: Quantum Field Theory

Course Number: PH 606

Credits: (3-0-0-3)

Prerequisites: Quantum Mechanics (PH513), Mathematical Physics (PH511).

Intended for: M.Sc. (Physics), Ph.D., I-Ph.D., B.Tech 3rd and 4th Year.

Distribution: Elective for I-Ph.D., Ph.D., M.Sc., B.Tech 3rd and 4th Year.

Preamble: Quantum field theory forms one of the central pillars of modern theoretical physics. The objective of the proposed course is to introduce students to some key ideas and methods in quantum field theory and also discuss relevant applications.

Course Outline: The course will start with a review of second quantization and some mathematical tools such as functional analysis. Then the course will move on to more formal and rigorous treatment of quantum fields. Important ideas of quantization of fields, symmetries, Feynman diagrams, and propagators will be introduced with several examples in the first five modules (canonical quantisation formulation). The instructor can choose either of the Module 6 (each of which is aimed at specific applications).

Modules:

Module 1: Mathematical preliminaries, Lagrangian and Hamiltonian density, second quantization, functionals, path integrals, functional field integrals, coherent states for bosons and fermions. [7 hours]
Module 2: Classical fields, Klein-Gordon field, massless scalar field theory, massive scalar fields, Phi-4 theory, complex scalar fields. [5 hours]

Module 3: Schrodinger, Heisenberg, and interaction pictures, time-evolution operator, translations and rotations in space-time, transformations of quantum fields, symmetries and conservation laws, Noether's theorem. [8 hours]

Module 4: Canonical quantization of fields with examples, normal ordering, internal symmetries, massive vector fields, polarizations, gauge fields and gauge theory. [7 hours]

Module 5: Propagators and Green's functions, Dyson equation, field and Feynman propagator, Smatrix, perturbation expansion, Wick's theorem, Feynman diagrams. [7 hours]

Module 6 (some applications of field theory in condensed matter physics): Superfluids and fields, Fermi liquid theory, field theory formulation of many-body problem in metals and superconductors, Hartree-Fock energy, random phase approximation, fractional quantum Hall effect. [8 hours]

OR

Module 6 (some applications of field theory in particle physics): Dirac and Weyl equation, spinors, transformation of spinors, quantizing the Dirac field, fermion propagator, quantum electrodynamics (QED), Feynman rules, QED scattering cross sections. [8 hours]

Books:

Text

1. Quantum field theory for gifted amateur, by Lancaster and Blundell, Oxford (2014).
2. Quantum field theory, by Mandl and Shaw, John Wiley and Sons (2010).
3. An introduction to quantum field theory, by Peskin and Schroeder, CRC Press (2018).

References

1. Quantum theory of Fields, Vol.1, by S. Weinberg, Cambridge (1995).
2. Quantum field theory, by M. Srednicki, Cambridge (2007).
3. Quantum field theory by M. H. Ryder, Cambridge (1996).

Online resources:

1. David Tong: lectures on QFT http://www.damtp.cam.ac.uk/user/tong/qft.html
2. Lectures on advanced quantum mechanics by Freeman Dyson. https://arxiv.org/pdf/quant-ph/0608140.pdf

Similarity Content Declaration with Existing Courses:

Sl. No.	Course code	Similarity content	Percentage
1)	PH 512 Classical Mechanics	Lagrangian, least action.	< 5%
2)	PH 613 Special topics in Quantum Mechanics	Klein-Gordon and Dirac equation.	< 5%
3)	PH 521 Electromagnetic Theory	Electromagnetic field tensor.	< 5%
4)	PH 613 Special topics in QM.	Klein-Gordon and Dirac equation	<5%

Justification for new course proposal if cumulative similarity content is > 30%: N/A

Approvals:

Other Faculty interested in teaching this course:

Proposed by: Dr. Girish Sharma (SBS)
and Dr. Sudhir Pandey (SE). **School:** School of Basic Sciences (SBS)

Signature: Girish Sharma 10/01/2021 Date:

Recommended/Not Recommended, with Comments:

Date:

Chairman, CPC

Approved / Not Approved

Date:

Chairman, Senate