REVISED CURRICULUM

As per the Senate directives upon adoption of NEP-2020 in its 30th Senate, IIT Patna took up a rigorous curriculum and syllabus revision exercise for all the running programmes (in-campus / hybrid mode of instruction) to ensure implementation of NEP-2020. During the course of revision, renowned resource persons from the respective area of specialization were invited to contribute through their insights and experience on the subject matter. Their experience and inputs have been instrumental in shaping at par curriculum and course structure where every Academic Department, faculty members and Academic section of the Institute have taken keen interest and delivered their best to create the revised structure of the Academic programmes listed below.

Common curriculum for 4-years B. Tech. / B. S. with Minors and 5-year sdual degree admitted through JoSAA

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	MA1101	Calculus and Linear Algebra	3	1	0	4.0
2.	CS1101	Foundations of Programming	3	0	3	4.5
3.	PH1101/PH1201	Physics	3	1	3	5.5
4.	CE1101/CE1201	Engineering Graphics	1	0	3	2.5
5.	EE1101/EE1201	Electrical Sciences	3	0	3	4.5
6.	HS1101	English for Professionals	2	0	1	2.5
TOTAL			**15**	**2**	**13**	**23.5**

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	MA1201	Probability Theory and Ordinary Differential Equations	3	1	0	4
2.	CS1201	Data Structure	3	0	3	4.5
3.	CH1201/CH1101	Chemistry	3	1	3	5.5
4.	ME1201/ME1101	Mechanical Fabrication	0	0	3	1.5
5.	ME1202/ME1102	Engineering Mechanics	3	1	0	4
6.	IK1201	Indian Knowledge System (IKS)	3	0	0	3
TOTAL			**15**	**3**	**9**	**22.5**

The syllabus of each of the courses in the curriculum framework listed herein above is available on the following link for perusal by the Senate members a priori for discussion in the Senate. The syllabus structure is vetted by a committee comprising respective Department faculty members and external experts invited during review rationalized for credit by an institute level committee comprising representative for all academic departments.

Link: 1. https://academics.iitp.ac.in/revised_curriculum
2. https://academics.iitp.ac.in/revised_syllabus

Note: At the current strength of Ist Year UG intake, the course teaching arrangement is stated as:
(a) 50% students will swap Physics with Chemistry (Sl. No. 3),
(b) and Engineering Graphics with Mechanical Fabrication (Sl. No. 4) and,
(c) Electrical Sciences with Engineering Mechanics (Sl. No. 5) in semester 1 and 2, respectively.

This arrangement may be reviewed based on intake capacity, strength of faculty and teaching infrastructure in due course of time.

(1.) B. Tech. Programme from the Department of Chemical and Biochemical Engineering

(i) B. Tech. in Chemical Engineering

Program Learning Objectives	Program Learning Outcomes
● This program aims to cultivate a comprehensive learning environment for students, equipping them with foundational and cutting-edge knowledge in chemical engineering so that students can thrive and excel in the global market. ● The emphasis will be on tackling a variety of real-world engineering challenges, supported by a strong base in mathematical, scientific, and chemical engineering principles. ● The program will impart expertise in designing and troubleshooting processes for the production of valuable products such as chemicals, fuels, foods, pharmaceuticals, and biologicals from raw materials and the optimization for maximizing productivity and product quality while minimizing costs.	● Graduates should have the capability to develop systems, components, or processes that meet defined specifications, taking into account practical considerations such as economic feasibility, environmental impact, health and safety regulations, manufacturability, and sustainability. ● After completion of the program, students will have acquired the expertise to tackle industrial and real-world challenges in chemical reactor design, separation and purification processes, reaction kinetics, modeling and simulation, automation and control, and heat, momentum, and mass balances, among other areas.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CB2101	Introduction to Chemical Engineering	2	0	0	2
2.	CB2102	Fluid Mechanics	3	1	2	5
3.	CB2103	Heat Transfer	3	0	3	4.5
4.	CB2104	Chemical Process Calculations	3	1	0	4
5.	CB2105	Chemical Engineering Thermodynamics	3	0	0	3
6.	HS21XX	HSS Elective-I	3	0	0	3
TOTAL			**17**	**2**	**5**	**21.5**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CB2201	Mechanical Operations	2	0	3	3.5
2.	CB2202	Mass Transfer-I	3	0	0	3
3.	CB2203	Fundamentals of Biochemical Engineering	3	0	0	3
4.	CB2204	Process Dynamics and Control	3	0	2	4
5.	CB2205	Chemical Reaction Engineering-I	3	0	0	3
6.	XX22PQ	IDE-I	3	0	0	3
TOTAL			**17**	**0**	**5**	**19.5**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	CB3101	Mass Transfer-II	3	0	3	4.5
2.	CB3102	Chemical Process Technology	3	0	0	3
3.	CB3103	Process Equipment Design	1	2	0	3
4.	CB3104	Chemical Reaction Engineering-II	3	0	2	4
5.	CB3105	Chemical Process Modeling and Simulation	2	0	3	3.5
6.	XX31PQ	IDE-II	3	0	0	3
TOTAL			**15**	**2**	**8**	**21**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	CB3201	Process Plant Design and Economics	3	0	0	3
2.	CB3202	Transport Phenomena	3	1	0	4
3.	CB3203	Numerical Methods in Chemical Engineering	3	1	0	4
4.	CB3204	AI/ML for Chemical Engineers	1	0	4	3
5.	CB3205	Chemical Plant Safety and Hazards	3	0	0	3
6.	CB32XX	DE-I	3	0	0	3
TOTAL			**16**	**2**	**4**	**20**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	CB41PQ	DE-II	3	0	0	3
2.	CB41PQ	DE-III	3	0	0	3
3.	XX41PQ	IDE-III	3	0	0	3
4.	HS31XX	HSS Elective-II	3	0	0	3
5.	CB4198	Summer Internship*	0	0	12	3
6.	CB4199	Project – I	0	0	12	6
TOTAL			**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	CB42XX	DE-IV	3	0	0	3
2.	CB42XX	DE-V	3	0	0	3
3.	CB42XX	DE-VI	3	0	0	3
4.	CB4299	Project – II	0	0	16	8
TOTAL			9	0	16	**17**

Total Credits (including B. Tech. first year): **166**

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB3206	Catalysis Science and Engineering	3	0	0	3
2.	CB3207	Biopharmaceutical Downstream Processing	3	0	0	3
3.	CB3208	Material Science and Engineering	3	0	0	3
4.	CB3209	Introduction to Microfluidics Technology	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB4101	Industrial Pollution Control	3	0	0	3
2.	CB4102	Introduction to Computational Biology	3	0	0	3
3.	CB4103	Molecular Modeling and Simulation	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB4104	Electrochemical Energy Systems	3	0	0	3
2.	CB4105	Fertilizer Technology	3	0	0	3
3.	CB4106	Nanomaterials	3	0	0	3
4.	CB4107	Combustion Engineering and Technology	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB4201	Membrane Separation	3	0	0	3
2.	CB4202	Energy Storage: Technologies and Applications	3	0	0	3
3.	CB4203	Process Integration	3	0	0	3

Department Elective - V						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB4204	Renewable Energy Sources	3	0	0	3
2.	CB4205	Advanced Separation Processes	3	0	0	3
3.	CB4206	Fluidization Engineering	3	0	0	3

Department Elective - VI						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB4207	Energy Management	3	0	0	3
2.	CB4208	Heterogeneous Catalysis: Fundamentals and Applications	3	0	0	3
3.	CB4209	Polymer Science and Technology	3	0	0	3
4.	CB4210	Petroleum Refinery Engineering	3	0	0	3

IDE floated by the Department (not applicable for B. Tech. Chemical Engineering students)

Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	CB2206	Environmental Science and Engineering	3	0	0	3
2.	CB3106	Introduction to Sustainable Engineering	3	0	0	3
3.	CB4108	Bioprocess Engineering	3	0	0	3

Minor in Chemical Engineering:

Total courses: 5
Total credits: 17

Sl. No.	**Semester**	**Code**	**Course**	**L**	**T**	**P**	**C**
1.	Sem III	CB2103	Heat Transfer	3	0	3	4.5
2.	Sem IV	CB2201	Mechanical Operations	2	0	3	3.5
3.	Sem V	CB3102	Chemical Process Technology	3	0	0	3
4.	Sem VI	CB2202	Mass Transfer-I	3	0	0	3
5.	Sem VI	CB2205	Chemical Reaction Engineering-I	3	0	0	3
Total				**14**	**0**	**6**	**17**

(2.) B. Tech. Programme from the Department of Civil and Environmental Engineering:

(i) B. Tech. in Civil Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CE2101	Geomatics Engineering	3	1	2	5.0
2.	CE2102	Structural Mechanics	3	1	0	4.0
3.	CE2103	Fluid Mechanics	3	1	2	5.0
4.	CE2104	Geology for Engineers	3	0	2	4.0
5.	HS21XX	HSS Elective - I	3	0	0	3.0
TOTAL			**15**	**3**	**6**	**21.0**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CE2201	Structural Analysis	3	0	2	4.0
2.	CE2202	Soil Mechanics	3	0	2	4.0
3.	CE2203	Civil Engineering Materials	3	0	2	4.0
4.	CE2204	Water Resources Engineering–I	3	0	0	3.0
5.	CE2205	Numerical Methods in Civil Engineering	3	0	0	3.0
6.	XX22PQ	IDE - I	3	0	0	3.0
TOTAL			**18**	**0**	**6**	**21.0**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	CE3101	Design of Reinforced Concrete Structures	3	0	2	4.0
2.	CE3102	Foundation Engineering	3	0	2	4.0
3.	CE3103	Transportation Engineering - I	3	1	2	5.0
4.	CE3104	Environmental Engineering - I	3	0	2	4.0
5.	XX31PQ	IDE - II	3	0	0	3.0
TOTAL			**15**	**1**	**8**	**20.0**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	CE3201	Design of Steel Structures	3	1	0	4.0
2.	CE3202	Infrastructure Drawing and Estimation	1	2	0	3.0
3.	CE3203	Construction Planning & Management	3	0	0	3.0
4.	CE3204	Environmental Engg-II	3	1	0	4.0
5.	CE3205	Water Resources Engineering - II	3	0	2	4.0
6.	CE3206	Transportation Engineering - II	3	0	0	3.0
TOTAL			**16**	**4**	**2**	**21.0**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	CE41XX	Departmental Elective – I	3	0	0	3.0
2.	CE41XX	Departmental Elective – II	3	0	0	3.0
3.	XX41PQ	IDE-III	3	0	0	3.0
4.	HS41XX	HSS Elective II	3	0	0	3.0
5.	CE4198	Summer Internship*	0	0	12	3.0
6.	CE4199	Project – I	0	0	12	6.0
TOTAL			**12**	**0**	**24**	**21.0**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :
a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	CE42XX	Departmental Elective – III	3	0	0	3.0
2.	CE42XX	Departmental Elective – IV	3	0	0	3.0
3.	CE42XX	Departmental Elective – V	3	0	0	3.0
4.	CE4299	Project – II	0	0	16	8.0
TOTAL			**9**	**0**	**16**	**17.0**
GRAND TOTAL (including Semester I & II)			**167.0**			

ELECTIVE GROUPS

Department Elective-I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4101	Introduction to Bridge Engineering	3	0	0	3
2.	CE4102	Prestressed and Precast Concrete Structures	3	0	0	3
3.	CE4103	Fundamentals of Solid Mechanics	3	0	0	3
4.	CE4104	Matrix Method for Structural Analysis	3	0	0	3

Department Elective-II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4105	Stochastic Hydrology	3	0	0	3
2.	CE4106	Irrigation Engineering and Hydraulic Structures	3	0	0	3
3.	CE4107	Elementary Soil Behaviour	3	0	0	3
4.	CE4108	Fundamentals of Geoenvironmental Engg.	3	0	0	3
5.	CE4109	Biogeotechnical Engineering	3	0	0	3
6.	CE4110	Pavement Geotechnology	3	0	0	3

Department Elective-III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4201	Elements of Remote Sensing and GIS	3	0	0	3
2.	CE4202	Introduction to Soil Structure Interaction	3	0	0	3
3.	CE4203	Introduction to Underground Excavation	3	0	0	3
4.	CE4204	Multiphysical Processes in fractured rocks	3	0	0	3
5	CE4205	Rock Engineering for Hydropower Projects	3	0	0	3
6	CE4206	Fundamentals of Forensic Geotech Engineering	3	0	0	3
7	CE4207	Ground Improvement for Civil Engineering Structures	3	0	0	3

Department Elective-IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4208	Solid Waste Engineering	3	0	0	3
2.	CE4209	Air Pollution Engineering	3	0	0	3
3.	CE4210	Pavement Evaluation and Management	3	0	0	3
4.	CE4211	Pavement Materials	3	0	0	3
5.	CE4212	Introduction to Traffic Flow Modelling and Intelligent Transportation systems	3	0	0	3
6.	CE4213	Design of Transportation Facilities and Safety	3	0	0	3

Department Elective-V						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4214	Introduction to Geotechnical Earthquake Engineering	3	0	0	3
2.	CE4215	Structural Dynamics and Earthquake Engineering	3	0	0	3
3.	CE4216	Rehabilitation of Structures	3	0	0	3
4.	CE4217	Introduction to Structural Health Monitoring	3	0	0	3

IDE (Available to students of B. Tech. other than Dept. of Civil and Environmental Engineering)

Sl. No.	Subject Code	Subject	L	T	P	C
1.	CE2206	IDE I: Construction Technology and Management	3	0	0	3
2.	CE3105	IDE II: Green Building	3	0	0	3
3.	CE4111	IDE III: Smart Transportation	3	0	0	3
4.	CE4112	IDE III: Industrial Pollution and Control	3	0	0	3

Minor in Infrastructure Engineering

Minor						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE2102	Minor I: Structural Mechanics	3	1	0	4
2.	CE2203	Minor II: Civil Engineering Materials	3	0	2	4
3.	CE3103	Minor III: Transportation Engineering – I	3	1	2	5
4.	CE3202	Minor IV: Infrastructure Drawing and Estimation	1	2	0	3
TOTAL			10	4	4	16

(3.) B. Tech. Programme from the Department of Chemistry

(i) B. Tech. in Chemical Science and Technology (CST)

Program Learning Objectives:	Program Learning Outcomes (PLO):
Program Goal 1: **Fundamental Understanding:** To impart knowledge and proficiency in an advanced level of theoretical and practical aspects in the major fields of Chemical Science and Technology.	**Program Learning Outcome 1:** **PLO-1:** Students will acquire knowledge and demonstrate understanding of the core concepts, principles, and processes across the fields of chemistry and Chemical technology. **Program Learning Outcome 2:** **PLO-2:** Students will be able to recognize when information is needed and have the ability to locate, evaluate, and use the needed information for a wide range of purposes pertaining to Organic, Inorganic, Physical, Polymer, Industrial, Analytical and Material Chemistry
Program Goal 2: **Basic Training for Research and Industry:** To provide quality training for conducting fundamental and advanced research in Chemistry and technology development. Ethics in scientific research and publication.	**Program Learning Outcome 3:** **PLO-3:** Students will learn the critical thinking skills necessary to apply the scientific method and develop problem-solving skills. This includes: applying scientific inquiry and hypothesis building strategy, designing and conducting investigative experiments, applying quantitative reasoning skills to answer scientific questions. Ethics in scientific research and publication. **Program Learning Outcome 4:** **PLO-4:** Students will learn to employ critical thinking and scientific inquiry in the performance, design, interpretation and documentation of laboratory experiments, at a level suitable to succeed at an entry-level position in chemical industry or a chemistry graduate program.
Program Goal 3: **Skill Enhancement:** To focus on skill enhancement in the core chemistry with practical expert hands. This will make students employable in academia and industries.	**Program Learning Outcome 5:** **PLO-5:** Students will synthesize knowledge, use quantitative reasoning and data to address issues in global scale to help them developing good skill in core chemistry suitable for getting employed in academia and industries.
Program Goal 4: **Communication Skill:** To develop various communication skills such as reading, listening, speaking, etc. This will help in expressing ideas and views clearly and effectively.	**Program Learning Outcome 6:** **PLO-6:** Students will learn how to read and understand research papers, make presentations and communicate to a large audience, develop the ability to work collaboratively.

Program Goal 5: **Social Awareness:** To make understand social, economic, health and environmental issues related to chemical science and technology and develop methods and means to abate and create awareness in society.	**Program Learning Outcome 7:** **PLO-7:** Students will have awareness on various global problems related to chemistry, such as global warming, climate change, environmental pollution, energy crisis, etc. **Program Learning Outcome 8:** **PLO-8:** Students will be able to use their intellectual skills to devise and develop solutions to environmental problems in their communities to apply fact-based chemical science and technology solutions to situations relevant to everyday life in areas such as education, human health, the natural environment, technological advances and policy.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CH2101	Organic Chemistry	3	1	0	4
2.	CH2102	Inorganic Chemistry	3	1	0	4
3.	CH2103	Introduction to Quantum Chemistry	3	1	0	4
4.	CH2104	Fluid Mechanics	3	1	2	5
5.	CH2105	Chemical Process Calculations	3	0	0	3
6.	HS21XX	HSS Elective-I	3	0	0	3
TOTAL			**18**	**4**	**2**	**23**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CH2201	Structure and function of Biomolecules	3	0	0	3
2.	CH2202	Introduction to Organometallics	3	1	0	4
3.	CH2203	Chemical Thermodynamics and Equilibrium	3	1	0	4
4.	CH2204	Industrial Chemistry	3	0	0	3
5.	CH2205	Chemical Technology Laboratory I	0	0	6	3
6.	XX22PQ	IDE-I	3	0	0	3
TOTAL			**15**	**2**	**6**	**20**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	CH3101	Macromolecular Science and Engineering	3	1	0	4
2.	CH3102	Design and Applications of Nanomaterials	2	1	0	3
3.	CH3103	Chemical Kinetics and Electrochemistry	3	0	0	3
4.	CH3104	Techniques for Chemical Analysis	3	1	0	4
5.	CH3105	Chemical Technology Laboratory II	0	0	6	3
6.	XX31PQ	IDE-II	3	0	0	3
TOTAL			**14**	**3**	**6**	**20**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	CH3201	Medicinal Chemistry	3	0	0	3
2.	CH3202	Environmental Science & Technology	3	0	0	3
3.	CH3203	Computational Chemistry	3	0	2	4
4.	CH3204	Chemistry for Propellants and Pyrotechnics	3	0	0	3
5.	CH3205	Chemical Technology Laboratory III	0	0	6	3
6.	CH32XX	Department Elective-I	3	0	0	3
TOTAL			**15**	**0**	**8**	**19**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	CH41XX	Departmental Elective – II	3	0	0	3
2.	CH41XX	Departmental Elective – III	3	0	0	3
3.	XX41PQ	IDE-III	3	0	0	3
4.	HS41XX	HSS Elective II	3	0	0	3
5.	CH4198	Summer Internship*	0	0	12	3
6.	CH4199	Project – I	0	0	12	6
TOTAL			**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	CH42XX	Departmental Elective – IV	3	0	0	3
2.	CH42XX	Departmental Elective – V	3	0	0	3
3.	CH42XX	Departmental Elective – VI	3	0	0	3
4.	CH4299	Project – II	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**

Grand Total : (Semester I to VIII) – 166

ELECTIVE GROUPS

Department Electives - I						
Sl. No.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CH3206	Metal Ions in Chemical Biology	3	0	0	3
2.	CH3207	Petroleum and Petrochemicals	3	0	0	3

	Department Electives - II					
Sl. No.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CH4107	Drug Design and Development	3	0	0	3
2.	CH4108	Dyes, Paints and Pigments	3	0	0	3

Department Electives - III						
Sl. No.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CH4109	Group Theory and Spectroscopy	3	0	0	3
2.	CH4110	Application of Statistical Mechanics in Chemistry.	3	0	0	3

Department Electives - IV						
Sl. No.	**Subject Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CH4207	Catalysis	3	0	0	3
2.	CH4208	Colloids and Interface Chemistry	3	0	0	3

Department Electives - V						
3.	CH4209	Food Chemistry	3	0	0	3
4.	CH4210	Green and Sustainable Chemistry	3	0	0	3

Department Electives - VI						
5.	CH4211	Materials Chemistry	3	0	0	3
6.	CH4212	Organic Semiconductors: Fundamentals to Applications	3	0	0	3

IDE (For students of B. Tech. other than Dept. of Chemistry)

Sl. No.	Course Code	Course Name	L	T	P	C
1.	CH2206	IDE-I: Green Science and Technology	3	0	0	3
2.	CH3106	IDE-II: Synthesis of Industrially Important Inorganic Molecules	3	0	0	3
3.	CH4111	IDE-III: Analytical Chemistry	3	0	0	3

(4.) B. Tech. Programme from the Department of Computer Science & Engineering

(i) B. Tech. Artificial Intelligence and Data Science (AI&DS)

Program Learning Objectives:	Program Learning Outcomes (PLO):
Program Goal 1: **Fundamental Understanding:** Establish a robust foundation in Artificial Intelligence (AI) and Data Science (DS) principles, theories, and methodologies.	**Program Learning Outcome 1 (PLO-1):** Students will acquire a deep understanding of the core concepts, algorithms, and tools used in AI, machine learning, deep learning, and data science. **Program Learning Outcome 2 (PLO-2):** Students will develop the ability to analyze and interpret complex data, using statistical and computational techniques to extract meaningful insights.
Program Goal 2: **Basic Training for Research and Innovation:** To equip students with the skills necessary to conduct cutting-edge research and innovate in the fields of AI and Data Science.	**Program Learning Outcome 3 (PLO-3):** Students will be able to innovate by developing new machine learning/ deep learning models, and systems in AI and DS, contributing to advancements in the field.
Program Goal 3: **Technical Skill Proficiency:** To enhance technical skills for developing AI and data-driven solutions for industry and academia.	**Program Learning Outcome 4 (PLO-4):** Students will demonstrate proficiency in programming, data management, and the use of AI and DS tools and frameworks in various fields including computer vision, natural language processing. **Program Learning Outcome 5 (PLO-5):** Students will be able to design and implement AI and DS solutions that are efficient, scalable, and reliable.
Program Goal 4: **Communication and Collaboration:** To develop communication and teamwork skills essential for professional success in AI and DS.	**Program Learning Outcome 6 (PLO-6):** Students will learn to effectively communicate AI and DS concepts, findings, and solutions to both technical and non-technical audiences.
Program Goal 5: **Ethics and Social Responsibility:** To understand the ethical, social, and environmental implications of AI and Data Science.	**Program Learning Outcome 7 (PLO-7):** Students will develop an awareness of ethical issues in AI and DS, such as data privacy, algorithmic bias, and the societal impacts of AI technologies. **Program Learning Outcome 8 (PLO-8):** Students will be able to apply ethical principles and responsible practices in the development and deployment of AI and DS solutions.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CS2101	Algorithm	3	0	3	4.5
2.	CS2102	Digital Logic and Computer Organization	3	0	3	4.5
3.	CS2103	Artificial Intelligence Concepts	2	0	2	3
4.	CS2104	Discrete Mathematics	3	0	0	3
5.	CS2105	Optimization Techniques	3	0	0	3
6.	HS21XX	HSS Elective - I	3	0	0	3
TOTAL			**17**	**0**	**8**	**21**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CS2201	Formal Language and Automata Theory	3	0	0	3
2.	CS2202	Database and Warehousing	3	0	2	4
3.	CS2203	Artificial Intelligence	3	0	3	4.5
4.	CS2204	IT Workshop	0	2	2	3
5.	CS2205	Data Analytics and Visualization	3	0	3	4.5
6.	XX22PQ	IDE-I	3	0	0	3
TOTAL			**15**	**2**	**10**	**22**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	CS3101	Operating System	3	0	3	4.5
2.	CS3102	Computer Network	3	0	3	4.5
3.	CS3103	Machine Learning	3	0	3	4.5
4.	CS3105	Natural Language Processing	3	0	3	4.5
5.	XX31PQ	IDE-II	3	0	0	3
TOTAL			**15**	**0**	**12**	**21**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1	CS3201	Cyber Security	3	0	2	4
2	CS3202	Deep Learning	3	0	3	4.5
3	CS3204	Computer Vision	3	0	3	4.5
4	CS3299	Capstone Project	0	0	6	3
5	CS32XX	DE-I (AI ELECTIVES LIST)	3	0	0	3
TOTAL			12	0	14	**19**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	CS41XX	DE-II (AI ELECTIVES LIST)	3	0	0	3
2.	CS41XX	DE-III (AI ELECTIVES LIST)	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41XX	HSS Elective - II	3	0	0	3
5.	CS4198	Summer Internship*/ Summer Project	0	0	12	3
6.	CS4199	Project – I	0	0	12	6
TOTAL			**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	CS42XX	DE-IV (AI ELECTIVES LIST)	3	0	0	3
2.	CS42XX	DE-V (AI ELECTIVES LIST)	3	0	0	3
3.	CS42XX	DE-VI (AI ELECTIVES LIST)	3	0	0	3
4.	CS4299	Project – II	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**
GRAND TOTAL (including Semester I & II)			**167**			

ELECTIVE GROUPS (AI & DS)

Department Elective - I						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS3205	Object-Oriented Programming	3	0	0	3
2.	CS3206	Agile Computing	3	0	0	3
3.	CS3207	Software Engineering	3	0	0	3
4.	CS3208	Bayesian Data Analysis	3	0	0	3
5.	CS3209	Data Mining	3	0	0	3
6.	CS3210	Information Retrieval	3	0	0	3

Department Elective - II						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4101	Pattern Recognition	3	0	0	3
2.	CS4102	Principles of Programming Languages	3	0	0	3
3.	CS4103	Social Networks	3	0	0	3
4.	CS4104	Multimedia System	3	0	0	3
5.	CS4105	Nature Inspired Algorithms	3	0	0	3

Department Elective - III						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4106	Graph Machine Learning	3	0	0	3
2.	CS4107	Bioinformatics	3	0	0	3
3.	CS4108	Time Series Analysis	3	0	0	3
4.	CS4109	Computational Data Analysis	3	0	0	3
5.	CS4110	Blockchain Technology	3	0	0	3
6.	CS4111	Evolutionary Computing	3	0	0	3

Department Elective - IV						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4201	Multivariate Analysis	3	0	0	3
2.	CS4202	Generative AI	3	0	0	3
3.	CS4203	Statistical Machine Learning	3	0	0	3
4.	CS4204	Text Mining	3	0	0	3

Department Elective - V						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4205	Cloud Computing	3	0	0	3
2.	CS4206	Quantum Computing	3	0	0	3
3.	CS4207	Drone Data Processing	3	0	0	3
4.	CS4208	Edge Computing	3	0	0	3
5.	CS4209	Wireless Networks	3	0	0	3

Department Elective - VI						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4210	Computer Security	3	0	0	3
2.	CS4211	Cryptography	3	0	0	3
3.	CS4212	Big Data Analytics	3	0	0	3
4.	CS4213	Computer Forensics	3	0	0	3

IDE from AI&DS (Available to students other than Dept. of CSE)

IDE	**Semester**	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
IDE-I	Semester-4	CS2207	Introduction to Data Science	3	0	0	3
IDE-II	Semester-5	CS3106	Computer Graphics	3	0	0	3

IDE-III	Semester-7	CS4113	Data Analysis and Visualization	3	0	0	3

Minor in AI&DS (List of Courses)						
	Course Code	**Course Name**	**L**	**T**	**P**	**C**
Minor-1	CS2103	Artificial Intelligence Concepts	2	0	2	3
Minor-2	CS2202	Database and Warehousing	3	0	2	4
Minor-3	CS3103	Machine Learning	3	0	3	4.5
Minor-4	CS3202	Deep Learning	3	0	3	4.5
		Total Credits	**16**			

(ii) B. Tech. in Computer Science and Engineering (CSE)

Program Learning Objectives:	Program Learning Outcomes (PLO):
Program Goal 1: **Fundamental Understanding:** To impart knowledge and proficiency in an advanced level of theoretical and practical aspects in the major fields of Computer Science and Engineering.	**Program Learning Outcome 1:** **PLO-1:** Students will acquire and demonstrate a comprehensive understanding of core concepts in computing principles, data structure, algorithms, programming languages. **Program Learning Outcome 2:** **PLO-2:** Students will be able to understand problems computationally, design efficient algorithms, and implement software solutions.
Program Goal 2: **Basic Training for Research and Industry:** To provide quality training for conducting fundamental and advanced research in Computer Science and Engineering and software development.	**Program Learning Outcome 3:** **PLO-3:** Students will develop the ability to apply the scientific method to computer science problems, including formulating hypotheses, designing experiments, and analyzing results. **Program Learning Outcome 4:** **PLO-4:** Students will demonstrate proficiency in software development, including the use of modern programming environments, operating systems, computer networks, version control, and collaborative development practices.
Program Goal 3: **Skill Enhancement:** To focus on skill enhancement in system development and security.	**Program Learning Outcome 5:** **PLO-5:** Students will be able to design, implement, and manage complex systems, computer architecture, networking, ensuring quality, and security.
Program Goal 4: **Communication Skill:** To develop various communication skills such as reading, listening, speaking, etc. This will help in expressing ideas and views clearly and effectively.	**Program Learning Outcome 6:** **PLO-6:** Students will develop the ability to communicate technical information effectively through written reports, oral presentations, and collaborative projects.
Program Goal 5: **Social Awareness:** To understand societal issues related to computer science and allied areas and develop methods and means to abate and create awareness in society.	**Program Learning Outcome 7:** **PLO-7:** Students will develop an awareness of ethical, social, and environmental issues related to computing, applying responsible practices in their professional activities. **Program Learning Outcome 8:** **PLO-8:** Students will learn to work effectively in teams, demonstrating leadership, collaboration, and project management skills.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CS2101	Algorithm	3	0	3	4.5
2.	CS2102	Digital Logic and Computer Organization	3	0	3	4.5
3.	CS2103	Artificial Intelligence Concepts	2	0	2	3
4.	CS2104	Discrete Mathematics	3	0	0	3
5.	CS2105	Optimization Techniques	3	0	0	3
6.	HS21XX	HSS Elective I	3	0	0	3
		TOTAL	**17**	**0**	**8**	**21**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CS2201	Formal Language and Automata Theory	3	0	0	3
2.	CS2202	Database and Warehousing	3	0	2	4
3.	CS2203	Artificial Intelligence	3	0	3	4.5
4.	CS2204	IT Workshop	0	2	2	3
5.	CS2206	Computer Architecture	3	0	3	4.5
6.	XX22PQ	IDE - I	3	0	0	3
		TOTAL	**15**	**2**	**10**	**22**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	CS3101	Operating System	3	0	3	4.5
2.	CS3102	Computer Network	3	0	3	4.5
3.	CS3103	Machine Learning	3	0	3	4.5
4.	CS3104	Compiler	3	0	3	4.5
5.	XX31PQ	IDE - II	3	0	0	3
		TOTAL	**15**	**0**	**12**	**21**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	CS3201	Cyber Security	3	0	2	4
2.	CS3202	Deep Learning	3	0	3	4.5
3.	CS3203	Internet of Things	3	0	3	4.5
4.	CS32XX	DE-I (CS ELECTIVES LIST)	3	0	0	3
5.	CS3299	Capstone Project	0	0	6	3
		TOTAL	**12**	**0**	**14**	**19**
		Minor - IV	**3**	**0**	**2**	**4**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	CS41XX	DE-II (CS ELECTIVES LIST)	3	0	0	3
2.	CS41XX	DE-III (CS ELECTIVES LIST)	3	0	0	3
3.	XX41PQ	IDE-III	3	0	0	3
4.	HS41XX	HSS Elective II	3	0	0	3
5.	CS4198	Summer Internship*/ Summer Project	0	0	12	3
6.	CS4199	Project – I	0	0	12	6
		TOTAL	**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	CS42XX	DE-IV (CS Elective List)	3	0	0	3
2.	CS42XX	DE-V (CS Elective List)	3	0	0	3
3.	CS42XX	DE-VI (CS Elective List)	3	0	0	3
4.	CS4299	Project – II	0	0	16	8
		TOTAL	**9**	**0**	**16**	**17**
GRAND TOTAL (including Semester I & II)			**167**			

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS3205	Object-Oriented Programming	3	0	0	3
2.	CS3206	Agile Computing	3	0	0	3
3.	CS3207	Software Engineering	3	0	0	3
4.	CS3208	Bayesian Data Analysis	3	0	0	3
5.	CS3209	Data Mining	3	0	0	3
6.	CS3210	Information Retrieval	3	0	0	3

Department Elective - II						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4101	Pattern Recognition	3	0	0	3
2.	CS4102	Principles of Programming Languages	3	0	0	3
3.	CS4103	Social Networks	3	0	0	3
4.	CS4104	Multimedia System	3	0	0	3
5.	CS4105	Program Analysis and Verification	3	0	0	3

Department Elective - III						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4106	Graph Machine Learning	3	0	0	3
2.	CS4107	Bioinformatics	3	0	0	3
3.	CS4108	Time Series Analysis	3	0	0	3
4.	CS4109	Computational Data Analysis	3	0	0	3
5.	CS4110	Blockchain Technology	3	0	0	3
6.	CS4112	Graph Theory	3	0	0	3

Department Elective - IV						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4201	Multivariate Analysis	3	0	0	3
2.	CS4202	Generative AI	3	0	0	3
3.	CS4203	Statistical Machine Learning	3	0	0	3
4.	CS4204	Text Mining	3	0	0	3
5.	CS4214	Combinatorial Optimization	3	0	0	3

Department Elective - V						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4205	Cloud Computing	3	0	0	3
2.	CS4206	Quantum Computing	3	0	0	3
3.	CS4207	Drone Data Processing	3	0	0	3
4.	CS4208	Edge Computing	3	0	0	3
5.	CS4209	Wireless Networks	3	0	0	3
6.	CS4215	Distributed Computing	3	0	0	3
7.	CS4216	Parallel Computing	3	0	0	3

Department Elective - VI						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	CS4210	Computer Security	3	0	0	3
2.	CS4211	Cryptography	3	0	0	3
3.	CS4212	Big Data Analytics	3	0	0	3
4.	CS4213	Computer Forensics	3	0	0	3

IDE from CSE (Available to student other than Dept. of CSE)						
	Course Code	**Course Name**	**L**	**T**	**P**	**C**
IDE- I	CS2207	Introduction to Data Science	3	0	0	3
IDE –II	CS3106	Computer Graphics	3	0	0	3
IDE -III	CS4113	Data Analysis and Visualization	3	0	0	3

Minor in Computer Science & Engineering						
Minors	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
Minor-I	CS2101	Algorithm	3	0	3	4.5
Minor-II	CS2202	Database and Warehousing	3	0	2	4
Minor-III	CS3101	Operating System	3	0	3	4.5
Minor-IV	CS3201	Cyber Security	3	0	2	4
		Total Credits	**17**			

(5.) B. Tech. Programme from the Department of Electrical Engineering

(i) B. Tech. in Electronics and Communication Engineering (ECE)

Program Learning Objectives:	**Program Learning Outcomes:**
1. Develop a solid foundation in electronics and communication engineering principles, including circuit analysis, electronic devices, signal processing, microprocessor/microcontroller systems, analog communication systems, digital communication, and RF circuits etc. 2. Develop electronics and communication project management skills, including the ability to plan, execute, and complete within specified timelines and budgets. 3. Work collaboratively in multidisciplinary teams, demonstrating effective teamwork and communication to solve complex engineering problems. 4. Recognize the importance of ongoing professional development, engaging in activities such as certifications, workshops, and conferences to stay updated of industry trends.	The graduates of this program will have 1. a successful career in an Academia/Industry/Entrepreneur. 2. strong fundamentals in electronics and communications engineering. 3. ability to design prototypes for real world problems related to electronics, communications and interdisciplinary fields. 4. ability to develop soft skills such as effective communications in both verbal and written forms, body language, time management, problem-solving, leadership, work in both team as well as individual in a professional manner.
Program Goal 1: Academic excellence by providing a curriculum that aligns with industry standards and encourages critical thinking in the field of electronics and communication engineering.	**Program Learning Outcome 1a:** Highly skilled market ready man power to serve the emerging electronic sectors **Program Learning Outcome 1b:** Skilled Human resource to cater the needs of next generation communication sectors
Program Goal 2: A culture of research and innovation by promoting faculty and student involvement in cutting-edge projects in electronic and communication technologies.	**Program Learning Outcome 2a:** Trained researchers for implementing research projects in line with national priorities such as CPS, Semiconductors, Clean Energy, Green Technologies **Program Learning Outcome 2b:** Design and develop innovative smart electronics products as per the societal need
Program Goal 3:. To design dynamic and flexible course structures for UG and PG programs as per the changing requirement of the industries	**Program Learning Outcome 3a:** Industry relevant UG, PG, and research programs **Program Learning Outcome 3b:** Trained manpower as per the industry requirement
Program Goal 4: To promote entrepreneurship among the students in the field of electronics and communication engineering	**Program Learning Outcome 4a:** Realization of working prototype towards product development

	Program Learning Outcome 4b: Promotion of in house technology based ventures catering societal needs
Program Goal 5: Equip students with strong communication skills, enabling them to articulate technical concepts clearly and effectively in both written and oral forms.	**Program Learning Outcome 5a:** Man power with enhanced soft skills to support the vision of developed India **Program Learning Outcome 5b:** Responsible citizen for the holistic growth of the country

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	EC2101	Analog Circuits	3	0	2	4
2.	EC2102	Signals and Systems	3	1	0	4
3.	EC2103	Semiconductor Devices	3	0	2	4
4.	EE2101	Measurements and Instrumentation	3	0	2	4
5.	EE2102	Network Analysis and Synthesis	3	0	0	3
6.	HS21XX	HSS Elective - I	3	0	0	3
		TOTAL	**18**	**1**	**6**	**22**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	EC2201	Digital Electronics	3	0	2	4
2.	EC2202	Microprocessor	2	0	2	3
3.	EC2203	Computer Organization and Architecture	3	0	0	3
4.	EC2204	Internet of Things	3	0	0	3
5.	EE2201	Control Systems	3	0	2	4
6.	XX22PQ	IDE I	3	0	0	3
		TOTAL	**17**	**0**	**6**	**20**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	EC3101	Microcontroller and Embedded System	3	0	2	4
2.	EC3102	VLSI Design	3	0	2	4
3.	EC3103	Analog Communication	3	0	2	4
4.	EC3104	Engineering Electromagnetics	3	0	0	3
5.	EC3105	Random Signals and Stochastic Processes	3	0	0	3
6.	XX31PQ	IDE - II	3	0	0	3
		TOTAL	**18**	**0**	**6**	**21**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	EC3201	Digital Communication	3	0	2	4
2.	EC3202	Digital Signal Processing	3	0	2	4
3.	EC3203	Introduction to AI/ML	3	0	0	3
4.	EC3204	Low Power MOSFETs Design and Modeling	3	0	0	3
5.	EC3205	Introduction to Wireless Communications	3	0	0	3
6.	EC3206	RF Systems	3	0	0	3
		TOTAL	**18**	**0**	**4**	**20**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	EC41XX	Department Elective - I	3	0	0	3
2.	EC41XX	Department Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41XX	HSS Elective - II	3	0	0	3
5.	EC4198	Summer Internship*	0	0	12	3
6.	EC4199	Project – I	0	0	12	6
		TOTAL	**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	EC42XX	Department Elective III	3	0	0	3
2.	EC42XX	Department Elective IV	3	0	0	3
3.	EC42XX	Department Elective V	3	0	0	3
4.	EC4299	Project – II	0	0	16	8
		TOTAL	**9**	**0**	**16**	**17**
		GRAND TOTAL (Semester I to VIII)	**167**			

ELECTIVE GROUPS

Department Elective I						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EC4101	Introduction to Quantum Computing	3	0	0	3
2.	EC4102	Deep Learning for Video Surveillance Systems	3	0	0	3
3.	EC4103	FPGA based System Design	3	0	0	3

Department Elective II						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EC4104	Introduction to Information Theory	3	0	0	3
2.	EC4105	Digital Image Processing	3	0	0	3
3.	EC4106	Graph Signal Processing	3	0	0	3

Department Elective III						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EC4201	Mobile Communications	3	0	0	3
2.	EC4202	Opto Electronic Devices	3	0	0	3
3.	EE4203	Introduction to Energy Storage Techniques	3	0	0	3

Department Elective IV						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EC4203	Introduction to Optical Communications	3	0	0	3
2.	EC4204	Low Power Circuits	3	0	0	3
3.	EE4206	Fundamentals of Electrical Vehicle Technology	3	0	0	3

Department Elective V						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EC4205	Biomedical Signal Processing	3	0	0	3
2.	EC4206	High Power Semiconductor Devices	3	0	0	3
3.	EC4207	Biomedical Instrumentation	3	0	0	3

Interdisciplinary Electives (Available to students of B. Tech. other than Dept. of EE)

Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
IDE-I						
1.	EE2203	Introduction to Electric Vehicle Technology	3	0	0	3
IDE-II						
1.	EC3106	Introduction to Communication System	3	0	0	3
IDE-III						
1.	EC4107	Quantum Computing Fundamantals	3	0	0	3

Minor in Communication Engineering:

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	EC2102	Signals and Systems	3	1	0	4
2.	EC2201	Digital Electronics	3	0	2	4
3.	EC3103	Analog Communication	3	0	2	4
4.	EC3201	Digital Communication	3	0	2	4

(ii) B. Tech. in Electrical and Electronics Engineering (EEE)

Program Learning Objectives:	**Program Learning Outcomes:**
1. Develop a solid foundation in electrical and electronics engineering principles, including circuit analysis, electromagnetic field theory, electrical machines, power systems, control systems, power electronics, signal processing, and microprocessor/microcontroller systems. 2. Develop electrical and electronics project management skills, including the ability to plan, execute, and complete within specified timelines and budgets. 3. Work collaboratively in multidisciplinary teams, demonstrating effective teamwork and communication to solve complex engineering problems. 4. Recognize the importance of ongoing professional development, engaging in activities such as certifications, workshops, and conferences to stay updated of industry trends.	The graduates of this program will have 1. a successful career in an Academia/Industry/Entrepreneur 2. strong fundamentals in electrical and electronics engineering. 3. ability to design prototypes for real world problems related to electrical, electronics, and interdisciplinary fields. 4. ability to develop soft skills such as effective communications in both verbal and written forms, body language, time managements, problem-solving, leadership, work in both team as well as individual in a professional manner
Program Goal 1: Academic excellence by providing a curriculum that aligns with industry standards and encourages critical thinking in electrical and electronics engineering**.**	**Program Learning Outcome 1a:** Highly skilled market ready manpower to serve the emerging electrical and electronic sectors **Program Learning Outcome 1b:** Skilled Human resource to cater the needs of next generation power systems and EV technologies.
Program Goal 2: A culture of research and innovation by promoting faculty and student involvement in innovative projects in electrical and electronic technologies.	**Program Learning Outcome 2a:** Trained researchers for implementing research projects in line with national priorities such as Energy, EVs, Smart Grids, Green Technologies **Program Learning Outcome 2b:** Design and develop innovative smart technologies/products in energy and EVs as per the societal need
Program Goal 3: To design dynamic and flexible course structures for UG and PG programs as per the changing requirement of the industries	**Program Learning Outcome 3a:** Industry relevant UG, PG, and research programs **Program Learning Outcome 3b:** Trained manpower as per the industry requirement
Program Goal 4: To promote entrepreneurship among the students in the field of electrical and electronics engineering	**Program Learning Outcome 4a:** Realization of working prototype towards product development **Program Learning Outcome 4b:** Promotion of in-house technology-based ventures catering societal needs

Program Goal 5: Equip students with effective communication skills, enabling them to articulate technical concepts clearly and effectively in both written and oral forms.	**Program Learning Outcome 5a:** Manpower with enhanced soft skills to support the vision of developed India **Program Learning Outcome 5b:** Responsible citizen for the holistic growth of the country

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	EE2101	Measurements and Instrumentation	3	0	2	4
2.	EE2102	Network Analysis and Synthesis	3	0	0	3
3.	EE2103	Electrical Machines – I	2	0	2	3
4.	EC2101	Analog Circuits	3	0	2	4
5.	EC2102	Signals and Systems	3	1	0	4
6.	HS21XX	HSS Elective - I	3	0	0	3
TOTAL			**17**	**1**	**6**	**21**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	EC2201	Digital Electronics	3	0	2	4
2.	EC2202	Microprocessor	2	0	2	3
3.	EC2204	Internet of Things	3	0	0	3
4.	EE2201	Control Systems	3	0	2	4
5.	EE2202	Electrical Machines-II	2	0	2	3
6.	XX22PQ	IDE - I	3	0	0	3
TOTAL			**16**	**0**	**8**	**20**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	EE3101	Power Systems-I	2	0	2	3
2.	EE3102	Modern Control Theory	3	0	2	4
3.	EC3101	Microcontroller and Embedded System	3	0	2	4
4.	EC3104	Engineering Electromagnetics	3	0	0	3
5.	EC3105	Random Signals and Stochastic Processes	3	0	0	3
6.	XX31PQ	IDE - II	3	0	0	3
TOTAL			**17**	**0**	**6**	**20**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	EE3201	Fundamentals of Electric Drives	3	0	2	4
2.	EE3202	Power System II	3	0	2	4
3.	EE3203	Power Electronics	3	0	2	4
4.	EE3204	Electrical Machine Design	1	0	2	2
5.	EC3202	Digital Signal Processing	3	0	2	4
6.	EC3203	Introduction to AI/ML	3	0	0	3
TOTAL			**16**	**0**	**10**	**21**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	EE41XX	Departmental Elective – I	3	0	0	3
2.	EE41XX	Departmental Elective – II	3	0	0	3
3.	HS41XX	HSS Elective - II	3	0	0	3
4.	XX41PQ	IDE - III	3	0	0	3
5.	EE4198	Summer Internship*	0	0	12	3
6.	EE4199	Project – I	0	0	12	6
TOTAL			**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :
a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	EE42XX	Departmental Elective – III	3	0	0	3
2.	EE42XX	Departmental Elective – IV	3	0	0	3
3.	EE42XX	Departmental Elective – V	3	0	0	3
4.	EE4299	Project – II	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**
GRAND TOTAL (Semester I to VIII)			**166**			

ELECTIVE GROUPS

Department Elective I						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EE4101	Electrical Traction and Propulsion	3	0	0	3
2.	EC4102	Deep Learning for Video Surveillance Systems	3	0	0	3
3.	EC4103	FPGA based System Design	3	0	0	3

Department Elective II						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EE4102	Power System Reliability	3	0	0	3
2.	EC4101	Introduction to Quantum Computing	3	0	0	3
3.	EC4105	Digital Image Processing	3	0	0	3

Department Elective III						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EE4201	Power System Protection	3	0	0	3
2.	EE4202	Digital Control Systems	3	0	0	3
3.	EE4203	Introduction to Energy Storage Techniques	3	0	0	3

Department Elective IV						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EE4204	Special Electrical Machines	3	0	0	3
2.	EE4205	High Voltage Engineering	3	0	0	3
3.	EE4206	Fundamentals of Electrical Vehicle Technology	3	0	0	3

Department Elective V						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	EC4205	Biomedical Signal Processing	3	0	0	3
2.	EC4206	High Power Semiconductor Devices	3	0	0	3
3.	EC4207	Biomedical Instrumentation	3	0	0	3

Interdisciplinary Electives (Available to students of B. Tech. other than Dept. of EE)

Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
IDE-I						
1.	EE2203	Introduction to Electric Vehicle Technology	3	0	0	3
IDE-II						
1.	EC3106	Introduction to Communication System	3	0	0	3
IDE-III						
1.	EC4107	Quantum Computing Fundamantals	3	0	0	3

(6.) BS Programme from the Department of Humanities and Social Sciences

(i) B. S. in Economics

Program Learning Objectives	Program Learning Outcomes
The program will prepare graduates to: 1. Understand the economic way of thinking, by which we mean the rational and purposeful utility maximizing choices made by individual agents, with the understanding of the trade-offs and opportunity costs such choices involve. 2. The ability to parsimoniously and formally model economic decisions. 3. Demonstrate logical and critical reasoning abilities in various domains of economics, social and ethical impacts of economic interventions along with policy analysis and its role in priority setting to undertake upliftment and betterment of the society at large. 3. The ability to analyze historical and current events from an economic perspective. 4. The ability to analyze, interpret and present economic data. 5. The ability to write clearly expressing an economic point of view. 6. Be exposed to alternative approaches to economic problems through exposure to course work in allied fields.	1. Utilize microeconomic and macroeconomic theory to analyze a specific economic scenario. 2. Utilize data to gain insight into a specific economic relationship. 3. Critically evaluate the relationship between the structure and operation of markets, institutions and the economy. 4. Apply microeconomic theory to produce a written assessment of the industrial structure, firm behaviour, and economic performance of a specific industry. 5. Formulate an economic research question and produce a review of the relevant scholarly economic literature as part of an independent research project. 6. Communicate effectively on complex economic activities and solutions towards the development of a better society. 7. Apply ethical practices in their personal and professional roles with defined norms to achieve egalitarian philosophy.

SEMESTER III						
Sl. No.	**Course Number**	**Course Title**	**L**	**T**	**P**	**C**
1.	HS2101	Mathematical Statistics	3	1	0	4
2.	HS2102	Fundamentals of Economics	3	1	0	4
3.	HS2103	Multivariate Analysis and Basic Econometrics	3	0	0	3
4.	HS2104	History of Economic Thought	3	0	0	3
5.	HS2105/ MA2102	Probability and Stochastic Processes	3	1	0	4
6.	HS21PQ	HSS Elective - I	3	0	0	3
TOTAL			**18**	**3**	**0**	**21**

SEMESTER IV						
Sl. No.	**Course Number**	**Course Title**	**L**	**T**	**P**	**C**
1.	HS2201	Growth and Development	3	1	0	4
2.	HS2202	Microeconomic Theory	3	1	0	4
3.	HS2203	Macroeconomic Theory	3	1	0	4
4.	HS2204	Econometrics-I	3	1	0	4
5.	XX22PQ	IDE-I	3	0	0	3
TOTAL			**15**	**4**	**0**	**19**

SEMESTER V						
Sl. No.	**Course Number**	**Course Title**	**L**	**T**	**P**	**C**
1.	HS3101	Econometrics – II	3	1	2	5
2.	HS3102	Mathematical Economics	3	1	0	4
3.	HS3103	International Trade and Investment	3	1	0	4
4.	HS3104	Debate in Indian Economy	3	1	0	4
5.	XX31PQ	IDE-II	3	0	0	3
TOTAL			**15**	**4**	**2**	**20**

SEMESTER VI						
Sl. No.	**Course Number**	**Course Title**	**L**	**T**	**P**	**C**
1.	HS3201	Categorical Data Analysis	3	1	2	5
2.	HS3202	Environmental Economics	3	1	0	4
3.	HS3203	Critical Economic Reading and Seminar	3	3	0	6
4.	HS3204	Indian Financial System	3	1	0	4
5.	HS3205	Health Economics	3	0	0	3
TOTAL			**15**	**6**	**2**	**22**

SEMESTER VII						
Sl. No.	**Course Number**	**Course Title**	**L**	**T**	**P**	**C**
1.	HS41XX	Specialization Elective 1	3	1	0	4
2.	HS41XX	Specialization Elective 2	3	1	0	4
3.	HS41XX	HSS Elective - II	3	0	0	3
4.	XX41PQ	IDE-III	3	0	0	3
5.	HS4198	**Summer Internship***	**0**	**0**	**12**	**3**
6.	HS4199	**Project-I** (Lab based project / Industry oriented problem solving/ Academic internship / Case Study/Design thinking-based project- Capstone Project)	0	0	12	6
		TOTAL	**12**	**2**	**24**	**23**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

SEMESTER VIII						
Sl. No.	**Course Number**	**Course Title**	**L**	**T**	**P**	**C**
1	HS42XX	Specialization Elective 3	3	1	0	4
2	HS42XX	Specialization Elective 4	3	1	0	4
3	HS4299	**Project-II** (Lab based project / Industry oriented problem solving / Academic internship / Case Study / Design thinking-based project-Capstone Project)	0	0	16	8
		TOTAL	**6**	**2**	**16**	**16**
		TOTAL CREDIT				**167**

ELECTIVE GROUPS

(List of HSS Electives for all approved B. Tech. / BS Program of the Institute:)

HSS Elective-I						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
1.	HS2106	Literature: Voices and Culture	3	0	0	3
2.	HS2107	Diasporic Literature from South Asia	3	0	0	3
3.	HS2108	Soft Skills	3	0	0	3
4.	HS2109	Feminist Writing in India	3	0	0	3
5.	HS2110	Language Human Mind and Indian Society	3	0	0	3
6.	HS2111	Introductory Sociology	3	0	0	3
7.	HS2112	Introduction to Demography	3	0	0	3

8.	HS2113	Fundamentals of Management	3	0	0	3
9.	HS2114	Data Science *(Pre-requisite IIM Mumbai)*	3	0	0	3
10.	HS2115	Introductory Microeconomics *(Pre-requisite IIM Mumbai)*	3	0	0	3
11.	HS2116	International Economics	3	0	0	3
HSS Elective-II						
1.	HS4114	IPR: Introduction, Application and Protection	2	0	2	3
2.	HS4115	3Ls: Leadership, Literature and Life	3	0	0	3
3.	HS4116	Gender in Indian Cinema	3	0	0	3
4.	HS4117	Media and Linguistics	3	0	0	3
5.	HS4118	Sociology of Development	3	0	0	3
6.	HS4119	Industrial Psychology *(Pre-requisite IIM Mumbai)*	3	0	0	3
7.	HS4120	Business Ethics	3	0	0	3

Interdisciplinary Elective (IDE) Course for B.Tech. (Available to students other than Dept. of HSS)

Sl. No.	Subject Code	Subject Name	L	T	P	C
IDE-I						
1.	HS2205	Science, Technology and Society	3	0	0	3
2.	HS2206	Healthcare Management	3	0	0	3
3.	HS2207	Entrepreneurship	3	0	0	3
4.	HS2208	Operations Management *(Pre-requisite IIM Mumbai)*	3	0	0	3
5.	HS2209	People Management *(Pre-requisite IIM Mumbai)*	3	0	0	3
IDE-II						
1.	HS3105	Gender and Women's Studies: An Introduction	3	0	0	3
2.	HS3106	Fundamentals of Speech Acoustics	3	0	0	3
3.	HS3107	Globalization and Social Change	3	0	0	3
4.	HS3108	Innovation and Entrepreneurship *(Pre-requisite IIM Mumbai)*	3	0	0	3
5.	HS3109	Financial Economics	3	0	0	3
6.	HS3110	Development Economics	3	0	0	3
IDE-III						
1.	HS4121	Critical and Creative Writing	3	0	0	3
2.	HS4122	Forensic Linguistics	3	0	0	3
3.	HS4123	Supply Chain Management *(Pre-requisite IIM Mumbai)*	3	0	0	3

List of Elective for Semester VII and VIII:

The students of B. S. Economics have the flexibility of acquiring specialized skill through three different tracks of specialized course structure noted below under different specializations

comprising Economic Theories, Finance & Risk Management and Data Analytics. Students will be required to choose at least 4 courses. To have a specialization in any one area, all the four courses **must be** from one specific track only.

Specialization 1: Economic Theories						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
Semester-VII						
1.	HS4101	Game Theory	3	1	0	4
2.	HS4102	Energy Economics	3	1	0	4
3.	HS4103	Labour Economics	3	1	0	4
4.	HS4104	Business Law and Economics	3	1	0	4
5.	HS4105	Advanced Macroeconomics	3	1	0	4
Semester-VIII						
6.	HS4201	Institutional Economics	3	1	0	4
7.	HS4202	Public Finance and Policy	3	1	0	4
8.	HS4203	Agrarian Economics	3	1	0	4
9.	HS4204	Political Economy and Development	3	1	0	4
10	HS4205	Mechanism Design	3	1	0	4

Specialization 2: Finance and Risk Management						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
Semester-VII						
1.	HS4106	Financial Analytics	3	1	0	4
2.	HS4107	Behavioural Economics and Finance	3	1	0	4
3.	HS4108	Programming/ Coding	3	1	0	4
4.	HS4109	Corporate Finance	3	1	0	4
Semester-VIII						
5.	HS4206	Financial Markets and Derivatives	3	1	0	4
6.	HS4207	Wealth Management	3	1	0	4

Specialization 3: Data Analytics						
Sl. No.	**Subject Code**	**Course**	**L**	**T**	**P**	**C**
Semester-VII						
1.	HS4106	Financial Analytics	3	1	0	4
2.	HS4110	Programming/ Coding	3	1	0	4
3.	HS4111	HR Analytics	3	1	0	4
4.	HS4112	Big Data Analytics	3	1	0	4
Semester-VIII						
5.	HS4208	Artificial Intelligence	3	1	0	4
6.	HS4209	Statistical Decision Theory	3	1	0	4
7.	HS4210	Algorithm with Lab	3	1	0	4
8.	HS4211	Machine Learning and DS	3	1	0	4

Minor in Business Studies: (Only open to B. Tech. / BS-MBA Dual Degree)

Sl. No.	Subject Code	Course Title	L	T	P	C
1.	HS2101	Mathematical Statistics *(Pre-requisite IIM Mumbai)*	3	1	0	4
2.	HS2209	People Management *(Pre-requisite IIM Mumbai)*	2	1	0	3
3.	HS3102	Mathematical Economics *(Pre-requisite IIM Mumbai)*	3	1	0	4
4.	HS3202	Environmental Economics *(Pre-requisite IIM Mumbai)*	3	1	0	4
5.	HS4109	Corporate Finance *(Pre-requisite IIM Mumbai)*	3	1	0	4
TOTAL			**14**	**5**	**0**	**19**

Minor in Financial Analytics:

Sl. No.	Subject Code	Course Title	L	T	P	C
1.	HS2204	Econometrics-I	3	1	0	4
2.	HS3101	Econometrics-II	3	1	2	5
3.	HS3204	Indian Financial System	3	1	0	4
4.	HS4106	Financial Analytics	3	1	0	4
TOTAL			**12**	**4**	**2**	**17**

(7.) B. Tech. Programme from the Department of Mathematics

(i) B. Tech. in Mathematics & Computing

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: To learn and excel in rigor of Mathematics	**Program Learning Outcome 1a:** The students are equipped with a mixture of basic and advanced mathematics courses during the program **Program Learning Outcome 1b:** A rigorous training in all basic courses in Mathematics is obtained
Program Goal 2: To be able to apply the concepts of Mathematics in problems	**Program Learning Outcome 2a:** Students pursue application-oriented courses in the form of electives **Program Learning Outcome 2b:** Application skills of using mathematics is acquired.
Program Goal 3: To learn and excel in contemporary courses in Computer Science domain	**Program Learning Outcome 3 a:** Students are exposed to both hardware and software courses. **Program Learning Outcome 3 b:** Acquainted with advanced courses in computer science.
Program Goal 4: To be leader in the area where both Mathematics and computer science skills are required	**Program Learning Outcome 4:** Leadership skills are developed through overall exposure to various components

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	MA2101	Design and Analysis of Algorithms	3	0	2	4
2.	MA2102	Probability and Stochastic Processes	3	1	0	4
3.	MA2103	Optimization Techniques	3	0	0	3
4.	MA2104	Algebra	3	0	0	3
5.	MA2105	Discrete Mathematics	3	0	0	3
6.	HS21XX	HSS Elective - I	3	0	0	3
TOTAL			**18**	**1**	**2**	**20**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	MA2201	Introduction to Machine Learning	2	0	2	3
2.	MA2202	Real Analysis and Measure Theory	3	0	0	3
3.	MA2203	Numerical Linear Algebra	3	0	2	4
4.	MA2204	Computer Architecture and Organization	3	0	3	4.5
5.	MA2205	Database Management Systems	3	0	3	4.5
6.	XX22PQ	IDE - I	3	0	0	3
TOTAL			**17**	**0**	**10**	**22**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	MA3101	Ordinary and Partial Differential Equations	3	0	0	3
2.	MA3102	Complex Analysis	3	0	0	3
3.	MA3103	Theory of Computation	3	0	0	3
4.	MA3104	Computer Networks	3	0	3	4.5
5.	MA3105	Operating Systems	3	0	3	4.5
6.	XX31PQ	IDE - II	3	0	0	3
TOTAL			**18**	**0**	**6**	**21**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	MA3201	Number Theory and Cryptography	3	0	0	3
2.	MA3202	Numerical Methods	3	0	2	4
3.	MA3203	Mathematical Statistics	3	0	0	3
4.	MA3204	Convex Optimization	3	0	2	4
5.	MA3205	Functional Analysis	3	0	0	3
6.	MA3206	Artificial Intelligence	3	0	2	4
TOTAL			**18**	**0**	**6**	**21**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	HS41XX	HSS Elective - II	3	0	0	3
2.	XX41PQ	IDE - III	3	0	0	3
3.	MA41XX	Departmental Elective – I	3	0	0	3
4.	MA41XX	Departmental Elective – II	3	0	0	3
5.	MA4198	Summer Internship*	0	0	12	3
6.	MA4199	Project – I	0	0	12	6
TOTAL						**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or

SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	MA42XX	Departmental Elective – III	3	0	0	3
2.	MA42XX	Departmental Elective – IV	3	0	0	3
3.	MA42XX	Departmental Elective – V	3	0	0	3
4.	MA4299	Project – II	0	0	16	8
TOTAL						**17**
GRAND TOTAL (Semester I to VIII)			**168**			

ELECTIVE GROUPS

Sl. No.	Course Code	Department Elective I	L	T	P	C
1.	MA4101	Advanced Algorithms	3	0	0	3
2.	MA4102	Cryptography and Network Security	3	0	0	3
3.	MA4103	Rings and Modules	3	0	0	3

Sl. No.	Course Code	Department Elective II	L	T	P	C
1.	MA4104	Deep Learning	2	0	2	3
2.	MA4105	Fields and Galois theory	3	0	0	3
3.	MA4106	Mathematical Finance	3	0	0	3

Sl. No.	Course Code	Department Elective III	L	T	P	C
1.	MA4201	Topology	3	0	0	3
2.	MA4206	Control Theory	3	0	0	3
3.	MA4207	Finite Element Analysis	3	0	0	3
4.	MA4208	Introduction to Coding Theory	3	0	0	3
5.	MA4209	Portfolio Theory and Risk Management	3	0	0	3

Sl. No.	Course Code	Department Elective IV	L	T	P	C
1.	MA4210	Differential Geometry	3	0	0	3
2.	MA4211	Introduction to Mathematical Biology	3	0	0	3
3.	MA4212	Statistical Decision Theory	3	0	0	3
4.	MA4213	Applied Computational Techniques	3	0	0	3

Sl. No.	Course Code	Department Elective V	L	T	P	C
1.	MA4214	Deep Learning for Computer Vision	2	0	2	3
2.	MA4212	Discrete Differential Geometry	3	0	0	3
3.	MA4216	Integral Equations and Calculus of Variations	3	0	0	3

IDE - I (Available to students other than Dept. of M&C)

Sl. No.	Code	Course Name	L	T	P	C
1.	MA2206	Introduction to Numerical Methods	3	0	0	3
2.	MA2207	Complex Analysis	3	0	0	3

IDE - II (Available to students other than Dept. of M&C)

Sl. No.	Code	Course Name	L	T	P	C
1.	MA3106	An Introduction to Computational Commutative Algebra	3	0	0	3
2.	MA3107	Partial Differential Equations	3	0	0	3

IDE - III (Available to students other than Dept. of M&C)

Sl. No.	Code	Course Name	L	T	P	C
1.	MA4107	Number Theory and Algebra	3	0	0	3
2.	MA4108	Theory of Relativity	3	0	0	3

(8.) B. Tech. Programme from the Department of Mechanical Engineering

(i) B. Tech. in Mechanical Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Apply basic knowledge of engineering principles to solve technical problems applied to mechanical systems, stress and strain analysis of structures, design of machine elements, control systems to achieve desirable performance and to assess life of mechanical components.	Program Learning Outcome 1: The students should be able to apply the principles of Kinematics and Dynamics of Mechanisms, mechanics of solid, system dynamics and control to the engineering problems of societal relevance.
Program Goal 2: To impart the ability to model and analyse pertinent transport phenomena based on the fundamental conservations laws of thermodynamics and fluid mechanics.	Program Learning Outcome 2: Upon completion of the course, students will possess the capability to design and implement mathematical models and simulation tools specifically tailored to address complex mechanical engineering issues within crucial domains such as energy and the environment.
Program Goal 3: The graduates will be possessing the knowledge of concepts and practices of material removal, material forming, material joining, additive manufacturing-based processes, identify damage and failure of material to meet the present and future demands of the industry.	Program Learning Outcome 3: The students should gain the knowledge of the behaviour and processing of engineering materials through different conventional and state-of-the-art material subtractive and additive based processes.
Program Goal 4: To train the graduates with adequate engineering knowledge to develop skills for solving multi-disciplinary problems and achieving optimal results.	Program Learning Outcome 4: The graduates will be able to embrace leadership and collaborative roles for societal, environmental and economic enterprise.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	ME2101	Dynamics	3	1	0	4
2.	ME2102	Thermodynamics	3	1	0	4
3.	ME2103	Fluid Mechanics	3	1	2	5
4.	ME2104	Engineering Materials	3	0	2	4
5.	HS21XX	HSS Elective - I	3	0	0	3
TOTAL			**15**	**3**	**4**	**20**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	ME2201	Kinematics and Dynamics of Mechanisms	3	1	2	5
2.	ME2202	Heat and Mass Transfer	3	1	2	5
3.	ME2203	Mechanics of Solids	3	1	0	4
4.	ME2204	Mechanical Measurements and Instrumentation	3	0	2	4
5.	XX22PQ	IDE-I	3	0	0	3
TOTAL			**15**	**3**	**6**	**21**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	ME3101	Data Analytics and Machine Learning Tools for Engineers	1	2	1	3.5
2.	ME3102	Design of Machine Elements	3	0	3	4.5
3.	ME3103	Manufacturing Technology- I	3	0	2	4
4.	ME3104	Engineering Software Laboratory	1	0	3	2.5
5.	ME3105	Numerical Methods for Engineers	3	0	0	3
6.	XX31PQ	IDE-II	3	0	0	3
TOTAL			**14**	**2**	**9**	**20.5**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	ME3201	Applied Thermodynamics and Turbomachinery	3	1	2	5
2.	ME3202	System Dynamics and Control	3	1	2	5
3.	ME3203	Manufacturing Technology -II	3	0	3	4.5
4.	ME3204	Industrial Engineering and Operations Research	3	1	0	4
5.	ME3205	Technical Writing and Presentations	0	0	4	2
TOTAL			**12**	**3**	**11**	**20.5**
Sl. No.	**Subject Code**	**SEMESTER VII**	**L**	**T**	**P**	**C**
1.	ME41XX	Departmental Elective-I	3	0	0	3
2.	ME41XX	Departmental Elective- II	3	0	0	3
3.	XX41PQ	IDE-III	3	0	0	3
4.	HS41PQ	HSS Elective-II	3	0	0	3
5.	ME4198	Summer Internship*	0	0	12	3
6.	ME4199	Project – I	0	0	12	6
TOTAL			**12**	**0**	**24**	**21**

*** For specific cases of internship after 6th Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note:

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	ME42XX	Departmental Elective – III	3	0	0	3
2.	ME42XX	Departmental Elective – IV	3	0	0	3
3.	ME42XX	Departmental Elective – V	3	0	0	3
4.	ME4299	Project – II	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**
GRAND TOTAL (Semester I to VIII)			**166**			

ELECTIVE GROUPS

Sl. No.	Subject Code	Department Electives - I	L	T	P	C
1.	ME4101	Tribology and Surface Engineering	3	0	0	3
2.	ME4102	Basics of Computational Fluid Dynamics	3	0	0	3
3.	ME4103	Industrial Automation	3	0	0	3

Sl. No.	Subject Code	Department Electives - II	L	T	P	C
1.	ME4104	Vehicle Dynamics	3	0	0	3
2.	ME4105	Mathematical Modelling of Computer Aided Design	3	0	0	3
3.	ME4106	Energy Engineering	3	0	0	3

Sl. No.	Subject Code	Department Electives - III	L	T	P	C
1.	ME4201	Finite Element Method	3	0	0	3
2.	ME4202	Refrigeration and Cryogenics	3	0	0	3
3.	ME4203	Mechanics, Processing and failure of Composite Materials	3	0	0	3

Sl. No.	Subject Code	Department Electives - IV	L	T	P	C
1.	ME4204	Mechanical Characterization of Materials	3	0	0	3
2.	ME4205	Internal Combustion Engines	3	0	0	3
3.	ME4206	Micro-manufacturing	3	0	0	3

Sl. No.	Subject Code	Department Electives - V	L	T	P	C
1.	ME4207	Energy Methods and Variational Principles in Applied Mechanics	3	0	0	3
2.	ME4208	Failure Analysis of Engineering Materials	3	0	0	3
3.	ME4209	Hydraulic Machines	3	0	0	3

Interdisciplinary Elective (IDE) Courses for B. Tech. (Available to students other than Dept. of ME)

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	ME2205	Manufacturing Processes for Metallic Materials	3	0	0	3
2.	ME3106	Automotive Technology	3	0	0	3
3.	ME4103	Nonlinear Dynamics and Chaos	3	0	0	3

Minor in Thermal Engineering

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	ME2102	Thermodynamics	3	1	0	4
2.	ME2202	Heat and Mass Transfer	3	1	2	5
3.	ME3104	Engineering Software Laboratory	1	0	3	2.5

4.	ME3201	Applied Thermodynamics and Turbomachinery	3	1	2	5

(9.) B. Tech. Programme from the Department of Metallurgical and Materials Engineering

(i) B. Tech. in Metallurgical and Materials Engineering (MME)

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: The B.Tech program in Metallurgical and Materials Engineering aims to equip graduates with the necessary knowledge, skills, and values to succeed in professional careers related to metallurgical and materials engineering.	**Program Learning Outcome 1a:** Upon successful completion of the B.Tech program in Metallurgical and Materials Engineering, graduates will be able to identify, formulate, and analyse complex engineering problems related to metallurgical and materials engineering. **Program Learning Outcome 1b:** Students will be able to understand the science behind the functioning mechanism of metals, ceramics, polymers and glass
Program Goal 2: Apply fundamental principles of science and engineering to solve complex problems in metallurgical and materials engineering and cultivate critical thinking and problem-solving skills in students to address real-world challenges in the metallurgy and materials domain.	**Program Learning Outcome 2:** Student will be able to apply research-based knowledge and methodologies, including experimental design, data analysis, and interpretation, to investigate complex problems in metallurgical and material engineering. Graduates will be capable to carry out research work in their area of interest either in academic area or in industry.
Program Goal 3: Expose the students to the scientific and engineering concepts on metals, ceramics, polymer and composites and apply engineering principles to design, develop, and improve materials and processes for specific applications.	**Program Learning Outcome 3a:** Students will be well versed with the concepts of microscopic analysis, characterization techniques, metallurgical testing, polymer synthesis & analysis, nano & electro ceramics, plasma-coating and flash sintering, mineral beneficiation & process metallurgy. **Program Learning Outcome 3b:** Students will be able to design and develop new engineering materials with desired properties based on demands of various engineering sectors.
Program Goal 4: To impart hand-on exposure to modern laboratory equipment through structured laboratory experiments.	**Program Learning Outcome 4a:** Students will be able to correlate the theoretical concepts with the experiments and will be ready to apply the experimental knowledge in industries. **Program Learning Outcome 4b:** Students will be ready for quality control, higher studies and research work in the domain of metallurgical and materials engineering.

Program Goal 5: To inculcate research aptitude in the students and prepare the students to be industry-ready after the completion of their B. Tech. programme.	**Program Learning Outcome 5:** Students will be able to design solutions for complex engineering problems related to materials, considering public health, safety, cultural, societal, and environmental factors. In addition, apply ethical principles and commit to professional ethics and social responsibility as a metallurgical and materials engineer. Graduate will be able to launch start-ups as entrepreneur to create job opportunities in the country.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	MM2101	Introduction to Metallurgical and Materials Engineering	3	0	0	3
2.	MM2102	Mineral Processing and Process Metallurgy	3	0	3	4.5
3.	MM2103	Thermodynamics and Phase Equilibria	3	0	3	4.5
4.	MM2104	Transport Phenomena	3	1	0	4
5.	MM2105	Fundamentals of Polymer Science and Technology	3	0	0	3
6.	HS21XX	HSS Elective - I	3	0	0	3
TOTAL			**18**	**1**	**6**	**22**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	MM2201	Iron and Steel Making	3	1	0	4
2.	MM2202	Techniques of Materials Characterization - I	3	0	3	4.5
3.	MM2203	Phase Transformation and Diffusion	3	1	0	4
4.	MM2204	Mechanical Behaviour of Materials	3	0	3	4.5
5.	MM2205	Welding and Solidification	3	0	0	3
6.	XX22PQ	IDE-I	3	0	0	3
TOTAL			**18**	**2**	**6**	**23**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	MM3101	Thermomechanical Processing of Metallic Materials	3	0	2	4
2.	MM3102	Computational Materials Science	2	1	0	3
3.	MM3103	Engineering Polymers	3	0	2	4
4.	MM3104	Ceramic Science and Technology	3	0	2	4
5.	MM3105	Metallography and Heat Treatment Laboratory	0	0	2	1
6.	XX31PQ	IDE-II	3	0	0	3
TOTAL			**14**	**1**	**8**	**19**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	MM3201	Techniques of Materials Characterization - II	3	0	3	4.5
2.	MM3202	Corrosion and Corrosion Prevention	3	0	2	4
3.	MM3203	Functional Materials	3	0	0	3
4.	MM3204	Non-ferrous Metals and Alloys	3	0	0	3
5.	MM3205	Capstone Laboratory	0	0	4	2
6.	MM3206	Metals Processing Laboratory	0	0	3	1.5
TOTAL			**12**	**0**	**12**	**18**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	MM41XX	Departmental Elective - I	3	0	0	3
2.	MM41XX	Departmental Elective - II	3	0	0	3
3.	HS41XX	HSS Elective - II	3	0	0	3
4.	XX41PQ	IDE-III	3	0	0	3
5.	MM4198	Summer Internship*	0	0	12	3
6.	MM4199	Project – I	0	0	12	6
TOTAL			**12**	**0**	**24**	**21**

Note :
*** For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :
a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	MM42XX	Departmental Elective - III	3	0	0	3
2.	MM42XX	Departmental Elective - IV	3	0	0	3
3.	MM42XX	Departmental Elective - V	3	0	0	3
4.	MM4299	Project – II	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**
GRAND TOTAL (Semester I to VIII)			**166**			

ELECTIVE GROUPS

Sl. No.	Subject Code	Departmental Elective - I	L	T	P	C
1.	MM4101	Environmental Sustainability and Industrial Safety	3	0	0	3
2.	MM4102	Glass Science and Technology	3	0	0	3
3.	MM4103	Semiconductor Materials and Devices	3	0	0	3

Sl. No.	Subject Code	Departmental Elective - II	L	T	P	C
1.	MM4104	Thin Films	3	0	0	3
2.	MM4105	Heat Treatment of Metals and Alloys	3	0	0	3
3.	MM4106	Creep, Fatigue and Fracture	3	0	0	3

Sl. No.	Subject Code	Departmental Elective - III	L	T	P	C
1.	MM4201	Smart Polymers	3	0	0	3
2.	MM4202	Energy Materials	3	0	0	3

Sl. No.	Subject Code	Departmental Elective - IV	L	T	P	C
1.	MM4203	Electroceramics	3	0	0	3
2.	MM4204	Biomaterials	3	0	0	3

Sl. No.	Subject Code	Departmental Elective - V	L	T	P	C
1.	MM4205	Crystallographic Texture and Analysis	3	0	0	3
2.	MM4206	Furnace and Refractories	3	0	0	3
3.	MM4207	Composite Science and Technology	3	0	0	3

Interdisciplinary Elective (IDE) Courses for B. Tech. (Available to students other than Dept. of MME)

Sl. No.	Subject Code	Interdisciplinary Elective (IDE)	L	T	P	C
1.	MM2206	Structure and Properties of Materials	3	0	0	3
2.	MM3106	Microscopy and X-ray Diffraction	3	0	0	3
3.	MM4107	Nanomaterials	3	0	0	3

Minor in Material Science & Engineering:

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	MM2101	Introduction to Metallurgical and Materials Engineering	3	0	0	3
2.	MM2202	Techniques of Materials Characterization	3	0	3	4.5
3.	MM3103	Engineering Polymers	3	0	0	3
4.	MM3203	Functional Materials	3	0	0	3
5.	MM4103	Semiconductor Materials and Devices	3	0	0	3

Total Credits: 16.5

(10.) B. Tech. Programme from the Department of Physics

(i) B. Tech. in Engineering Physics

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: To nurture young engineers with a strong foundation in science and engineering for producing highly skilled engineers and scientists.	**Program Learning Outcome 1a:** Developing skills to apply strong knowledge of mathematics, science, engineering fundamentals. **Program Learning Outcome 1b:** To use research-based knowledge and research methodologies for developing cutting edge technology and for solving complex engineering problems.
Program Goal 2: Enhancement of problem-solving skills and independent thinking through a research oriented curriculum to conduct research or contribute to technology development projects, either individually or as a team leader.	**Program Learning Outcome 2a:** Develop highly skilled engineers who can contribute to the solution of technical and engineering problems that are based on broad principles of physics. **Program Learning Outcome 2b:** Ability to participate as members and project leaders on multidisciplinary teams in diverse workplaces and communities. Be able to communicate effectively in oral and written form.
Program Goal 3: To provide career opportunities in rapidly-advancing scientific and technical areas, R&D establishments, Modern cutting edge technologies, higher degree, Academia/Industry and etc .	**Program Learning Outcome 3a:** To practice and inculcate an ability of utilizing scientific knowledge and engineering design for developing technology for public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors. **Program Learning Outcome 3b:** Be able to demonstrate an understanding of professional and ethical responsibility.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	EP2101	Quantum Physics	3	1	0	4
2.	EP2102	Optics and Lasers	3	0	3	4.5
3.	EP2103	Classical dynamics: discrete and continuum systems	3	1	0	4
4.	EP2104	Thermal physics with engineering applications	3	1	0	4
5.	HS21XX	HSS Elective – I	3	0	0	3
Total Credit			**15**	**3**	**3**	**19.5**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	EP2201	Introduction to Nuclear and Particle Physics	2	1	0	3
2.	EP2202	Mathematical Methods for Engineers	3	1	0	4
3.	EP2203	Electromagnetism	3	1	0	4
4.	EP2204	Introductory Statistical Mechanics	2	1	0	3
5.	EP2205	Analog Electronics	2	0	3	3.5
6.	XX22PQ	IDE – I	3	0	0	3
Total Credit			**15**	**4**	**3**	**20.5**

Sl. No.	Subject Code	SEMESTER V	L	T	P	C
1.	EP3101	Computational Techniques	2	0	3	3.5
2.	EP3102	Data Science for Physicists	1	1	3	3.5
3.	EP3103	Digital Electronics and Microprocessors	2	0	3	3.5
4.	EP3104	Solid State Physics	3	1	2	5
5.	EP3105	Instrumentation Techniques	2	0	2	3
6.	XX31PQ	IDE – II	3	0	0	3
Total Credit			**13**	**2**	**13**	**21.5**

Sl. No.	Subject Code	SEMESTER VI	L	T	P	C
1.	EP3201	Nonlinear Dynamics	2	1	0	3
2.	EP3202	Interfacing and data analysis	1	0	4	3
3.	EP3203	Atomic and Molecular Physics	3	1	2	5
4.	EP3204	Soft Condensed Matter Physics	3	0	0	3
5.	PH32XX	DE – I	3	0	0	3
6.	PH32XX	DE – II	3	0	0	3
Total Credit			**15**	**2**	**6**	**20**

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	EP4105	Quantum Technology Laboratory	1	0	3	2.5
2.	PH41XX	DE-III	3	0	0	3
3.	HS41XX	HSS Elective – II	3	0	0	3
4.	XX41PQ	IDE – III	3	0	0	3
5.	PH4198	Summer Internship*	0	0	12	3
6.	PH4199	Project – I	0	0	12	6
Total Credit			**10**	**0**	**27**	**20.5**

*** For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note:

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	PH42XX*	DE-IV	3	0	0	3
2.	PH42XX	DE-V	3	0	0	3
3.	PH42XX	DE-VI	3	0	0	3
4.	PH42XX	DE-VII	3	0	0	3
5.	PH4299	Project – II	0	0	16	8
Total Credit			**9**	**0**	**16**	**20**
Grand Total Credit (Semester I to VIII)			**168**			

* Valid only for the course PH4206 since this is common to M. Sc. and Engineering Physics

ELECTIVE GROUPS

Sl. No.	Course Code	Departmental Elective – I	L	T	P	C
1.	PH3201	Engineering Optics	3	0	0	3
2.	PH3202	Cryogenic Engineering	3	0	0	3
3.	PH3203	Advanced Quantum Mechanics	3	0	0	3
4.	PH3204	Power Sources for Electric Vehicles	3	1	0	4
5.	PH3205	Engineering Electromagnetics	3	0	0	3

Sl. No.	Course Code	Departmental Elective – II	L	T	P	C
1.	PH3206	Laser Physics	3	0	0	3
2.	PH3207	Advanced Mathematical Methods	2	1	0	3
3.	PH3208	Electron Microscopy	3	0	0	3
4.	PH3209	Quantum Computation	2	1	0	3
5.	PH3210	Device Modeling and Design	2	1	0	3

Sl. No.	Course Code	Departmental Elective – III	L	T	P	C
1.	PH4106	Science and Technology of Nanomaterials	3	0	0	3
2.	PH4107	Optical Quantum Communication	3	0	0	3
3.	PH4108	Photovoltaics: Concepts and Applications	3	0	0	3
4.	PH4109	Electronic Devices and Circuits	3	0	0	3

Sl. No.	Course Code	Departmental Elective – IV	L	T	P	C
1.	PH4205	Quantum Mechanics - II	2	1	0	3
2.	PH4206	Thin Film Technology	3	0	0	3
3.	PH4209	Solar Energy and Photovoltaics	3	0	0	3
4.	PH4210	Modeling Complex Systems	3	0	0	3
5.	PH4211	AC Network Analysis	3	0	0	3

Sl. No.	Course Code	Departmental Elective – V	L	T	P	C
1.	PH4212	X-ray and Applications	3	0	0	3
2.	PH4213	Materials Engineering	3	0	0	3
3.	PH4214	Superconducting Qubits: Fundamentals and Operation	3	0	0	3
4.	PH4215	Analytical Techniques	3	0	0	3

Sl. No.	Course Code	Departmental Elective – VI	L	T	P	C
1.	PH4216	Computational Methods for Classical and Quantum Physics	3	0	0	3
2.	PH4217	LASER Technology	3	0	0	3
3.	PH4218	Atomtronics & Quantum Technology	3	0	0	3
4.	PH4219	Nanoscale Devices	3	0	0	3

Sl. No.	Course Code	Departmental Elective – VII	L	T	P	C
1.	PH4220	Medical Physics and Applications	3	0	0	3
2.	PH4221	Emerging Technologies in Photonics	3	0	0	3
3.	PH4222	Micro Nano Fabrication	3	0	0	3
4.	PH4223	Nanogenerators and Application in Self-powered System	3	0	0	3

Interdisciplinary Electives (Available to students of B. Tech. other than Dept. of Physics)

Sl. No.	Subject Code	Subject	L	T	P	C
IDE-I						
1.	PH2201	Fundamentals of Electromagnetism	3	0	0	3
2.	PH2202	Waves and Particles	3	0	0	3
3.	PH2203	Fuel Cell Fundamentals	3	0	0	3
IDE-II						
1.	PH3101	Energy Materials Processing	3	0	0	3
2.	PH3102	Mechanics in Physics	3	0	0	3
IDE-III						
1.	PH4110	Photovoltaics and Fuel Cell Technology	3	0	0	3

Minor Options from the Dept. of Physics

1. Minor in Physics

Sl. No.	Subject Code	Subject	L	T	P	C
1.	EP2101	Quantum Physics	3	1	0	4
2.	EP2203	Electromagnetism	3	1	0	4
3.	EP3104	Solid State Physics	3	1	2	5
4. Minor-IV (Any One)						
i.	PH3201	Engineering Optics	3	0	0	3
ii.	PH3206	Laser Physics	3	0	0	3
iii.	PH3210	Device Modeling and Design	2	1	0	3
5. Minor-V (Any One)						
i.	PH4106	Science and Technology of Nanomaterials	3	0	0	3
ii.	PH4107	Optical Quantum Communication	3	0	0	3
iii.	PH4108	Photovoltaics: Concepts and Applications	3	0	0	3

Total Credits : 19

2. Minor in Nanoscience

Sl. No.	Subject Code	Subject	L	T	P	C
1.	EP2101	Quantum Physics	3	1	0	4
2.	EP2203	Electromagnetism	3	1	0	4
3.	EP3105	Instrumentation Techniques	2	0	2	3
4.	PH3208	Electron Microscopy	3	0	0	3
5.	PH4206	Thin Film Technology	3	0	0	3

Total Credits : 17

1. Minor in Optics

Sl. No.	Subject Code	Subject	L	T	P	C
1.	EP2102	Optics and Lasers	3	0	3	4.5
2.	EP2203	Electromagnetism	3	1	0	4
3.	EP3105	Instrumentation Techniques	2	0	2	3
4.	PH3201	Engineering Optics	3	0	0	3
5.	PH4221	Emerging Technologies in Photonics	3	0	0	3

Total Credits : 17.5

2. Minor in Energy Storage Technology

Brief outline: Emergent issues of global significance comprising fast depleting fossil fuels reserve, carbon foot print, visible climate change, temperature rise and melting of glaciers causing sea level rise are interrelated. These challenging issue are threatening sustainable growth and even survival of the planet earth.

To exercise an effective control well in time, therefore, requires "zero emission" culture and effective implementation of clean and green energy alternatives without any loss of time. This requirement has put pressing demand for development of newer clean energy technology on R&D institutions, its commercialization on industry, creation of talent pool in the area under demand by academic institutions and better industry-academia tie up in this emergent area. A positive signal has already become visible with faster adoption of electric vehicles (EVs) on road that is likely to emerge as a multiplicative technology market in near future.

Keeping this realistic fact in mind, the department of Physics has come up with a minor program in *"Energy Storage Technology"* with following course structure:

Sl. No.	Subject Code	Subject	L	T	P	C
1.	PH2101	Energy Storage Fundamentals	3	0	0	3
2.	PH2203	Fuel Cell Fundamentals	3	0	0	3
3.	PH3101	Energy Materials Processing	3	0	0	3
4.	PH3204	Power Sources for Electric Vehicles	3	1	0	4
5.	PH4108	Photovoltaics: Concepts and Applications	3	0	0	3

Total Credits : 16

Minor in Quantum Technology

Sl. No.	Subject Code	Subject	L	T	P	C
1.	EP2101	Quantum Physics	3	1	0	4
2.	EP2204	Introductory Statistical Mechanics	2	1	0	3
3.	EP3101	Computational Techniques	2	0	3	3.5
4.	PH3209	Quantum Computation	2	1	0	3
5.	PH4107	Optical Quantum Communication	3	0	0	3

Total Credits : 16.5

Curriculum for 2-years M.Sc. Programme

(1.) M. Sc. Programme from the Department of Chemistry

(i) M. Sc. in Chemistry

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: **Fundamental Understanding:** To impart an advanced level theoretical and practical knowledge in the major fields of Chemistry	**Program Learning Outcome 1a:** Students will learn the basic concepts of Physical, Inorganic, Organic, Computational, Biochemistry, Polymer, and Solid State Chemistry, Quantum Chemistry etc. **Program Learning Outcome 1b:** Students will have comprehensive practical knowledge in Physical, Inorganic, and Organic chemistry, etc.
Program Goal 2: **Basic Training for Research:** To provide quality training for conducting fundamental and advanced research in Chemistry	**Program Learning Outcome 2a:** Students will be acquainted with different research techniques, such as synthetic organic chemistry, inorganic chemistry, biochemistry, polymer chemistry, solid-state chemistry, material design, ab-intio calculation, semi-empirical methods, molecular dynamics simulation, and analytical equation solving approach, determining reaction kinetics etc. **Program Learning Outcome 2b:** Students will learn to run different advanced instruments, to write research articles for publication, and to work collaboratively with Ph.D. students
Program Goal 3: **Skill Enhancement:** To focus on skill enhancement in the core chemistry with practical expert hands which will make students employable in academia and industries.	**Program Learning Outcome 3:** Students will get good skills in core chemistry suitable for getting employed in academia, industries, and encourage entrepreneurship.
Program Goal 4: **Communication Skill:** To develop various communication skills such as reading, listening, speaking, etc., which will help in expressing ideas and views clearly and effectively	**Program Learning Outcome 4:** Students will learn how to read and understand research papers, make technical presentations, and communicate with a large audience.

Program Goal 5: **Social Awareness:** To make understand the environmental issues (especially in Indian context), such as global warming, climate change, acid rain, ozone depletion and will create awareness in society.	**Program Learning Outcome 5a:** Students will have awareness and appreciation on various global problems related to chemistry, such as global warming, climate change, environmental sustenance, energy crisis, waste-to-wealth, and toxicological implications of chemicals in societies, etc. **Program Learning Outcome 5b:** Students will learn to fundamentally apply themselves for social outreach at local and global levels.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	CH4101	Quantum Chemistry	3	1	0	4
2.	CH4102	Organic Chemistry-I	3	1	0	4
3.	CH4103	Inorganic Chemistry-I	3	1	0	4
4.	CH4104	Principles of Molecular Spectroscopy	3	0	0	3
5.	CH4105	Symmetry & Group Theory	3	0	0	3
6.	CH4106	Organic Chemistry Lab	0	0	6	3
7.	HS4111	Soft Skills for Employability	1	2	0	3
		TOTAL	**16**	**5**	**6**	**24**

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CH4201	Thermodynamics	3	1	0	4
2.	CH4202	Organic Chemistry-II	3	0	0	3
3.	CH4203	Inorganic Chemistry-II	3	0	0	3
4.	CH4204	Chemical Kinetics	3	0	0	3
5.	CH4205	Modern Methods of Analysis	3	1	0	4
6.	CH4206	Inorganic Chemistry Lab	0	0	6	3
		TOTAL	**15**	**2**	**6**	**20**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CH5101	Physical Chemistry Lab	0	0	6	3
2.	CH5102	Inorganic Chemistry-III	3	0	0	3
3.	CH5103	Organic Chemistry-III	3	0	0	3
4.	CH5199	Project-I	0	0	12	6
5.	CH51XX/ CH61XX	Department Elective-I	3	0	0	3
6.	XX61PQ	IDE-I	3	0	0	3
		TOTAL	**12**	**0**	**18**	**21**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CH6201	Computer Programming for Chemists	2	0	2	3
2.	CH5299	Project-II	0	0	16	8
3.	CH62XX	Department Elective - II	3	0	0	3
4.	XX62PQ	IDE-II	3	0	0	3
5.	IK5201	Indian Knowledge System	2	0	0	2
		TOTAL	**10**	**0**	**18**	**19**

Total Credits = 84

Elective Groups

Sl. No.	Course Code	Department Elective - I	L	T	P	C
1.	CH5104	Biochemistry	3	0	0	3
2.	CH5105	Basic Polymer Chemistry	3	0	0	3
3.	CH5106	Consumer Chemistry	3	0	0	3
4.	CH5107	Non-Equilibrium Statistical Mechanics	3	0	0	3

Sl. No.	Course Code	Department Elective - II	L	T	P	C
1.	CH6202	Solid State Chemistry	3	0	0	3
2.	CH6203	Nanotechnology for Biomedical Applications	3	0	0	3
3.	CH6204	Bioanalytical Techniques	3	0	0	3
4.	CH6205	Advanced Medicinal Chemistry	3	0	0	3
5.	CH6206	Organic and Organometallic Catalysis	3	0	0	3
6.	CH6207	Advanced Optical Spectroscopy	3	0	0	3
7.	CH6208	Chemistry of Heterocycles	3	0	0	3
8.	CH6209	Syntheses and Applications of Industrial Polymers	3	0	0	3

*An upgraded version of M. Sc. 5/6 level electives need to be essentially upgraded for PhD students with additional contents comprising additional lectures / assignments / tutorials / miniproject making the total credit : 3-1-0-4 / 3-0-2-4. Such course proposals with an advanced level (6/7 level course number) are listed separately for PhD students.

IDE for M. Sc. students (Other than Dept. of Chemistry)

Sl. No.	Course Code	Department Elective - II	L	T	P	C
1.	CH6101	Sustainable Chemistry	3	0	0	3
2.	CH6210	Chemistry and Applications of Nanostructured Materials	3	0	0	3

(2.) M. Sc. Programme from the Department of Mathematics

(i) M. Sc. in Mathematics

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: To learn and excel in the rigour of Mathematics	**Program Learning Outcome 1a:** The students are prepared with a mix of basic and advance mathematics courses during the program **Program Learning Outcome 1b:** A rigorous training in all basic concepts in Mathematics is provided
Program Goal 2: To be able to apply the concepts of Mathematics to problem solving	**Program Learning Outcome 2a:** Students pursue application-oriented courses in the form of electives **Program Learning Outcome 2b:** The concepts of mathematics learned are explored in courses that apply the knowledge.
Program Goal 3: To be a leader in the area where both pure mathematics and applied mathematics skills are required by offering a variety of electives	**Program Learning Outcome 3a:** Leadership skills are inculcated through learning **Program Learning Outcome 3b:** With clarity of the topics learnt, the students serve as better human resource
Program Goal 4: To prepare fundamentals of mathematics as a strong foundation to achieve goals in higher academic degrees or industries	**Program Learning Outcome 4a:** The foundation is made strong with systematics training in mathematics, which helps to pursue a higher academic degree. **Program Learning Outcome 4b:** Industry-oriented courses will help in acquiring a position in the industry.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	MA4107	Computer Programming	2	0	4	4
2.	MA4108	Linear Algebra	3	1	0	4
3.	MA4109	Real Analysis	3	1	0	4
4.	MA4110	Algebra	3	1	0	4
5.	MA4111	Ordinary Differential Equations	3	1	0	4
6.	HS4111	Soft Skills for Employability	1	2	0	3
		TOTAL	**15**	**6**	**4**	**23**

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	MA4201	Topology	3	0	0	3
2.	MA4202	Numerical Analysis	3	0	2	4
3.	MA4203	Complex Analysis	3	1	0	4
4.	MA4204	Linear Optimization Techniques	3	0	2	4
5.	MA4205	Probability and Statistics	3	0	0	3
		TOTAL	**15**	**1**	**4**	**18**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	MA5101	Measure Theory	3	0	0	3
2.	MA5102	Functional Analysis	3	0	0	3
3.	MA5103	Partial Differential Equations	3	0	0	3
4.	MA51XX/ MA61XX	DE-I	3	0	0	3
5.	XX61PQ	IDE-I	3	0	0	3
6.	MA5199	Project I	0	0	12	6
		TOTAL	**15**	**0**	**12**	**21**

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	MA52XX/ MA62XX	DE-II	3	0	0	3
2.	MA52XX/ MA62XX	DE-III	3	0	0	3
3.	MA52XX/ MA62XX	DE-IV	3	0	0	3
4.	XX62PQ	IDE-II	3	0	0	3
5.	MA5299	Project II	0	0	16	8
6.	IK5201	Indian Knowledge System	2	0	0	2
		TOTAL	**14**	**0**	**16**	**22**

Total Credits : 84

ELECTIVE GROUPS

Sl. No.	Subject Code	Department Elective - I	L	T	P	C
1.	MA5104	Cryptography and Network Security	3	0	0	3
2.	MA5105	Fundamentals of Block Chain	3	0	0	3
3.	MA5106	Mathematical Finance	3	0	0	3
4.	MA6101	Advanced Graph Theory	3	0	0	3
5.	MA6102	Introduction to Algebraic D-modules	3	0	0	3
6.	MA6103	Nonlinear Optimization	2	0	2	3
7.	MA6104	Generative AI	2	0	2	3
8.	MA6105	Rings and Modules	3	0	0	3
9.	MA6106	Large Language Models (LLMs)	2	0	2	3
10.	MA6107	Number Theory	3	0	0	3
11.	MA6108	Stochastic Calculus for Finance	3	0	0	3

Sl. No.	Subject Code	Department Elective – II	L	T	P	C
1.	MA5201	Portfolio Theory and Risk Management	3	0	0	3
2.	MA6201	Randomized Algorithms	3	0	0	3
3.	MA6202	Introduction to Biomathematics	3	0	0	3
4.	MA6203	Introduction to Homological Algebra	3	0	0	3

5.	MA6204	Noncommutative Algebra	3	0	0	3
6.	MA6205	Sobolev Spaces	3	0	0	3
7.	MA6206	Wavelet Transform	3	0	0	3

Sl. No.	Subject Code	Department Elective – III	L	T	P	C
1.	MA6207	Differential Manifolds	3	0	0	3
2.	MA6208	Graph Algorithms	3	0	0	3
3.	MA6209	Numerical solutions of PDEs	2	0	2	3
4.	MA6210	Statistical Inference	3	0	0	3

Sl. No.	Subject Code	Department Elective – IV	L	T	P	C
1.	MA5202	Mathematical methods in classical mechanics	3	0	0	3
2.	MA6211	Advanced complex analysis	3	0	0	3
3.	MA6212	Algebraic Coding Theory	3	0	0	3
4.	MA5203	Discrete Mathematics	3	0	0	3
5.	MA6213	Finite Element Analysis	3	0	0	3
6.	MA6214	Introduction to Algebraic Geometry	3	0	0	3
7.	MA6215	Operators on Hilbert Spaces	3	0	0	3
8.	MA6216	Riemannian Geometry	3	0	0	3

*An upgraded version of M. Sc. 5/6 level electives need to be essentially upgraded for PhD students with additional contents comprising additional lectures / assignments / tutorials / miniproject making the total credit : 3-1-0-4 / 3-0-2-4. Such course proposals with an advanced level (6/7 level course number) are listed separately for PhD students.

Interdisciplinary Elective (IDE) Course for M. Sc. (Available to students other than Maths)

Sl. No.	Subject Code	IDE - I	L	T	P	C
1.	MA6109	Mathematical Modeling	3	0	0	3

Sl. No.	Subject Code	IDE - II	L	T	P	C
1.	MA6218	Matrix Computation	3	0	0	3

(3.) M. Sc. Programme from the Department of Physics

(i) M. Sc. in Physics

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Prepare and aid the students in acquiring strong foundation in various Physics subjects	Program Learning Outcome 1a: Strong fundamentals in core Physics Program Learning Outcome 1b: Problem solving skills and temperament using Physics
Program Goal 2: Provide specialized knowledge in core and applied areas of Physics	Program Learning Outcome 2a: Specialized knowledge to pursue further work in theoretical Physics Program Learning Outcome 2b: Specialized knowledge to pursue further work in experimental Physics
Program Goal 3: Prepare and aid the students for a career in Physics that may include one or more of the following: a school/college teacher in Physics, research staff in lab / industry, eligibility for pursuing a higher degree and a career in academia / industry, science communicator / science journalism, etc.	Program Learning Outcome 3: Strong problem-solving skills, troubleshooting ability, ability to understand and formulate problem statements, construct models/experiments to provide insights into the problem.

Semester-I

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	PH4101	Mathematical Physics-I	3	1	0	4
2.	PH4102	Classical Mechanics	3	1	0	4
3.	PH4103	Quantum Mechanics-I	3	1	0	4
4.	PH4104	Numerical Techniques	2	0	2	3
5.	PH4105	Electronics	3	0	4	5
6.	HS4111	Soft-Skills for Employability	1	2	0	3
		Total	**15**	**5**	**6**	**23**

Semester-II

Sl. No.	Code	Course Name	L	T	P	C
1.	PH4201	Electrodynamics-I	3	1	0	4
2.	PH4202	Statistical Physics	3	1	0	4
3.	PH4203	Modern Optics	3	0	4	5
4.	PH4204	Introduction to Nuclear and Particle Physics	3	0	0	3
5.	PH42XX	Department Elective-I	2	1	0	3
		Total	**14**	**3**	**4**	**19**

Semester-III

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	PH5101	Atomic and Molecular Physics	3	1	0	4
2.	PH5102	Condensed Matter Physics-I	3	0	0	3
3.	PH5103	Atomic, Molecular and Nuclear Physics Laboratory	0	0	4	2
4.	PH51XX	Department Elective - II	X	X	X	3*
5.	XX61PQ	Inter-Disciplinary Elective - I	3	0	0	3*
6.	PH5199	Project - I	0	0	12	6
		Total				**21**

Semester-IV

Sl. No.	Code	Course Name	L	T	P	C
1.	PH5201	Condensed Matter Physics Lab	0	0	4	2
2.	PH52XX	Department Elective - III	X	X	X	3*
3.	PH52XX	Department Elective - IV	X	X	X	3*
4.	XX62PQ	Inter-Disciplinary Elective II	3	0	0	3
5.	IK5201	Indian Knowledge Systems	2	0	0	2
2.	PH5299	Project II	0	0	16	8
		Total				**21**

Total Credits: 84

* The values for L-T-P may change depending on nature of course with final credit remaining fixed at 3. However, the total credit for electives has to be maintained. Electives can be floated in either semester; the course code will be PHX1XX, and PHX2XX for the same elective running in odd and even semester, respectively.

Theme Based Elective Groups

Themes:
Theme 1: General Electives
Theme 2: Condensed Matter Physics and Materials Science
Theme 3: Optics and Photonics
Theme 4: High-energy Physics and Cosmology
Theme 5: Quantum Information and Quantum Techniques

Sl. No.	Subject Code	Departmental Elective – I	L	T	P	C
1.	PH4205	Quantum Mechanics-II	2	1	0	3
2.	PH4206	Thin Film Technology	3	0	0	3
3.	PH4207	Introduction to Medical Physics	2	1	0	3
4.	PH4208	Introduction to Data Science for Physicists	2	1	0	3

Sl. No.	Subject Code	Departmental Elective - II	L	T	P	C
1.	PH5104	Electrodynamics-II	3	0	0	3
2.	PH5105	Nanophotonics	2	1	0	3
3.	PH5106	Nanoscience	2	1	0	3
4.	PH5107	Quantum Theory of Collisions	2	1	0	3
5.	PH5108	Introductory Biophysics	2	1	0	3
6.	PH5109	Spintronics	2	1	0	3
7.	PH5110	Magnetism at Nanoscale	2	1	0	3
8.	PH5111	Mathematical Physics-II	2	1	0	3
9.	PH5112 /PH5208	Introduction to Nonlinear Dynamics and Chaos	3	0	0	3
10.	PH5113 /PH5219	Quantum Field Theory	2	1	0	3
11.	PH5114	Physics of Ultracold Atoms	2	1	0	3

Sl. No.	Subject Code	Departmental Elective – III	L	T	P	C
1.	PH5202	General Relativity and Cosmology	2	1	0	3
2.	PH5203	Nanoelectronics	2	1	0	3
3.	PH5204	Measurement Techniques	2	0	2	3
4.	PH5205	Quantum Optics & Quantum Information	2	1	0	3
5.	PH5206	Quantum Transport in Mesoscopic Systems	2	1	0	3
6.	PH5207	Condensed Matter Physics-II	3	0	0	3
7.	PH5208 /PH5112	Introduction to Nonlinear Dynamics and Chaos	3	0	0	3
8.	PH5209	Ultrafast Optics and Spectroscopy	2	1	0	3
9.	PH5210	Magnetism: Fundamentals to Application	2	1	0	3
10.	PH5211	Ferroic Phenomena	2	1	0	3
11.	PH5212	Materials for Engineering Applications	2	1	0	3

Sl. No.	Subject Code	Departmental Elective - IV	L	T	P	C
1.	PH5213	Nanoionics: Concepts and Technological Applications	3	0	0	3
2.	PH5214	Computational Physics	2	0	2	3
3.	PH5215	Scanning Probe Microscopy	2	1	0	3
4.	PH5216	Biophotonics	2	1	0	3
5.	PH5217	Magnetic Materials and Applications	2	1	0	3
6.	PH5218	Fourier Optics and Holography	2	1	0	3
7.	PH5219 /PH5113	Quantum Field Theory	2	1	0	3
8.	PH5220	Particle Physics	2	1	0	3
9.	PH5221	Soft Matter Physics	3	0	0	3
10.	PH5222	Quantum Materials	2	1	0	3
11.	PH5223	Low Temperatures Techniques	2	0	2	3

*An upgraded version of M. Sc. 5/6 level electives need to be essentially upgraded for PhD students with additional content comprising additional lectures / assignments / tutorials /

miniproject making the total credit : 3-1-0-4 / 3-0-2-4. Such course proposals with an advanced level (6/7 level course number) are listed separately for PhD students.

List of Inter Disciplinary Electives (IDEs) – For students other than Dept. of Physics

Sl. No.	Subject Code	Subject	L	T	P	C
1.	PH6101/6201	Physics of Complex Systems	3	0	0	3
2.	PH6102/6202	Physics of Nanoscience	3	0	0	3
3.	PH6103/6203	Semiconductor Processing: An Interdisciplinary approach	3	0	0	3

Curriculum for 2-years M. Tech. Programme

(1.) M. Tech. Programme from the Department of Chemical and Biochemical Engineering

(i) M. Tech. in Chemical Engineering

Program Learning Objectives	Program Learning Outcomes
Program Goal 1: Prepare students to undertake professional roles in fundamental and applied research within the chemical engineering industries as well as academics.	● Apply mathematics, science, and engineering principles to address complex challenges within the field of Chemical Engineering. ● Ability to identify and analyze engineering challenges to effectively formulate the appropriate solutions.
Program Goal 2: The goal is to equip students with a deep understanding of advanced concepts so they can effectively solve real-world problems, with a specific emphasis on integrating processes improving energy efficiency, and implementing sustainable production practices.	● Create and implement real-time systems to meet specific requirements in the field of Chemical Engineering. ● Collect, analyze, and display research data in appropriate formats while following scientific principles and methodologies ● Efficiently employ contemporary tools and methodologies to simulate intricate problems and suggest alternative resolutions.
Program Goal 3: The objective is to equip students with advanced technical skills to promote economic and social progress in both rural and urban areas of India.	● Develop engineering systems while taking into account societal, legal, cultural, security, health, and safety considerations. ● Apply methodologies, expertise, and contemporary engineering instruments necessary for environmental and sustainable advancement. Showcase expertise in the field while maintaining ethical obligations. ● Take on administrative duties involving project and financial management with assurance, showcasing leadership attributes and maintaining a steadfast dedication to continuous learning.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CB5101	Advanced Reaction Engineering	3	1	0	4
3.	CB5102	Advanced Heat Transfer	3	1	0	4
4.	CB5103	Introduction to Computational Techniques	1	0	3	2.5
5.	CB61XX	DE-I	3	0	0	3
6.	CB61XX	DE-II	3	0	0	3
7.	XX61PQ	IDE - I	3	0	0	3
TOTAL			**17**	**4**	**5**	**23.5**

IDE (Inter Disciplinary Electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CB5201	Advanced Mass Transfer	3	1	0	4
2.	CB5202	Classical and Statistical Thermodynamics	3	1	0	4
3.	CB5203	Analytical Characterization Lab	1	0	3	2.5
4.	CB62XX	DE-III	3	0	0	3
5.	CB62XX	DE-IV	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
TOTAL			**19**	**3**	**3**	**23.5**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CB6198	Summer Internship/Mini Project*	0	0	12	3
2.	CB6199	Project I**	0	0	30	15
TOTAL			0	0	42	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority..

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CB6299	Project II	0	0	42	21
TOTAL			**0**	**0**	**42**	**21**

Total Credits: 86

ELECTIVE GROUPS

Sl. No.	Code	Department Elective - I	L	T	P	C
1.	CB6101	Principles of Electrochemical Engineering	3	0	0	3
2.	CB6102	Molecular Simulations: Principles & Applications	3	0	0	3
3.	CB6103	Nucleation and Crystallization Phenomena	3	0	0	3
4.	CB6104	Preparative Chromatography	3	0	0	3

Sl. No.	Code	Department Elective - II	L	T	P	C
1.	CB6105	CO_2 Capture and Utilization	3	0	0	3
2.	CB6106	Biological Wastewater Treatment	3	0	0	3
3.	CB6107	Principles of Polymer Processing	3	0	0	3
4.	CB6108	Artificial Intelligence in Chemical Engineering	3	0	0	3

Sl. No.	Code	Department Elective - III	L	T	P	C
1.	CB6201	Photoelectrochemical and Photocatalytic Processes	3	0	0	3
2.	CB6202	Colloids and Interfacial Engineering	3	0	0	3
3.	CB6203	Climate Change, Sustainability, and Engineering	3	0	0	3
4.	CB6204	Advanced Numerical Methods in Chemical Engineering	3	0	0	3

Sl. No.	Code	Department Elective - IV	L	T	P	C
1.	CB6205	Optimization for Chemical Engineers	3	0	0	3
2.	CB6206	Molecular Theory of Solutions	3	0	0	3
3.	CB6207	Non-Newtonian Fluid Dynamics and Rheology	3	0	0	3
4.	CB6208	Systematic Design of Chemical Processes	3	0	0	3
5.	CB6209	Design of Experiments for Chemical Engineers	3	0	0	3

(2.) M. Tech. Programme from the Department of Civil and Environmental Engineering

(i) M. Tech. in Environmental Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems.
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CE5101	Chemistry for Environmental Engineers	3	0	2	4
3.	CE5102	Physico-Chemical Principles and Processes	3	0	0	3
4.	CE5103	Solid and Hazardous Waste Management	3	0	0	3
5.	CE51XX/ CE61XX	DE-I (Environmental Elective)	3	0	0	3
6.	CE51XX/ CE61XX	DE-II (Environmental / Department Elective)	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**2**	**4**	**23**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CE5201	Biological Principles and Processes	3	0	0	3
2.	CE5202	Air Pollution and Control	3	0	2	4
3.	CE5203	Environmental Impact Assessment	3	0	0	3
4.	CE52XX/ CE62XX	DE-III (Environmental Elective)	3	0	0	3
5.	CE52XX/ CE62XX	DE-IV (Environmental Elective/ Department Elective)	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**2**	**23**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CE6198	Summer Internship/Mini Project*	0	0	12	3
2.	CE6199	Project I **	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CE6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV: 85

ELECTIVE GROUPS

Department Elective -I: Environmental Elective Course						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6101	Atmospheric Physics and Chemistry	3	0	0	3
2.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engineering	3	0	0	3
3.	CE6103	Environmental Toxicology and Risk Assessment	3	0	0	3
4.	CE6104	Environmental Hydraulics	3	0	0	3
5.	CE6105	Atmospheric Science and Climate Change	3	0	0	3

Department Elective -II: Department Elective Course						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5117	Water Resources Management	3	0	0	3
2.	CE6109	Geoenvironmental Engineering	3	0	0	3
3.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3
4.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3

5.	CE6131	Sustainability of Water Resources System	3	0	0	3

Department Elective -III: Environmental Elective Course						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6201	E-waste Management for Circular Economy	3	0	0	3
2.	CE6202	Industrial Pollution Control and Prevention	3	0	0	3
3.	CE6203	Water Supply and Sewerage Network Design	3	0	0	3
4.	CE6204	Design of Water and Wastewater Treatment Facilities	3	0	0	3
5.	CE6205	Advanced Water and Wastewater Engineering	3	0	0	3

Department Elective - IV: Department Elective Course						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE5218	Groundwater Hydrology	3	0	0	3
3.	CE5219	Open Channel Hydraulics	3	0	0	3
4.	CE6208	Mine Wastes Generation and Management	3	0	0	3
5.	CE6211	Utilization of industrial Byproducts for Geotechnical Application	3	0	0	3
6.	CE6218	Finite Element Method	3	0	0	3
7.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
8.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CEE)

Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	CE6132	Data Science for Engineers	3	0	0	3

(ii) M. Tech. in Geotechnical Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems.
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CE5104	Geotechnical Exploration	3	0	2	4
3.	CE5105	Advanced Soil Mechanics	3	0	0	3
4.	CE5106	Rock Engineering	3	0	2	4
5.	CE51XX/ CE61XX	DE-I: (Geotechnical Elective)	3	0	0	3
6.	CE51XX/ CE61XX	DE-II: (Dept. Elective/Geotechnical Elective)	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
TOTAL			**19**	**2**	**6**	**24**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CE5204	Advanced Foundation Engineering	3	0	0	3
2.	CE5205	Computational Geomechanics	3	0	2	4
3.	CE5206	Fundamentals of Soil Behaviour	3	0	0	3
4.	CE52XX/ CE62XX	DE-3: (Geotechnical Elective)	3	0	0	3
5.	CE52XX/ CE62XX	DE-4: (Dept. Elective/Geotechnical Elective)	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
TOTAL			**21**	**1**	**2**	**23**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CE6198	Summer Internship/Mini Project*	0	0	12	3
2.	CE6199	Project I **	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CE6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV: 86

ELECTIVE GROUPS

Department Elective - I (Geotechnical Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6106	Soil Dynamics	3	0	0	3
2.	CE6107	Rock Slope Engineering	3	0	0	3
3.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
4.	CE6109	Geoenvironmental Engineering	3	0	0	3
5.	CE6110	Biogeotechnics	3	0	0	3

Department Elective - II (Geotechnical Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6111	Rock Mechanics	3	0	0	3
2.	CE6112	Environmental Rock Engineering	3	0	0	3
3.	CE6113	Pavement Geotechnics	3	0	0	3
4.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3

Department Elective - II (Departmental Electives)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engineering	3	0	0	3
2.	CE6103	Environmental Toxicology and Risk Assessment	3	0	0	3
3.	CE6115	Advanced Structural Mechanics	3	0	0	3
4.	CE6116	Bridge Engineering and Design	3	0	0	3
5.	CE6125	Bituminous materials	3	0	0	3
6.	CE6128	Highway Geometric Design and Safety	3	0	0	3
7.	CE6129	Airport Engineering	3	0	0	3

Department Elective - III (Geotechnical Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
2.	CE6207	Soil-Structure Interaction Analysis	3	0	0	3
3.	CE6208	Mine Wastes Generation and Management	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6211	Utilization of industrial byproducts for geotechnical applications	3	0	0	3
7.	CE6212	Rock Engineering for River Valley Projects	3	0	0	3

Department Elective - IV (Geotechnical Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6213	Design of Underground Excavations	3	0	0	3
2.	CE6214	Special Topics in Geotechnical Engineering	3	0	0	3
3.	CE6215	Forensic Geotechnical Engineering	3	0	0	3

Department Elective - IV (Departmental Electives)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE5218	Groundwater Hydrology	3	0	0	3
3.	CE5219	Open Channel Hydraulics	3	0	0	3
4.	CE6218	Finite Element Method	3	0	0	3
5.	CE6219	Structural Health Monitoring	3	0	0	3
6.	CE6220	Condition Assessment and Retrofitting of Structures	3	0	0	3
7.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
8.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3
9.	CE6229	Advanced Flexible Pavement Analysis and Design	3	0	0	3
10.	CE6230	Advanced Concrete Pavement Analysis and Design	3	0	0	3
11.	CE6231	Advanced Pavement Material Characterization	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CE)

Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	CE6132	Data Science for Engineers	3	0	0	3

(iii) M. Tech. in Rock Engineering for Infrastructure Development

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems.
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CE5105	Advanced Soil Mechanics	3	0	0	3
3.	CE5106	Rock Engineering	3	0	2	4
4.	CE5107	Engineering Behaviour of Rock	3	0	0	3
5.	CE51XX/ CE61XX	DE-I: (Rock Engineering Elective)	3	0	0	3
6.	CE51XX/ CE61XX	DE-II: (Dept. / Rock Engineering Elective)	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**2**	**4**	**23**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CE5205	Computational Geomechanics	3	0	2	4
2.	CE5207	Analysis and Design of Underground Structures	3	0	2	4
3.	CE5208	Landslides and Avalanches	3	0	0	3
4.	CE52XX/ CE62XX	DE-III: (Rock Engineering Elective)	3	0	0	3
5.	CE52XX/ CE62XX	DE-IV: (Dept. / Rock Engineering Elective)	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**4**	**24**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CE6198	Summer Internship/Mini Project*	0	0	12	3
2.	CE6199	Project I	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	**SEMESTER IV**	**L**	**T**	**P**	**C**
1.	CE6299	Project II**	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV: 86

ELECTIVE GROUPS

Department Elective - I (Rock Engineering Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6106	Soil Dynamics	3	0	0	3
2.	CE6107	Rock Slope Engineering	3	0	0	3
3.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
4.	CE6109	Geoenvironmental Engineering	3	0	0	3
5.	CE6110	Biogeotechnics	3	0	0	3

Department Elective – II (Rock Engineering Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6111	Rock Mechanics	3	0	0	3
2.	CE6112	Environmental Rock Engineering	3	0	0	3
3.	CE6113	Pavement Geotechnics	3	0	0	3
4.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3

Department Elective – II (Departmental Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6103	Environmental Toxicology and Risk Assessment	3	0	0	3
2.	CE6115	Advanced Structural Mechanics	3	0	0	3
3.	CE6116	Bridge Engineering and Design	3	0	0	3
4.	CE6128	Highway Geometric Design and Safety	3	0	0	3
5.	CE6129	Airport Engineering	3	0	0	3

Department Elective - III (Rock Engineering Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
2.	CE6207	Soil-Structure Interaction Analysis	3	0	0	3
3.	CE6208	Mine Wastes Generation and Management	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6211	Utilization of industrial byproducts for geotechnical applications	3	0	0	3
7.	CE6212	Rock Engineering for River Valley Projects	3	0	0	3

Department Elective – IV (Rock Engineering Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6213	Design of Underground Excavations	3	0	0	3
2.	CE6215	Forensic Geotechnical Engineering	3	0	0	3
3.	CE6216	Special Topics in Rock Engineering for Infrastructural Development	3	0	0	3

Department Elective – IV (Departmental Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE5218	Groundwater Hydrology	3	0	0	3
3.	CE5219	Open Channel Hydraulics	3	0	0	3
4.	CE6218	Finite Element Method	3	0	0	3
5.	CE6219	Structural Health Monitoring	3	0	0	3
6.	CE6220	Condition Assessment and Retrofitting of Structures	3	0	0	3
7.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
8.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3
9.	CE6229	Advanced Flexible Pavement Analysis and Design	3	0	0	3

10.	CE6230	Advanced Concrete Pavement Analysis and Design	3	0	0	3
11.	CE6231	Advanced Pavement Material Characterization	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CE)

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	CE6132	Data Science for Engineers	3	0	0	3

(iv) M. Tech. in Transportation Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental (Transportation) engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil (transportation) engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil (transportation) engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil (transportation) engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CE5111	Urban Transportation Planning	3	0	0	3
3.	CE5112	Pavement Analysis and Design	3	0	0	3
4.	CE5113	Traffic Engineering and Management	3	0	3	4.5
5.	CE51XX/ CE61XX	DE-I (Transportation Elective)	3	0	0	3
6.	CE51XX/ CE61XX	DE-II (Transportation Elective/ Department Elective)	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**2**	**5**	**23.5**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CE5212	Highway Materials	3	0	3	4.5
2.	CE5213	Railway Engineering	3	0	0	3
3.	CE5214	Computer Applications in Transportation Engineering	2	1	0	3
4.	CE52XX/ CE62XX	DE-III (Transportation Elective)	3	0	0	3
5.	CE52XX/ CE62XX	DE-IV (Transportation Elective/ Department Elective)	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
TOTAL			**20**	**2**	**3**	**23.5**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CE6198	Summer Internship/Mini Project*	0	0	12	3
2.	CE6199	Project I	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CE6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV: 86

ELECTIVE GROUPS

Department Elective - I (Transportation Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6125	Bituminous materials	3	0	0	3
2.	CE6126	Intelligent Transportation Systems	3	0	0	3
3.	CE6127	Pavement Management Systems	3	0	0	3

Department Elective - II (Transportation Elective/ Department Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engineering	3	0	0	3
2.	CE6106	Soil Dynamics	3	0	0	3
3.	CE6107	Rock Slope Engineering	3	0	0	3
4.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
5.	CE6111	Rock Mechanics	3	0	0	3
6.	CE6113	Pavement Geotechniques	3	0	0	3
7.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3

8.	CE6116	Bridge Engineering and Design	3	0	0	3
9.	CE6122	Advanced Concrete Technology	3	0	0	3
10.	CE6128	Highway Geometric Design and Safety	3	0	0	3
11.	CE6129	Airport Engineering	3	0	0	3
12.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3

Department Elective - III (Transportation Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6227	Traffic Flow Theory	3	0	0	3
2.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3
3.	CE6229	Advanced Flexible Pavement Analysis and Design	3	0	0	3

Department Elective - IV (Transportation Elective/ Department Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
3.	CE6208	Mine Wastes Generation and Management	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6211	Utilization of industrial byproducts for geotechnical applications	3	0	0	3
7.	CE6213	Design of Underground Excavations	3	0	0	3
8.	CE6214	Special Topics in Geotechnical Engineering	3	0	0	3
9.	CE6215	Forensic Geotechnical Engineering	3	0	0	3
10.	CE6218	Finite Element Method	3	0	0	3
11.	CE6219	Structural Health Monitoring	3	0	0	3
12.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
13.	CE6230	Advanced Concrete Pavement Analysis and Design	3	0	0	3
14.	CE6231	Advanced Pavement Material Characterization	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CE)

Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	CE6132	Data Science for Engineers	3	0	0	3

(v.) M. Tech. in Structural Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems.
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CE5108	Advanced Structural Analysis	3	0	2	4
3.	CE5109	Structural Dynamics	3	0	2	4
4.	CE5110	Theory of Plates and Shells	3	0	0	3

5.	CE51XX/ CE61XX	DE- I: Structure Elective	3	0	0	3
6.	CE51XX/ CE61XX	DE- II: Structure / Department Elective	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
TOTAL						**24**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	**Subject Code**	**SEMESTER II**	**L**	**T**	**P**	**C**
1.	CE5209	Advanced Concrete Design	3	0	2	4
2.	CE5210	Earthquake Resistant Design of Structures	3	0	2	4
3.	CE5211	Stability of Structures	3	0	0	3
4.	CE52XX/ CE62XX	DE-3: Structure Elective	3	0	0	3
5.	CE52XX/ CE62XX	DE-4: Structure / Department Elective	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
TOTAL						**24**

Sl. No.	**Subject Code**	**SEMESTER III**	**L**	**T**	**P**	**C**
1.	CE6198	Summer Internship/Mini Project*	0	0	12	3
2.	CE6199	Project I **	0	0	30	15
TOTAL						**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations.

In the III[rd] Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CE6299	Project II	0	0	42	21
TOTAL						**21**

Total Credits: 87

ELECTIVE GROUPS

Department Elective - I (Structure Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6115	Advanced Structural Mechanics	3	0	0	3
2.	CE6116	Bridge Engineering and Design	3	0	0	3
3.	CE6117	Masonry Structures	3	0	0	3
4.	CE6118	Wind Analysis and Design of Structures	3	0	0	3
5.	CE6119	Special Topics in Structural Analysis	3	0	0	3
6.	CE6120	Analysis Plates and Shells Structure	3	0	0	3

Department Elective-II (Structure / Department Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6106	Soil Dynamics	3	0	0	3
2.	CE6107	Rock Slope Engineering	3	0	0	3
3.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
4.	CE6111	Rock Mechanics	3	0	0	3
5.	CE6113	Pavement Geotechnics	3	0	0	3
6.	CE6114	Probabilistic Methods in Geotechnical Engineering	3	0	0	3
7.	CE6121	Prestressed Concrete Structure: Theory & Design	3	0	0	3
8.	CE6122	Advanced Concrete Technology	3	0	0	3
9.	CE6123	Structural Fire Engineering	3	0	0	3
10.	CE6124	Advanced Structural Dynamics	3	0	0	3
11.	CE6128	Highway Geometric Design and Safety	3	0	0	3
12.	CE6129	Airport Engineering	3	0	0	3
13.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3

Department Elective - III (Structure Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6217	Advanced Steel Design	3	0	0	3
2.	CE6218	Finite Element Method	3	0	0	3
3.	CE6219	Structural Health Monitoring	3	0	0	3
4.	CE6220	Condition Assessment and Retrofitting of Structures	3	0	0	3
5.	CE6221	Advanced Topics in Reinforced Concrete Design	3	0	0	3
6.	CE6222	Seismic Analysis and Design of Structures	3	0	0	3

Department Elective-IV (Structure / Department Elective)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
3.	CE6207	Soil-Structure Interaction Analysis	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6213	Design of Underground Excavations	3	0	0	3
7.	CE6215	Forensic Geotechnical Engineering	3	0	0	3
8.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
9.	CE6224	Nonlinear Structural Mechanics	3	0	0	3
10.	CE6225	Theory of Random Vibration	3	0	0	3
11.	CE6226	Analysis of Structural Stability	3	0	0	3

12.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3
13.	CE6230	Advanced Concrete Pavement Analysis and Design	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CE)

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	CE6132	Data Science for Engineers	3	0	0	3

(vi.) M. Tech. in Civil Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	CE5181	Advanced Engineering Mathematics	3	0	0	3
3.	CE5182	Civil Engineering Design – I	1	2	0	3
4.	CE5183	Civil Engineering Lab-I	0	0	3	1.5
5.	CE51XX/ CE61XX	Elective-I	3	0	0	3
6.	CE51XX/ CE61XX	Elective-II	3	0	0	3
7.	CE51XX/ CE61XX	Elective-III	3	0	0	3

8.	XX61PQ	IDE	3	0	0	3
	TOTAL		**17**	**4**	**5**	**23.5**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	**Subject Code**	**SEMESTER II**	**L**	**T**	**P**	**C**
1.	CE5281	Civil Engineering Design – II	1	2	0	3
2.	CE5282	Finite Element Methods	3	0	0	3
3.	CE5283	Civil Engineering Lab-II	0	0	3	1.5
4.	CE52XX/ CE62XX	Elective-IV	3	0	0	3
5.	CE52XX/ CE62XX	Elective-V	3	0	0	3
6.	CE52XX/ CE62XX	Elective-VI	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**19**	**3**	**3**	**23.5**

Sl. No.	**Subject Code**	**SEMESTER III**	**L**	**T**	**P**	**C**
1.	CE6198	Summer Internship/Mini Project*	0	0	12	3
2.	CE6199	Project I **	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host

institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CE6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV : 86

ELECTIVE GROUPS

Departmental Elective – DE-I, DE-II and DE-III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5103	Solid and Hazardous Waste Management	3	0	0	3
2.	CE5117	Water Resources Management	3	0	0	3
3.	CE6101	Atmospheric Physics and Chemistry	3	0	0	3
4.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engg.	3	0	0	3
5.	CE6103	Environmental Toxicology and Risk Assessment	3	0	0	3
6.	CE6104	Environmental Hydraulics	3	0	0	3
7.	CE6105	Atmospheric Science and Climate Change	3	0	0	3
8.	CE6106	Soil Dynamics	3	0	0	3
9.	CE6107	Rock Slope Engineering	3	0	0	3
10.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
11.	CE6109	Geoenvironmental Engineering	3	0	0	3

12.	CE6110	Biogeotechnics	3	0	0	3
13.	CE6111	Rock Mechanics	3	0	0	3
14.	CE6112	Environmental Rock Engineering	3	0	0	3
15.	CE6113	Pavement Geotechnics	3	0	0	3
16.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3
17.	CE6115	Advanced Structural Mechanics	3	0	0	3
18.	CE6116	Bridge Engineering and Design	3	0	0	3
19.	CE6117	Masonry Structures	3	0	0	3
20.	CE6118	Wind Analysis and Design of Structures	3	0	0	3
21.	CE6119	Special Topics in Structural Analysis	3	0	0	3
22.	CE6120	Analysis Plates and Shells Structure	3	0	0	3
23.	CE6121	Prestressed Concrete Structure: Theory & Design	3	0	0	3
24.	CE6122	Advanced Concrete Technology	3	0	0	3
25.	CE6123	Structural Fire Engineering	3	0	0	3
26.	CE6124	Advanced Structural Dynamics	3	0	0	3
27.	CE6125	Bituminous materials	3	0	0	3
28.	CE6126	Intelligent Transportation Systems	3	0	0	3
29.	CE6127	Pavement Management Systems	3	0	0	3
30.	CE6128	Highway Geometric Design and Safety	3	0	0	3
31.	CE6129	Airport Engineering	3	0	0	3
32.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3
33.	CE6131	Sustainability of Water Resources System	3	0	0	3

Departmental Elective – DE-IV, DE-V and DE-VI						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE5218	Groundwater Hydrology	3	0	0	3
3.	CE5219	Open Channel Hydraulics	3	0	0	3
4.	CE6201	E-waste Management for Circular Economy	3	0	0	3
5.	CE6202	Industrial Pollution Control and Prevention	3	0	0	3
6.	CE6203	Water Supply and Sewerage Network Design	3	0	0	3
7.	CE6204	Design of Water and Wastewater Treatment Facilities	3	0	0	3
8.	CE6205	Advanced Water and Wastewater Engineering	3	0	0	3
9.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
10.	CE6207	Soil-Structure Interaction Analysis	3	0	0	3
11.	CE6208	Mine Wastes Generation and Management	3	0	0	3
12.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
13.	CE6210	Ground Improvement Techniques	3	0	0	3

14.	CE6211	Utilization of industrial byproducts for geotechnical applications	3	0	0	3
15.	CE6212	Rock Engineering for River Valley Projects	3	0	0	3
16.	CE6213	Design of Underground Excavations	3	0	0	3
17.	CE6214	Special Topics in Geotechnical Engineering	3	0	0	3
18.	CE6215	Forensic Geotechnical Engineering	3	0	0	3
19.	CE6216	Special Topics in Rock Engineering for Infrastructural Development	3	0	0	3
20.	CE6227	Traffic Flow Theory	3	0	0	3
21.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3
22.	CE6229	Advanced Flexible Pavement Analysis and Design	3	0	0	3
23.	CE6230	Advanced Concrete Pavement Analysis and Design	3	0	0	3
24.	CE6231	Advanced Pavement Material Characterization	3	0	0	3
25.	CE6232	Porous Media Flow: Advanced topics	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CE)

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	CE6132	Data Science for Engineers	3	0	0	3

(3.) M. Tech. Programme from the Department of Computer Science & Engineering

(i) M. Tech. in Artificial Intelligence

Program Learning Objectives:	Program Learning Outcomes (PLO):
Program Goal 1: **Fundamental Understanding:** Establish a robust foundation in Artificial Intelligence (AI) and Data Science (DS) principles, theories, and methodologies.	**Program Learning Outcome 1 (PLO-1):** Students will acquire a deep understanding of the core concepts, algorithms, and tools used in AI, machine learning, deep learning, and data science. **Program Learning Outcome 2 (PLO-2):** Students will develop the ability to analyze and interpret complex data, using statistical and computational techniques to extract meaningful insights.
Program Goal 2: **Basic Training for Research and Innovation:** To equip students with the skills necessary to conduct cutting-edge research and innovate in the fields of AI and Data Science.	**Program Learning Outcome 3 (PLO-3):** Students will be able to innovate by developing new machine learning/ deep learning models, and systems in AI and DS, contributing to advancements in the field.
Program Goal 3: **Technical Skill Proficiency:** To enhance technical skills for developing AI and data-driven solutions for industry and academia.	**Program Learning Outcome 4 (PLO-4):** Students will demonstrate proficiency in programming, data management, and the use of AI and DS tools and frameworks in various fields including computer vision, natural language processing. **Program Learning Outcome 5 (PLO-5):** Students will be able to design and implement AI and DS solutions that are efficient, scalable, and reliable.
Program Goal 4: **Communication and Collaboration:** To develop communication and teamwork skills essential for professional success in AI and DS.	**Program Learning Outcome 6 (PLO-6):** Students will learn to effectively communicate AI and DS concepts, findings, and solutions to both technical and non-technical audiences.
Program Goal 5: **Ethics and Social Responsibility:** To understand the ethical, social, and environmental implications of AI and Data Science.	**Program Learning Outcome 7 (PLO-7):** Students will develop an awareness of ethical issues in AI and DS, such as data privacy, algorithmic bias, and the societal impacts of AI technologies. **Program Learning Outcome 8 (PLO-8):** Students will be able to apply ethical principles and responsible practices in the development and deployment of AI and DS solutions.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	CS5101	Design and Analysis of Algorithms	3	1	0	4
2.	CS5102	Foundations of Computer Systems	3	0	0	3
3.	CS5103	Computing Lab-1	0	1	2	2
4.	CS61XX	DE-I	3	0	0	3
5.	CS61XX	DE-II	3	0	0	3
6.	HS5111	Technical Writing and Soft Skill	1	2	2	4
7.	XX61PQ	IDE-I	3	0	0	3
	TOTAL		**16**	**4**	**4**	**22**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CS5201	Advanced Artificial Intelligence	3	0	0	3
2.	CS5203	Natural Language Processing	3	0	0	3
3.	CS5205	Advanced Artificial Intelligence Lab	0	1	2	2
4.	CS62XX	DE-III	3	0	0	3
5.	CS62XX	DE-IV	3	0	0	3
6.	CS62XX	DE-V	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**2**	**2**	**24**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CS6198	Summer Internship/Mini Project*	0	0	12	3
2.	CS6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations.

In the III[rd] Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	**SEMESTER IV**	**L**	**T**	**P**	**C**
1.	CS6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total credits - 85

ELECTIVE GROUPS

Department Elective – I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6101	Advanced Blockchain Technology	3	0	0	3
2.	CS6102	Advanced Cyber Security	3	0	0	3
3.	CS6103	Advanced Pattern Recognition	3	0	0	3
4.	CS6104	Formal Methods in Program Analysis and Verification	3	0	0	3
5.	CS6105	Federated Learning	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6106	Advanced Cloud Computing	3	0	0	3
2.	CS6107	Advanced Edge Computing	3	0	0	3
3.	CS6108	Advanced Computational Data Analysis	3	0	0	3
4.	CS6109	Reinforcement Learning	3	0	0	3
5.	CS6110	Advanced Graph Machine Learning	3	0	0	3
6.	CS6111	Advanced Time Series Analysis	3	0	0	3

Department Elective – III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6201	Artificial Internet of Things	3	0	0	3
2.	CS6202	Game Theory	3	0	0	3
3.	CS6203	Text Mining & Analytics	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6204	Knowledge Distillation	3	0	0	3
2.	CS6205	Physics of Neural Network	3	0	0	3
3.	CS6206	Selected Topics in Wireless Networks	3	0	0	3
4.	CS6207	Advanced Big Data Analytics	3	0	0	3

Department Elective - V						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6208	Quantum Machine Learning	3	0	0	3
2.	CS6209	Meta Learning	3	0	0	3
3.	CS6210	Selective Topics in Generative AI	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to non CSE Dept. students)

IDE from CSE - IDE-I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6112	Drone Data Processing & Analysis	3	0	0	3

(ii) M. Tech. in Computer Science & Engineering

Program Learning Objectives:	Program Learning Outcomes (PLO):
Program Goal 1: **Advanced Knowledge Acquisition:** To deepen students' knowledge and understanding of advanced theoretical and practical aspects in the major fields of Computer Science and Engineering (CSE).	**Program Learning Outcome 1:** **PLO-1:** Students will demonstrate a profound understanding of advanced computing principles, data structure, algorithms, high-level programming languages. **Program Learning Outcome 2:** **PLO-2:** Students will be able to understand advanced computational problem-solving techniques, design efficient algorithms, and implement software solutions.
Program Goal 2: **Research Proficiency and Innovation:** To equip students with the skills necessary to conduct high-quality research in Computer Science and Engineering, contributing to the advancement of the field.	**Program Learning Outcome 3:** **PLO-3:** Students will be able to identify research gaps, formulate hypotheses, design experiments, and utilize statistical methods to analyze research data, leading to significant contributions to the field. **Program Learning Outcome 4:** **PLO-4:** Students will demonstrate the ability to innovate by developing novel software, hardware solutions, and computational models that address current and emerging challenges in the field.
Program Goal 3: **Specialized Skill Development:** To enhance students' expertise in system development, security, and other specialized areas within CSE.	**Program Learning Outcome 5:** **PLO-5:** Students will be capable of designing, implementing, and securing complex computing systems, with a focus on various emerging areas.
Program Goal 4: **Professional and Communication Skills:** To cultivate effective communication skills and professional behavior necessary for successful careers in academia, research, and industry.	**Program Learning Outcome 6:** **PLO-6:** Students will effectively communicate complex technical information through scholarly writing, presentations, and collaboration, demonstrating clarity, precision with exhibit in leadership and teamwork skills.
Program Goal 5: **Ethical Responsibility and Societal Impact:** To instill a sense of ethical responsibility and awareness of the societal impact of technology.	**Program Learning Outcome 7:** **PLO-7:** Students will understand and apply ethical principles in research and professional practices, ensuring that their work positively impacts society and adheres to global standards. **Program Learning Outcome 8:** **PLO-8:** Students will be prepared to address societal challenges through technological solutions, contributing to sustainable development and social welfare.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	CS5101	Design and Analysis of Algorithms	3	1	0	4
2.	CS5102	Foundations of Computer Systems	3	0	0	3
3.	CS5103	Computing Lab-I	0	1	2	2
4.	CS61XX	DE-I	3	0	0	3
5.	CS61XX	DE-II	3	0	0	3
6.	HS5111	Technical Writing and Soft Skill	1	2	2	4
7.	XX61PQ	IDE-I	3	0	0	3
	TOTAL		**16**	**4**	**4**	**22**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	CS5201	Advanced Artificial Intelligence	3	0	0	3
2.	CS5202	Theoretical Computer Science	3	0	0	3
3.	CS5204	Computing Lab-II	0	1	2	2
4.	CS5205	Advanced Artificial Intelligence Lab	0	1	2	2
5.	CS62XX	DE-III	3	0	0	3
6.	CS62XX	DE-IV	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**18**	**3**	**4**	**23**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	CS6198	Summer Internship/Mini Project*	0	0	12	3
2.	CS6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	CS6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total credits - 84

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6101	Advanced Blockchain Technology	3	0	0	3
2.	CS6102	Advanced Cyber Security	3	0	0	3
3.	CS6103	Advanced Pattern Recognition	3	0	0	3
4.	CS6104	Formal Methods in Program Analysis and Verification	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6106	Advanced Cloud Computing	3	0	0	3
2.	CS6107	Advanced Edge Computing	3	0	0	3
3.	CS6108	Advanced Computational Data Analysis	3	0	0	3
4.	CS6109	Reinforcement Learning	3	0	0	3
5.	CS6110	Advanced Graph Machine Learning	3	0	0	3
6.	CS6111	Advanced Time Series Analysis	3	0	0	3
7.	CS6113	Cyber Physical Systems	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6201	Artificial Internet of Things	3	0	0	3
2.	CS6202	Game Theory	3	0	0	3
3.	CS6203	Text Mining & Analytics	3	0	0	3
4.	CS6204	Knowledge Distillation	3	0	0	3
5.	CS6208	Quantum Machine Learning	3	0	0	3
6.	CS6210	Selective Topics in Generative AI	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6206	Selected Topics in Wireless Networks	3	0	0	3
2.	CS6207	Advanced Big Data Analytics	3	0	0	3
3.	CS6215	Quantum Cyber Security	3	0	0	3
4.	CS6216	High Performance Computing	3	0	0	3
5.	CS6211	Selected Topics in Cryptography	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than CSE)

IDE from CSE - IDE-I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6112	Drone Data Processing & Analysis	3	0	0	3

(4.) M. Tech. Programme from the Department of Electrical Engineering

(i) M. Tech. in Communication System and Signal Processing (CSSP)

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: To equip students with technical skills necessary for the design, analysis, and implementation of communication system technologies and networks.	**Program Learning Outcome 1a:** Demonstrate proficiency in one or more specialized areas within communication system engineering, such as wireless communication, optical communication, microwave and millimeter wave technologies, digital signal processing, or network engineering. **Program Learning Outcome 1b:** Demonstrate advanced knowledge and understanding of communication engineering principles, theories, and concepts.
Program Goal 2: To foster research and development skills, enabling students to contribute to the advancement of communication technologies through innovation and problem-solving.	**Program Learning Outcome 2:** Conduct independent research, including literature review, experimentation, data analysis, and interpretation, to address communication engineering challenges and contribute to knowledge advancement in the field.
Program Goal 3: To develop critical thinking and analytical skills for evaluating and solving complex communication engineering problems.	**Program Learning Outcome 3a:** Apply analytical and problem-solving skills to design, analyze, and optimize communication systems and networks. **Program Learning Outcome 3b:** Collaborate effectively in multidisciplinary teams to solve complex communication engineering problems, demonstrating leadership, interpersonal, and teamwork skills.
Program Goal 4: To prepare students for professional practice in communication engineering roles in industry, academia, research institutions, or government agencies.	**Program Learning Outcome 4a:** Design, simulate, and implement communication systems and networks using appropriate tools, techniques, and methodologies.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	EC5101	Information Theory and Coding	3	1	0	4
3.	EC5102	Advanced Digital Signal Processing	3	0	2	4
4.	EC5103	Antenna and Microwave Devices	3	0	2	4
5.	EC51XX/ EC61XX	DE-I	3	0	0	3
6.	EC51XX/ EC61XX	DE-II	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**3**	**6**	**25**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	EC5201	Wireless Communication	3	0	2	4
2.	EC5202	Advanced Communication Systems	3	0	2	4
3.	EC52XX/ EC62XX	DE-III	3	0	0	3
4.	EC52XX/ EC62XX	DE-IV	3	0	0	3
5.	EC52XX/ EC62XX	DE-V	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**4**	**24**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	EC6198	Summer Internship/ Mini Project*	0	0	12	3
2.	EC6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	EC6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

TOTAL CREDIT: 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5107	RF and Microwave Active Circuits	3	0	0	3
2.	EC5108	Internet of Things (IoT) Networks	3	0	0	3
3.	EC5109	Radio Frequency Integrated Circuits	3	0	0	3
4.	~~EC5110~~ EC5116	Advanced Digital Image Processing	3	0	0	3
5.	EC6101	Advance Antenna and Microwave Devices	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5111	VLSI Architecture Design and Implementation	3	0	0	3
2.	EC5112	Bio Sensors and Circuits	3	0	0	3
3.	EC5113	Quantum Computing	3	0	0	3
4.	EC6102	Computer Vision	3	0	0	3
5.	EC6103	Radio Frequency Design and Technology	3	0	0	3

6.	EC6104	VLSI Signal Processing	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5205	Patterns Recognition and Machine Learning	3	0	0	3
2.	EC5206	Multimedia Communication	3	0	0	3
3.	EC5207	Optical Communication	3	0	0	3
4.	EC6201	RF and Microwave Measurement Techniques	3	0	0	3
5.	EC6202	Smart Antenna: From Theory to Practice	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5208	Quantum Computing	3	0	0	3
2.	EC6203	Adaptive filtering: From theory to practice	3	0	0	3
4.	EC6204	Antenna Design and Characterization	3	0	0	3
5.	EC6205	Statistical Signal Processing	3	0	0	3
6.	EE6214	Random Signals and Systems	3	0	0	3

Department Elective - V						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5209	Communication Networks	3	0	0	3
2.	EC5210	Advanced Biomedical Signal Processing	3	0	0	3
3.	EC5211	Silicon Photonics	3	0	0	3
4.	EC6206	Optimization Theory and Techniques for Electrical Engineering	3	0	0	3
5.	EC6207	Microwave and Millimetre Wave Integrated Circuits (MMIC)	3	0	0	3
6.	EC6208	Generative AI for Video Surveillance System	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than EE)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE6107	Renewable Energy Sources	3	0	0	3

(ii) M. Tech. in Power and Control Systems (P&CS)

Program Learning Objectives:	**Program Learning Outcomes:**
(i) Specialized training in the field of Power and Control system. (ii) Develop an orientation towards industrial training on specialized field. (iii) Imparting world class training to develop the foundation for making world class researcher in this field of research. (iv) Work collaboratively in multidisciplinary teams, demonstrating effective teamwork and communication to solve complex engineering problems. (v) Recognize the importance of ongoing professional development, engaging in activities such as certifications, workshops, and conferences to stay updated of industry trends.	The graduates of this program will have ● strong fundamentals in Power and Control system engineering. ● ability to analyze and synthesize engineering problems including design and conduct experiments, use standard test equipment and interpret experimental data. ● ability to design prototypes for real world problems. ● ability to work in a multidisciplinary team environment. ● ability to appreciate the complexities of professional environments, including taking responsibility for oneself, working effectively and professionally as a team member, and being mindful of ethical, economic, and contemporary concerns. ● ability to continue learning in Power and Control system field. ● ability to independently accomplish engineering tasks related to Power and Control research areas. ● ability to enter industry with the engineering techniques, skills, and tools required to be able to solve real-world problems in Power and Control system engineering.
Program Goal 1: Academic excellence by providing a curriculum that aligns with industry standards and encourages critical thinking in Power and Control system engineering**.**	**Program Learning Outcome 1a:** Highly skilled market ready manpower to serve the emerging electrical and electronic sectors **Program Learning Outcome 1b:** Skilled Human resource to cater the needs of next generation power systems and EV technologies.
Program Goal 2: A culture of research and innovation by promoting faculty and student involvement in innovative projects in Power and Control system technologies.	**Program Learning Outcome 2a:** Trained researchers for implementing research projects in line with national priorities such as Energy, EVs, Smart Grids, Green Technologies. **Program Learning Outcome 2b:** Design and develop innovative smart technologies/products in energy and EVs as per the societal need

Program Goal 3: To design dynamic and flexible course structures for UG and PG programs as per the changing requirement of the industries.	**Program Learning Outcome 3a:** Industry relevant UG, PG, and research programs **Program Learning Outcome 3b:** Trained manpower as per the industry requirement
Program Goal 4: To promote entrepreneurship among the students in the field of Power and Control system engineering	**Program Learning Outcome 4a:** Realization of working prototype towards product development **Program Learning Outcome 4b:** Promotion of in-house technology-based ventures catering societal needs.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	EE5101	Computer Aided Power System Analysis	3	0	2	4
3.	EE5102	Advanced Power Electronics Converters	3	0	2	4
4.	EE5103	FACTS and Its Applications	3	0	2	4
5.	EE51XX/ EE61XX	DE-I	3	0	0	3
6.	EE51XX/ EE61XX	DE-II	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**2**	**8**	**25**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	EE5201	Power System Dynamics, Control and Protection	3	0	2	4
2.	EE5202	Nonlinear Dynamical Systems	3	0	2	4
3.	EE52XX/ EE62XX	DE-III	3	0	0	3
4.	EE52XX/ EE62XX	DE-IV	3	0	0	3
5.	EE52XX/ EE62XX	DE-V	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**4**	**24**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	EE6198	Summer internship/Mini Project*	0	0	12	3

2.	EE6199	Project I**	0	0	30	15
	TOTAL		0	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	**Subject Code**	**SEMESTER IV**	**L**	**T**	**P**	**C**
1.	EE6299	Project II	0	0	42	21
		TOTAL	**0**	**0**	**42**	**21**

GRAND TOTAL - 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5104	Renewable Energy Integration	3	0	0	3
2.	EE6101	Advanced Power System Reliability	3	0	0	3
3.	EE6102	Advanced State Estimation and Target Tracking	3	0	0	3
4.	EE6103	Multivariable Control System	3	0	0	3
5.	EC6105	CMOS Phase Locked Loops	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5105	Power System Deregulation	3	0	0	3
2.	EE6104	Advanced Power System Protection	3	0	0	3
3.	EE6105	Switched Mode Power Converters	3	0	0	3
4.	EE6106	Advanced Digital Control System	3	0	0	3
5.	EC5111	VLSI Architecture Design and Implementation	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5203	Recent Trends in Optimization Techniques	3	0	0	3
2.	EE6201	Model Predictive Control	3	0	0	3
3.	EE6202	HVDC Transmission Systems	3	0	0	3
4.	EC6211	Advance FPGA Platform and System	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE6212	Power System Optimization	3	0	0	3
2.	EE6213	Advance Electric Drives	3	0	0	3
3.	EE6214	Random Signals and Systems	3	0	0	3
4.	EE6215	Quantitative Feedback Theory	3	0	0	3

Department Elective - V						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5204	Electric Vehicle Technology	3	0	0	3
2.	EE6216	Control Techniques in Power Electronics	3	0	0	3
3.	EE6217	Telemetry and SCADA	3	0	0	3
4.	EE6218	Optimal Control	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than EE)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE6107	Renewable Energy Sources	3	0	0	3

(iii) M. Tech. in VLSI and Embedded System

Program Learning Objectives:	**Program Learning Outcomes:**
Program Goal 1: Identify, formulate and solve engineering problems in the field of Embedded system and VLSI	**Program Learning Outcome 1a:** Graduates will be able to take up career in the field of design, testing and implementation of VLSI systems in any said domain in the real world. **Program Learning Outcome 1b:** Identify and apply appropriate Electronic Design Automation (EDA) to solve real world problems in VLSI and Embedded Systems domain to create innovative products and systems.
Program Goal 2: Apply knowledge, proper methodology and modern tools to analyze and solve the problems in the domain VLSI Design and Technology.	**Program Learning Outcome 2:** Acquire in-depth knowledge of VLSI and Embedded systems in wider and global perspective, with an ability to discriminate, evaluate, analyze, synthesize and integrate for enhancement of knowledge.
Program Goal 3: Acquire competency in areas of VLSI and Embedded Systems, IC Fabrication, Design, Testing, Verification and prototype development focusing on applications.	**Program Learning Outcome 3a:** Pursue career in research in VLSI Design and Embedded Systems domain through self-learning and self-directed on cutting edge technologies **Program Learning Outcome 3b:** Graduates will be able to achieve broad and in-depth knowledge of analysis and design of micro-electronic components which will support them to pursue research studies.
Program Goal 4: Acquire professional and intellectual integrity and ethics of research and recognize the need to engage in learning with a high level of enthusiasm and commitment to contribute to the community for sustainable development of society.	**Program Learning Outcome 4a:** Graduates will be able to asses, innovate, implement and serve the end users problems with cutting edge solutions to meet industry standards **Program Learning Outcome 4b:** Graduates will be able to work both as an individual and a team on multidisciplinary projects and excel in their career

Sl. No.	**Subject Code**	**SEMESTER I**	**L**	**T**	**P**	**C**
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	EC5104	Digital VLSI System	3	0	2	4
3.	EC5105	Embedded System	3	0	2	4
4.	EC5106	Semiconductor Device Modeling and Simulation	3	0	2	4

5.	EC51XX/ EC61XX	DE-I	3	0	0	3
6.	EC51XX/ EC61XX	DE-II	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**2**	**8**	**25**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	**Subject Code**	**SEMESTER II**	**L**	**T**	**P**	**C**
1.	EC5203	Analog and Mixed Signal Integrated Circuits	3	0	2	4
2.	EC5204	High Performance Embedded Computing system	3	0	2	4
3.	EC52XX/ EC62XX	DE-III	3	0	0	3
4.	EC52XX/ EC62XX	DE-IV	3	0	0	3
5.	EC52XX/ EC62XX	DE-V	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**4**	**24**

Sl. No.	**Subject Code**	**SEMESTER III**	**L**	**T**	**P**	**C**
1.	EC6198	Summer Internship/ Mini Project*	0	0	12	3
2.	EC6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation

from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

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(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	EC6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit : 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5114	Opto-Electronics Materials and Devices	3	0	0	3
2.	EC5115	Radio Frequency Integrated Circuits	3	0	0	3
3.	EC5116	Advanced Digital Image Processing	3	0	0	3
4.	EC5117	VLSI Testing and Verification	3	0	0	3
5.	EC5118	Bio Sensors and Circuits	3	0	0	3
6.	EC6105	CMOS Phase Locked Loops	3	0	0	3

Department Elective - II

Sl. No.	Subject Code	Subject	L	T	P	C
1.	EC5111	VLSI Architecture Design and Implementation	3	0	0	3
2.	EC5119	Quantum Computing	3	0	0	3
3.	EC5120	Semiconductor Packaging Technology	3	0	0	3
4.	EC6104	VLSI Signal Processing	3	0	0	3
5.	EC6106	Computer Vision	3	0	0	3
Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5205	Patterns Recognition and Machine Learning	3	0	0	3
2.	EC5213	Multimedia Communication	3	0	0	3
3.	EC5214	VLSI Technology	3	0	0	3
4.	EC5215	Sensors and Actuators	3	0	0	3
5.	EC6209	MEMS and NEMS	3	0	0	3
6.	EC6210	Advance FPGA Platform and System	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5216	Low Power VLSI	3	0	0	3
2.	EC5217	CAD VLSI	3	0	0	3
3.	EC6211	Hardware Security system	3	0	0	3
4.	EC6212	Network on Chip	3	0	0	3
5.	EE5203	Recent Trends in Optimization Techniques	3	0	0	3
6.	EE6214	Random Signals and Systems	3	0	0	3

Department Elective - V						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5218	Silicon Photonics	3	0	0	3
2.	EC5219	Embedded System Integration	3	0	0	3
3.	EC5220	High Power Semiconductor Devices	3	0	0	3
4.	EC6208	Generative AI for Video Surveillance System	3	0	0	3
5.	EC6213	System-on-Programmable-Chip Design	3	0	0	3
6.	EC6214	Real time Embedded Operating Systems	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than EE)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE6107	Renewable Energy Sources	3	0	0	3

(5.) M. Tech. Programme from the Department of Mathematics

(i.) M. Tech. in Mathematics and Computing

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: To train students in both Mathematics and Computer Science to be able to address the increasing demand in both the areas.	**Program Learning Outcome 1:** With a mix of Mathematics and Computer Science courses, students explore the deep connection between computing and fundamental mathematics.
Program Goal 2: To pursue a bright career in industry.	**Program Learning Outcome 2:** Students become experts in different fields in industry due to their strong fundamental in Mathematics and Computer Science.
Program Goal 3: To pursue a successful career in academia.	**Program Learning Outcome 3:** Courses from Mathematics and Computer Science introduce the flavor of research and motivate the students to build a successful career in academia.
Program Goal 4: To prepare basics as strong foundation to achieve goals in higher academic degrees.	**Program Learning Outcome 4a:** Foundation is made strong with systematics training in pure and applied mathematics which helps in higher degrees. **Program Learning Outcome 4b:** Computer science courses provide a platform to further explore the programs in the contemporary areas of computer science

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skills	1	2	2	4
2.	MC5101	Design and Analysis of Algorithms	3	1	0	4
3.	MC5102	Probability and Statistics	2	0	2	3
4.	MC5103	Computing Lab-1	0	1	2	2
5.	XX51PQ/ XX61PQ	DE-I	3	0	0	3
6.	XX51PQ/ XX61PQ	DE-II	3	0	0	3
7.	XX51PQ/ XX61PQ	DE-III	3	0	0	3
8.	XX61PQ	IDE	3	0	0	3
	TOTAL		**18**	**4**	**6**	**25**

Important Note:

1. Department electives of Computer Science offered to M. Tech. (CSE) students may be chosen as department elective by M. Tech. (M&C) students.

2. IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	MC5201	Advanced Artificial Intelligence	3	0	0	3
2.	MC5202	Numerical Linear Algebra and Optimization Techniques	2	0	2	3
3.	MC5203	Advance Artificial Intelligence Lab	0	1	2	2
4.	XX52PQ/ XX62PQ	DE-IV	3	0	0	3
5.	XX52PQ/ XX62PQ	DE-V	3	0	0	3
6.	XX52PQ/ XX62PQ	DE-VI	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	Indian Knowledge System	3	0	0	3
	TOTAL		**20**	**2**	**4**	**24**

Imp. Note : Department electives of Computer Science offered to M. Tech. (CSE) students may be chosen as department elective by M. Tech. (M&C) students.

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	MC6198	Summer Internship Evaluation / Mini Project*	0	0	12	3
2.	MC6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	MC6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit - 88

ELECTIVE GROUPS

Sl. No.	Subject Code	Department Elective - I	L	T	P	C
1.	MA5104	Cryptography and Network Security	3	0	0	3
2.	MA6101	Advanced Graph Theory	3	0	0	3
3.	MA6102	Introduction to Algebraic D-modules	3	0	0	3
4.	MA6103	Nonlinear Optimization	3	0	0	3
5.	CS6101	Advanced Blockchain Technology	3	0	0	3
6.	CS6102	Advanced Cyber Security	3	0	0	3
7.	CS6103	Advanced Pattern Recognition	3	0	0	3
8.	CS6104	Formal Methods in Program Analysis and Verification	3	0	0	3
9.	CS6105	Federated Learning	3	0	0	3

Sl. No.	Subject Code	Department Elective - II	L	T	P	C
1.	MA5104	Fundamentals of Block Chain	3	0	0	3
2.	MA5105	Mathematical Finance	3	0	0	3
3.	MA6104	Generative AI	2	0	2	3
4.	MA6105	Rings and Modules	3	0	0	3
5.	CS6106	Advanced Cloud Computing	3	0	0	3
6.	CS6107	Advanced Edge Computing	3	0	0	3
7.	CS6108	Advanced Computational Data Analysis	3	0	0	3
8.	CS6109	Reinforcement Learning	3	0	0	3
9.	CS6110	Advanced Graph Machine Learning	3	0	0	3
10.	CS6111	Advanced Time Series Analysis	3	0	0	3

Sl. No.	Subject Code	Department Elective - III	L	T	P	C
1.	MA6106	Large Language Models (LLMs)	2	0	2	3
2.	MA6107	Number Theory	3	0	0	3
3.	MA6108	Stochastic Calculus for Finance	3	0	0	3

Sl. No.	Subject Code	Department Elective - IV	L	T	P	C
1.	MA5201	Portfolio Theory and Risk Management	3	0	0	3
2.	MA6202	Introduction to Biomathematics	3	0	0	3
3.	MA6203	Introduction to Homological Algebra	3	0	0	3
4.	MA6204	Noncommutative Algebra	3	0	0	3
5.	MA6205	Sobolev Spaces	3	0	0	3
6.	MA6206	Wavelet Transform	3	0	0	3
7.	CS6201	Artificial Internet of Things	3	0	0	3
8.	CS6202	Game Theory	3	0	0	3
9.	CS6203	Text Mining & Analytics	3	0	0	3

Sl. No.	Subject Code	Department Elective - V	L	T	P	C
1.	MA6207	Differential Manifolds	3	0	0	3
2.	MA6208	Graph Algorithms	3	0	0	3
3.	MA6209	Numerical solutions of PDEs	2	0	2	3
4.	MA6210	Statistical Inference	3	0	0	3
5.	MA6217	Database and Data Mining	2	0	2	3
6.	CS6204	Knowledge Distillation	3	0	0	3
7.	CS6205	Physics of Neural Network	3	0	0	3
8.	CS6206	Selected Topics in Wireless Networks	3	0	0	3
9.	CS6207	Advanced Big Data Analytics	3	0	0	3

Sl. No.	Subject Code	Department Elective - VI	L	T	P	C
1.	MA5203	Discrete Mathematics	3	0	0	3
2.	MA6211	Advanced Complex Analysis	3	0	0	3
3.	MA6212	Algebraic Coding Theory	3	0	0	3
4.	MA6213	Finite Element Analysis	3	0	0	3
5.	MA6214	Introduction to Algebraic Geometry	3	0	0	3

6.	MA6215	Operators on Hilbert Spaces	3	0	0	3
7.	MA6216	Riemannian Geometry	3	0	0	3
8.	CS6208	Quantum Machine Learning	3	0	0	3
9.	CS6209	Meta Learning	3	0	0	3
10.	CS6210	Selective Topics in Generative AI	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than Math)

Sl. No.	Subject Code	IDE	L	T	P	C
1.	MA6109	Mathematical Modeling	3	0	0	3

(6.) M. Tech. Programme from the Department of Mechanical Engineering

(i) M. Tech. in Mechanical Design

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: The graduates will acquire contemporary knowledge and concepts of mechanical equipment design.	**Program Learning Outcome 1a**: Understanding of conventional and advanced stress analysis. **Program Learning Outcome 1b**: Analytical ability to critically evaluate the design performance of various basic and advanced mechanical equipment designs.
Program Goal 2: The graduates will possess the concepts of materials deformation and their mechanisms.	**Program Learning Outcome 2a**: Understanding the dynamics of mechanical components. **Program Learning Outcome 2b**: Identify and critically evaluate the dynamic performance of mechanical equipment.
Program Goal 3: The graduates will possess state-of-art in the knowledge of advanced materials failure and failure theories.	**Program Learning Outcome 3**: Ability to analyse the cause and prevention of failure in mechanical components
Program Goal 4: The graduates will possess the state-of-the-art practical and numerical approach for the analysis of mechanical design.	**Program Learning Outcome 4a**: Acquire the appropriate engineering skill and knowledge pertaining to design processes. **Program Learning Outcome 4b**: Possess the computational and analytical expertise required for the analysis of mechanical equipment design.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	ME5101	Advanced Engineering Mathematics	3	1	0	4
3.	ME5102	Theory of Elasticity	3	0	0	3
4.	ME5103	Finite Element Analysis	3	0	0	3
5.	ME5104	Design Lab - I	0	0	3	1.5
6.	ME61XX	DE-I	3	0	0	3
7.	ME61XX	DE-II	3	0	0	3
8.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**3**	**5**	**24.5**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	ME5201	Advanced Engineering Software Lab	1	0	4	3
2.	ME5202	Advanced Dynamics & Vibration	3	1	0	4
3.	ME5203	Measurement and Instrumentation	3	0	0	3
4.	ME5204	Design Lab - II	0	0	3	1.5
5.	ME62XX	DE-III	3	0	0	3
6.	ME62XX	DE-IV	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**19**	**2**	**7**	**24.5**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	ME6198	Summer Internship / Mini Project*	0	0	12	3
2.	ME6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	ME6299	Project II**	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV - 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6105	Acoustics	3	0	0	3
2.	ME6106	Mobile Robotics	3	0	0	3
3.	ME6107	Digital Manufacturing and Industry 4.0	3	0	0	3
4.	ME6108	Wear & Lubrication of Machine Components	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6103	Continuum Mechanics	3	0	0	3
2.	ME6109	Vehicle Dynamics and Multi-body Systems	3	0	0	3
3.	ME6110	Biomechanics	3	0	0	3
4.	ME6112	Advanced Mechanical Characterisation of Alloys	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6207	Rotor Dynamics	3	0	0	3
2.	ME6208	Robot Motion Planning	3	0	0	3
3.	ME6209	Non-linear Systems Dynamics	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6210	Robotics: Advanced Concepts & Analysis	3	0	0	3
2.	ME6211	Analysis of Welding Processes	3	0	0	3
3.	ME6212	Fracture and Fatigue	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than ME)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6113	Soft Computing Application in Engineering	3	0	0	3

(ii) M. Tech. in Thermal and Fluids Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: The graduates will acquire advanced knowledge and concepts of Thermal and Fluids Engineering.	**Program Outcome 1**: After completion of the M-Tech in Thermal and Fluids Engineering, the students will be able to manage and solve technical problems associated with thermo-fluid systems.
Program Goal 2: To provide the students an opportunity to upgrade their skills and qualifications.	**Program Outcome 2**: After completion of the M-Tech in Thermal and Fluids Engineering, the students will update their engineering skills for career growth.
Program Goal 3: The graduates will possess the state-of-the art practical, analytical and computational approach for the analysis of thermo-fluid systems.	**Program Outcome 3**: Possess the computational and analytical expertise required for the analysis of thermo-fluid systems with focus in industrial and research applications.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	ME5101	Advanced Engineering Mathematics	3	1	0	4
3.	ME5105	Advanced Fluid Mechanics	3	0	0	3
4.	ME5106	Gas Dynamics and Propulsion	3	0	0	3
5.	ME5107	Thermo-Fluid Lab-I	0	0	3	1.5
6.	ME61XX	DE-I	3	0	0	3
7.	ME61XX	DE-II	3	0	0	3
8.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**3**	**5**	**24.5**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	ME5201	Advanced Engineering Software Lab	1	0	4	3
2.	ME5203	Measurement and Instrumentation	3	0	0	3
3.	ME5205	Advanced Heat Transfer	3	1	0	4
4.	ME5206	Thermo-Fluid Lab-II	0	0	3	1.5
5.	MEX2XX	DE-III	3	0	0	3
6.	MEX2XX	DE-IV	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**19**	**2**	**7**	**24.5**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	ME6198	Summer Internship / Mini Project*	0	0	12	3
2.	ME6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	ME6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV - 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6101	Multiphase Flow & Heat Transfer	3	0	0	3
2.	ME6102	Computational Fluid Dynamics	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6103	Continuum Mechanics	3	0	0	3
2.	ME6104	Refrigeration and Air-Conditioning	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6201	Turbulent Shear Flow	3	0	0	3
2.	ME6202	Cryogenics	3	0	0	3
3.	ME6203	Laser Processing of Materials	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6204	Aerodynamics	3	0	0	3
2.	ME6205	Advances in IC Engine	3	0	0	3
3.	ME6206	Microfluidics and Microsystems	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than ME)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6113	Soft Computing Application in Engineering	3	0	0	3

(iii) M. Tech. in Advanced Manufacturing Technology

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: The graduates will be current in the knowledge of concepts and practices of material removal processes.	Program Learning Outcome 1a: Appraise the mechanism of conventional and advanced material removal processes. Program Learning Outcome 1b: Identify and critically evaluate the process performance of various basic and advanced machining processes.
Program Goal 2: The graduates will possess the concepts of materials deformation and various forming processes.	Program Learning Outcome 2: Critically appraise and analyze the deformation behavior during bulk and sheet material forming processes.
Program Goal 3: The graduates will be current in the knowledge of advanced materials and their processing techniques, damage and failure of materials.	Program Learning Outcome 3a: Appraise the behavior and processing of advanced materials. Program Learning Outcome 3b: Understand and identify the damage and failure of materials.
Program Goal 4: The graduates will be enriched with the various advanced concepts of manufacturing processes to meet the present and future demands of the industry.	Program Learning Outcome 4: Appraise the recent industrial demands and identify the manufacturing processes and associated strategies to meet the need.
Program Goal 5: The graduates will possess the state-of-the art practical, and numerical approach for the analysis of manufacturing processes.	Program Learning Outcome 5a: Acquire the appropriate engineering skill and knowledge pertaining to processes, characterization of products or parts. Program Learning Outcome 5b: Possess the computational, and analytical expertise required for the analysis of manufacturing processes with focus in industrial and research applications.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	ME5101	Advanced Engineering Mathematics	3	1	0	4
3.	ME5103	Finite Element Analysis	3	0	0	3
4.	ME5108	Deformation-based Manufacturing	3	0	0	3
5.	ME5109	Manufacturing Lab - I	0	0	3	1.5
6.	ME61XX	DE-I	3	0	0	3
7.	ME61XX	DE-II	3	0	0	3
8.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**3**	**5**	**24.5**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	ME5201	Advanced Engineering Software Lab	1	0	4	3
2.	ME5203	Measurement and Instrumentation	3	0	0	3
3.	ME5207	Solidification-based Manufacturing	3	1	0	4
4.	ME5208	Manufacturing Lab - II	0	0	3	1.5
5.	ME62XX	DE-III	3	0	0	3
6.	ME62XX	DE-IV	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**19**	**2**	**7**	**24.5**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	ME6198	Summer Internship / Mini Project*	0	0	12	3
2.	ME6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	ME6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV - 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6102	Computational Fluid Dynamics	3	0	0	3
2.	ME6106	Mobile Robotics	3	0	0	3
3.	ME6107	Digital Manufacturing and Industry 4.0	3	0	0	3
4.	ME6108	Wear & Lubrication of Machine Components	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6103	Continuum Mechanics	3	0	0	3
2.	ME6110	Biomechanics	3	0	0	3
3.	ME6111	Advanced Manufacturing Processes	3	0	0	3
4.	ME6112	Advanced Mechanical Characterisation of Alloys	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6203	Laser Processing of Materials	3	0	0	3
2.	ME6208	Robot Motion Planning	3	0	0	3
3.	ME6214	Additive Manufacturing of Metals: Theory and Practice	3	0	0	3
4.	ME6215	Computer Numerical Controlled Machine Tools	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6210	Robotics: Advanced Concepts & Analysis	3	0	0	3
2.	ME6211	Analysis of Welding Processes	3	0	0	3
3.	ME6212	Fracture and Fatigue	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than ME)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6113	Soft Computing Application in Engineering	3	0	0	3

(iv) M. Tech. in Mechatronics

Program Learning Objectives	Program Learning Outcomes
Program Goal 1: The graduates will acquire the knowledge and concepts of Mechatronics.	**Program Outcome 1:** After completion of M-Tech in Mechatronics, the students will be able to manage and solve system-level technical problems.
Program Goal 2: To provide the students an opportunity to acquire specialized skills in the area of Mechatronics.	**Program Outcome 2:** After completion of the M-Tech in Mechatronics, the students will be able to apply their knowledge to industry as well as academic research and development.
Program Goal 3: To provide the students with an opportunity to gain thorough knowledge in the areas of • Mechatronics • Robotics and automation, • Aircraft engineering, • Computer-aided design, etc**.**	**Program Outcome 3:** The M-Tech Program in Mechatronics will impart the training to the students to become leaders in the cutting-edge areas of Mechatronics.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	MH5101	Fundamentals of Mechatronics	3	0	0	3
3.	MH5102	Mechatronics Lab – I	0	0	3	1.5
4.	ME5101	Advanced Engineering Mathematics	3	1	0	4
5.	EC5105	Embedded System	3	0	2	4
6.	XX51PQ/ XX61PQ	DE–I	3	0	0	3
7.	XX61PQ	DE–II	3	0	0	3
8.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**3**	**7**	**25.5**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	MH5201	Sensors and Actuators	3	0	0	3
2.	MH5202	Modeling and Simulation of Mechatronic Systems	3	0	0	3
3.	MH5203	Mechatronics Lab – II	0	0	3	1.5
4.	XX62PQ	DE-III	3	0	0	3
5.	XX62PQ	DE-IV	3	0	0	3
6.	XX52PQ/ XX62PQ	DE-V	3	0	0	3
7.	RM6201	Research Methodology	3	1	0	4
8.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**3**	**23.5**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	MH6198	Summer Internship / Mini Project*	0	0	12	3
2.	MH6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations. In the IIIrd Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	MH6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credit from Semester I to IV - 88

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6105	Acoustics	3	0	0	3
2.	ME6106	Mobile Robotics	3	0	0	3
3.	ME6107	Digital Manufacturing and Industry 4.0	3	0	0	3
4.	~~EC5114~~ EC5116	Advanced Digital Image Processing	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6103	Continuum Mechanics	3	0	0	3
2.	ME6109	Vehicle Dynamics and Multi-body Systems	3	0	0	3
3.	EC6104	VLSI Signal Processing	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6208	Robot Motion Planning	3	0	0	3
2.	ME6209	Non-linear Systems Dynamics	3	0	0	3
3.	ME6215	Computer Numerical Controlled Machine Tools	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6206	Microfluidics and Microsystems	3	0	0	3
2.	ME6210	Robotics: Advanced Concepts & Analysis	3	0	0	3

Department Elective - V						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5205	Patterns Recognition and Machine Learning	3	0	0	3
2.	EC6208	Generative AI for Video Surveillance System	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than ME)

Sl. No.	Subject Code	IDE	L	T	P	C

1.	ME6113	Soft Computing Application in Engineering	3	0	0	3

(7.) M. Tech. Programme from Department of Metallurgical and Materials Engineering

(i) M. Tech. in Materials Science and Engineering

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: To equip graduates with a comprehensive understanding of the fundamental principles of materials science and engineering, encompassing the relationships between processing, microstructure, properties, and performance of materials.	**Program Learning Outcome 1a:** At the end of M. Tech program students will be able to apply fundamental principles of materials science and engineering to understand the relationships between processing, microstructure, properties, and performance of various materials. **Program Learning Outcome 1b:** Students will be able to analyze the structure, properties, and behaviour of different material classes, including metals, ceramics, polymers and composites.
Program Goal 2: To foster the ability to apply scientific and engineering knowledge to design, develop, characterize, and optimize novel materials for diverse applications.	**Program Learning Outcome 2:** Utilize advanced processing techniques to synthesize and manipulate materials at different scales (macro, micro, and nano). Students will be able to characterize and refine innovative materials for a variety of uses.
Program Goal 3: Demonstrate a deep understanding of the structure, properties, and behaviour of various material classes, including metals, ceramics, polymers, and composites.	**Program Learning Outcome 3a:** To cultivate critical thinking, problem-solving, and analytical skills to address complex challenges in materials research and development. **Program Learning Outcome 3b:** Apply fundamental scientific and engineering principles to design and develop materials with tailored properties for specific applications.
Program Goal 4: To gain knowledge of advanced materials concepts, such as nanomaterials, functional materials, and smart materials, and the latest research trends in materials science and engineering.	**Program Learning Outcome 4:** Graduates will demonstrate professionalism, adhere to ethical principles in research and development activities, and contribute to sustainable development through responsible material design and utilization. Acquire expertise in cutting-edge materials concepts like nanomaterials, functional materials, and smart materials, and to stay abreast of the latest developments in materials science and engineering research.

Sl. No.	Subject Code	SEMESTER I	L	T	P	C
1.	HS5111	Technical Writing and Soft Skill	1	2	2	4
2.	MM5101	Thermodynamics and Phase Transformation	3	1	0	4
3.	MM5102	Concepts in Materials Science	3	0	0	3
4.	MM5103	Mechanical Behavior of Materials	3	0	2	4
5.	MM5104	Nano-structured Materials	3	0	0	3
6.	MM61XX	DE-I	3	0	0	3
7.	XX61PQ	IDE	3	0	0	3
	TOTAL		**19**	**3**	**4**	**24**

IDE (Inter Disciplinary electives) in the curriculum aims to create multitasking professionals/ scientists with learning opportunities for students across disciplines/aptitude of their choice by opting level (5 or 6) electives, as appropriate, listed in the approved curriculum.

Sl. No.	Subject Code	SEMESTER II	L	T	P	C
1.	MM5201	Advanced Polymer Technology	3	0	2	4
2.	MM5202	Advanced Engineering Materials	3	0	2	4
3.	MM62XX	DE-II	3	0	0	3
4.	MM62XX	DE-III	3	0	0	3
5.	MM62XX	DE-IV	3	0	0	3
6.	RM6201	Research Methodology	3	1	0	4
7.	IK6201	IKS	3	0	0	3
	TOTAL		**21**	**1**	**4**	**24**

Sl. No.	Subject Code	SEMESTER III	L	T	P	C
1.	MM6198	Summer Internship/ Mini Project*	0	0	12	3
2.	MM6199	Project I**	0	0	30	15
	TOTAL		**0**	**0**	**42**	**18**

***Note: Summer Internship (Credit based)**

(i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening summer vacation between Semester II and III. It may be pursued in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

(ii) Further, on return from 60 days internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

** **Note: M. Tech. Project outside the Institute:** A project-based internship may be permitted in industries/academia (outside IITP) in 3rd or 4th semester in accordance with academic regulations.

In the III[rd] Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Sl. No.	Subject Code	SEMESTER IV	L	T	P	C
1.	MM6299	Project II	0	0	42	21
	TOTAL		**0**	**0**	**42**	**21**

Total Credits - 87

ELECTIVE GROUPS

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	MM6101	Processing technology of Metal, Ceramic and Composites	3	0	0	3
2.	MM6102	Surface Engineering	3	0	0	3
3.	MM6103	Nanomaterials: Structure, Property and Applications	3	0	0	3
4.	MM6104	Field-assisted Sintering Techniques	3	0	0	3

Department Elective - II

Sl. No.	Subject Code	Subject	L	T	P	C
1.	MM6201	Defects and Diffusion in Materials	3	0	0	3
2.	MM6202	Polymer Matrix Composite	3	0	0	3
3.	MM6203	Functional Ceramics	3	0	0	3

Department Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	MM6204	Materials Characterization Techniques	3	0	0	3
2.	MM6205	Selection of Alloys and Heat Treatment	3	0	0	3
3.	MM6206	Thin films - An Engineering Approach	3	0	0	3
4.	MM6207	Joining of Materials	3	0	0	3

Department Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	MM6208	Crystal Symmetry and Tensor properties	3	0	0	3
2.	MM6209	Coating Technology	3	0	0	3
3.	MM6210	Fabrication of Solid-state Devices	3	0	0	3

Interdisciplinary Elective (IDE) Course for M. Tech. (Available to students other than MME)

IDE						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	MM6105	Structural Characterization of Materials	3	0	0	3
2.	MM6106	Composite Science and Technology	3	0	0	3

Curriculum for 5-years B.Tech. – M.Tech. Dual Degree Programme

Pathway for B. Tech. – M. Tech. Dual Degree starts diverging from Sem – VII with a focus towards their M. Tech. specialization. The B. Tech. project starting in Sem – VII continues over the next four semesters up to Sem – X fulfilling project credit requirements for B. Tech. – M. Tech. Dual Degree.

(1.) B. Tech. – M. Tech. Dual Degree Programme from the Department of Civil and Environmental Engineering

(i) B. Tech. (Civil Engineering) – M. Tech. (Environmental Engineering)

Program Learning Objectives:	**Program Learning Outcomes:**
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Semester – VII

Sl. No.	Course Code	Course	L	T	P	C
1.	CE41PQ	B. Tech. Elective - I	3	0	0	3
2.	CE41PQ	B. Tech. Elective – II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41XX	HSS Elective - II	3	0	0	3
5.	XX4198	Summer Internship*	0	0	12	3
6.	XX4199	Project – I	0	0	12	6
7.	CE5102	Physico-Chemical Principles and Processes	3	0	0	3
TOTAL			**15**	**0**	**24**	**24**

Note :

*** For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Semester – VIII

Sl. No.	Course Code	Course	L	T	P	C
1.	RM6201	Research Methodology	3	1	0	4
2.	CE5201	Biological Principles and Processes	3	0	0	3
3.	CE5202	Air Pollution and Control	3	0	2	4
4.	CE52PQ/ CE62PQ	M. Tech. Elective - I	3	0	0	3
5.	CE4299	Project - II	0	0	12	6
TOTAL			**12**	**1**	**14**	**20**

Semester – IX

Sl. No.	Course Code	Course	L	T	P	C
1.	CE51PQ/ CE61PQ	M. Tech. Elective - II	3	0	0	3
2.	CE51PQ/ CE61PQ	M. Tech. Elective - III	3	0	0	3
3.	CE51PQ/ CE61PQ	M. Tech. Elective - IV	3	0	0	3
4.	CE5199	Project - III	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**

Semester – X

Sl. No.	Course Code	Course	L	T	P	C
1.	CE5299	Project – IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Total Credit - 208 (including B. Tech. Sem I to Sem VI credits)

ELECTIVE GROUPS

SEMESTER-VII: DEPARTMENT ELECTIVE COURSE

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4101	Introduction to Bridge Engineering	3	0	0	3
2.	CE4102	Prestressed and Precast Concrete Structures	3	0	0	3
3.	CE4103	Fundamentals of Solid Mechanics	3	0	0	3
4.	CE4104	Matrix Methods for Structural Analysis	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4105	Stochastic Hydrology	3	0	0	3
2.	CE4106	Irrigation Engineering and Hydraulic Structures	3	0	0	3
3.	CE4107	Elementary Soil Behaviour	3	0	0	3
4.	CE4108	Fundamentals of Geoenvironmental Engineering	3	0	0	3
5.	CE4109	Biogeotechnical Engineering	3	0	0	3
6.	CE4110	Pavement Geotechnology	3	0	0	3

SEMESTER-VIII: ELECTIVE COURSE

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6201	E-waste Management for Circular Economy	3	0	0	3
2.	CE6202	Industrial Pollution Control and Prevention	3	0	0	3
3.	CE6203	Water Supply and Sewerage Network Design	3	0	0	3
4.	CE6204	Design of Water and Wastewater Treatment Facilities	3	0	0	3
5.	CE6205	Advanced Water and Wastewater Engineering	3	0	0	3

SEMESTER-IX: ELECTIVE COURSE

M. Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6101	Atmospheric Physics and Chemistry	3	0	0	3
2.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engineering	3	0	0	3
3.	CE6103	Environmental Toxicology and Risk Assessment	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6104	Environmental Hydraulics	3	0	0	3
2.	CE6105	Atmospheric Science and Climate Change	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6109	Geoenvironmental Engineering	3	0	0	3
2.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3
3.	CE5117	Water Resources Management	3	0	0	3
4.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3
5.	CE6131	Sustainability of Water Resources System	3	0	0	3

(ii) B. Tech. (Civil Engineering) – M. Tech. (Geotechnical Engineering)

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Semester – VII

Sl. No.	Course Code	Course	L	T	P	C
1.	XX41PQ	B. Tech. Elective - I	3	0	0	3
2.	XX41PQ	B. Tech. Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41PQ	HSS Elective – II	3	0	0	3
5.	XX4198	Summer Internship*	0	0	12	3
6.	XX4199	Project – I	0	0	12	6
7.	CE5105	Advanced Soil Mechanics	3	0	0	3
TOTAL			**12**	**0**	**24**	**24**

***Note :**

For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Semester – VIII

Sl. No.	Course Code	Course	L	T	P	C
1.	RM6201	Research Methodology	3	1	0	4
2.	CE5204	Advanced Foundation Engineering	3	0	0	3
3.	CE5205	Computational Geomechanics	3	0	2	4
4.	CE52PQ/ CE62PQ	M Tech Elective - I	3	0	0	3
5.	CE4299	Project - II	0	0	12	6
TOTAL			**12**	**0**	**14**	**20**

Semester – IX

Sl. No.	Course Code	Course	L	T	P	C
1.	CE51PQ/ CE61PQ	M Tech Elective - II	3	0	0	3
2.	CE51PQ/ CE61PQ	M Tech Elective - III	3	0	0	3
3.	CE51PQ/ CE61PQ	M Tech Elective - IV	3	0	0	3
4.	CE5199	Project - III	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**

Semester – X

Sl. No.	Course Code	Course	L	T	P	C
1.	CE5299	Project – IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Total Credits = 208 (including B. Tech. Sem I to Sem VI credits)

ELECTIVE GROUPS

SEMESTER VII

Department Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4101	Introduction to Bridge Engineering	3	0	0	3
2.	CE4102	Prestressed and Precast Concrete Structures	3	0	0	3
3.	CE4103	Fundamentals of Solid Mechanics	3	0	0	3
4.	CE4104	Matrix Method for Structural Analysis	3	0	0	3

Department Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4105	Stochastic Hydrology	3	0	0	3
2.	CE4106	Irrigation Engineering and Hydraulic Structures	3	0	0	3
3.	CE4107	Elementary Soil Behaviour	3	0	0	3
4.	CE4108	Fundamentals of Geoenvironmental Engineering	3	0	0	3
5.	CE4109	Biogeotechnical Engineering	3	0	0	3
6.	CE4110	Pavement Geotechnology	3	0	0	3

M. Tech. Elective I (5/6 level)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
2.	CE6207	Soil-Structure Interaction Analysis	3	0	0	3
3.	CE6208	Mine Wastes Generation and Management	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6211	Utilization of industrial byproducts for geotechnical applications	3	0	0	3
7.	CE6212	Rock Engineering for River Valley Projects	3	0	0	3
8.	CE6213	Design of Underground Excavations	3	0	0	3
9.	CE6214	Special Topics in Geotechnical Engineering	3	0	0	3
10.	CE6215	Forensic Geotechnical Engineering	3	0	0	3

M. Tech. Elective II (5/6 level)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6106	Soil Dynamics	3	0	0	3
2.	CE6107	Rock Slope Engineering	3	0	0	3
3.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
4.	CE6109	Geoenvironmental Engineering	3	0	0	3
5.	CE6110	Biogeotechnics	3	0	0	3

M. Tech. Elective III (5/6 level)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6111	Rock Mechanics	3	0	0	3
2.	CE6112	Environmental Rock Engineering	3	0	0	3
3.	CE6113	Pavement Geotechnics	3	0	0	3
4	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3

M. Tech. Elective IV (5/6 level)						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engineering	3	0	0	3
2.	CE6103	Environmental Toxicology and Risk Assessment	3	0	0	3
3.	CE6115	Advanced Structural Mechanics	3	0	0	3
4.	CE6116	Bridge Engineering and Design	3	0	0	3
5.	CE6125	Bituminous materials	3	0	0	3
6.	CE6128	Highway Geometric Design and Safety	3	0	0	3
7.	CE6129	Airport Engineering	3	0	0	3

(iii) B. Tech. (Civil Engineering) – M. Tech. (Structural Engineering)

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems.
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Semester – VII

Sl. No.	Course Code	Course	L	T	P	C
1.	CE41PQ	B. Tech. Elective - I	3	0	0	3
2.	CE41PQ	B. Tech. Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3

4.	HS41PQ	HSS Elective - II	3	0	0	3
5.	CE4198	Summer Internship*	0	0	12	3
6.	CE4199	Project - I	0	0	12	6
7.	CE5109	Structural Dynamics	3	0	2	4
TOTAL			**15**	**0**	**26**	**25**

Note :

*** For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :
a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Semester – VIII

Sl. No.	Course Code	Course	L	T	P	C
1.	RM6201	Research Methodology	3	1	0	4
2.	CE5209	Advanced Concrete Design	3	0	2	4
3.	CE5210	Earthquake Resistant Design of Structures	3	0	2	4
4.	CE52PQ / CE62PQ	M Tech Elective - I	3	0	0	3
5.	CE4299	Project - II	0	0	12	6
TOTAL			**12**	**1**	**16**	**21**

Semester – IX

Sl. No.	Course Code	Course	L	T	P	C
1.	CE52PQ / CE62PQ	M Tech Elective - II	3	0	0	3
2.	CE52PQ / CE62PQ	M Tech Elective - III	3	0	0	3
3.	CE52PQ / CE62PQ	M Tech Elective - IV	3	0	0	3
4.	CE5199	Project – III**	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**

Semester – X

Sl. No.	Course Code	Course	L	T	P	C
1.	CE5299	Project – IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Total Credit = 210 (including B. Tech. Sem I to Sem VI credits)

ELECTIVE GROUPS

B.Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4101	Introduction to Bridge Engineering	3	0	0	3
2.	CE4102	Prestressed and Precast Concrete Structures	3	0	0	3
3.	CE4103	Fundamentals of Solid Mechanics	3	0	0	3
4.	CE4104	Matrix Method for Structural Analysis	3	0	0	3

B.Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4105	Stochastic Hydrology	3	0	0	3
2.	CE4106	Irrigation Engineering and Hydraulic Structures	3	0	0	3
3.	CE4107	Elementary Soil Behaviour	3	0	0	3
4.	CE4108	Fundamentals of Geoenvironmental Engineering	3	0	0	3
5.	CE4109	Biogeotechnical Engineering	3	0	0	3
6.	CE4110	Pavement Geotechnology	3	0	0	3
M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
3.	CE6207	Soil-Structure Interaction Analysis	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6213	Design of Underground Excavations	3	0	0	3
7.	CE6215	Forensic Geotechnical Engineering	3	0	0	3
8.	CE6217	Advanced Steel Design	3	0	0	3
9.	CE6218	Finite Element Method	3	0	0	3
10.	CE6219	Structural Health Monitoring	3	0	0	3
11.	CE6220	Condition Assessment and Retrofitting of Structures	3	0	0	3
12.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
13.	CE6224	Nonlinear Structural Mechanics	3	0	0	3
14.	CE6225	Theory of Random Vibration	3	0	0	3
15.	CE6226	Analysis of Structural Stability	3	0	0	3

M. Tech. Elective - II

Sl. No.	Subject Code	Subject	L	T	P	C
1.	CE6117	Masonry Structures	3	0	0	3
2.	CE6118	Wind Analysis and Design of Structures	3	0	0	3
3.	CE6119	Special Topics in Structural Analysis	3	0	0	3
4.	CE6120	Analysis Plates and Shells Structure	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6115	Advanced Structural Mechanics	3	0	0	3
2.	CE6116	Bridge Engineering and Design	3	0	0	3
3.	CE6121	Prestressed Concrete Structure: Theory & Design	3	0	0	3
4.	CE6122	Advanced Concrete Technology	3	0	0	3
5.	CE6123	Structural Fire Engineering	3	0	0	3
6.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6106	Soil Dynamics	3	0	0	3
2.	CE6107	Rock Slope Engineering	3	0	0	3
3.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
4.	CE6111	Rock Mechanics	3	0	0	3
5.	CE6113	Pavement Geotechnics	3	0	0	3
6.	CE6114	Probabilistic Methods in Geotechnical Engineering	3	0	0	3
7.	CE6128	Highway Geometric Design and Safety	3	0	0	3
8.	CE6129	Airport Engineering	3	0	0	3

(iv) B. Tech. (Civil Engineering) – M. Tech. (Transportation Engineering)

Program Learning Objectives:	Program Learning Outcomes:
Program Goal 1: Equip the students with strong foundation in civil and environmental engineering for both research and industrial scenarios.	**Program Learning Outcome 1a:** Student develops ability to design and conduct experiments. **Program Learning Outcome 1b:** Student is able to organize and analyze the experiment data to draw conclusions.
Program Goal 2: Provide scientific and technical knowledge in planning, design, construction, operation and maintenance of civil engineering infrastructure.	**Program Learning Outcome 2:** Students are able to (i) develop material and process specifications, (ii) analyze and design projects, (iii) perform estimate and costing and (iv) manage technical activities.
Program Goal 3: Prepares the students to apply knowledge in policy and decision making related to civil engineering infrastructure.	**Program Learning Outcome 3a:** Student develops understanding of professional and ethical responsibility. **Program Learning Outcome 3b:** Student is able to consider economic, environmental, and societal contexts while developing engineering solutions.
Program Goal 4: Prepare students to attain leadership careers to meet the challenges and demands in civil engineering practice.	**Program Learning Outcome 4a:** Students is prepared for leading roles/profiles in government sector, construction industry, consultancy services, NGOs, corporate houses and international organizations. **Program Learning Outcome 4b:** Student develops ability to identify, formulate, and solve engineering problems
Program Goal 5: Nurture interdisciplinary education for finding innovative solutions.	**Program Learning Outcome 5:** Student is able to solve complex engineering problems by applying principles of engineering and science.

Semester – VII

Sl. No.	Course Code	Course	L	T	P	C
1.	CE41PQ	B. Tech. Elective - I	3	0	0	3
2.	CE41PQ	B. Tech. Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41PQ	HSS Elective - II	3	0	0	3
5.	CE4198	Summer Internship*	0	0	12	3
6.	CE4199	Project – I	0	0	12	6
7.	CE5113	Traffic Engineering and Management	3	0	3	4.5
TOTAL			**15**	**0**	**27**	**25.5**

*** For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:**

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar..

Semester – VIII

Sl. No.	Course Code	Course	L	T	P	C
1.	RM6201	Research Methodology	3	1	0	4
2.	CE5212	Highway Materials	3	0	3	4.5
3.	CE5213	Railway Engineering	3	0	0	3
4.	CE52PQ/ CE62PQ	M. Tech. Elective - I	3	0	0	3
5.	CE4299	Project - II	0	0	12	6
TOTAL			**12**	**1**	**15**	**20.5**

Semester – IX

Sl. No.	Course Code	Course	L	T	P	C
1.	CE52PQ/ CE62PQ	M. Tech .Elective - II	3	0	0	3
2.	XX52PQ/ CE62PQ	M. Tech. Elective - III	3	0	0	3
3.	CE52PQ/ CE62PQ	M. Tech. Elective - IV	3	0	0	3
4.	CE5199	Project – III**	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**

Semester – X

Sl. No.	Course Code	Course	L	T	P	C
1.	CE5299	Project – IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

Total Credit = 210 (including B. Tech. Sem I to Sem VI credits)

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

ELECTIVE GROUPS

B. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4101	Introduction to Bridge Engineering	3	0	0	3
2.	CE4102	Prestressed and Precast Concrete Structures	3	0	0	3
3.	CE4103	Fundamentals of Solid Mechanics	3	0	0	3
4.	CE4104	Matrix Method for Structural Analysis	3	0	0	3

B.Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE4105	Stochastic Hydrology	3	0	0	3
2.	CE4106	Irrigation Engineering and Hydraulic Structures	3	0	0	3
3.	CE4107	Elementary Soil Behaviour	3	0	0	3
4.	CE4108	Fundamentals of Geoenvironmental Engineering	3	0	0	3
5.	CE4109	Biogeotechnical Engineering	3	0	0	3
6.	CE4110	Pavement Geotechnology	3	0	0	3

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE5217	Geoinformatics for Engineers	3	0	0	3
2.	CE6206	Geotechnical Earthquake Engineering	3	0	0	3
3.	CE6208	Mine Wastes Generation and Management	3	0	0	3
4.	CE6209	Coupled Process in Fractured Geological Media	3	0	0	3
5.	CE6210	Ground Improvement Techniques	3	0	0	3
6.	CE6211	Utilization of industrial by-products for geotechnical applications	3	0	0	3
7.	CE6213	Design of Underground Excavations	3	0	0	3
8.	CE6214	Special Topics in Geotechnical Engineering	3	0	0	3
9.	CE6215	Forensic Geotechnical Engineering	3	0	0	3
10.	CE6218	Finite Element Method	3	0	0	3
11.	CE6219	Structural Health Monitoring	3	0	0	3
12.	CE6223	Uncertainty, Risk and Reliability Analyses in Civil Engineering	3	0	0	3
13.	CE6227	Traffic Flow Theory	3	0	0	3
14.	CE6228	Analytical Techniques for Infrastructure Systems Analysis	3	0	0	3
15.	CE6229	Advanced Flexible Pavement Analysis and Design	3	0	0	3
16.	CE6230	Advanced Concrete Pavement Analysis and Design	3	0	0	3
17.	CE6231	Advanced Pavement Material Characterization	3	0	0	3

M. Tech. Elective – II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6125	Bituminous materials	3	0	0	3
2.	CE6126	Intelligent Transportation Systems	3	0	0	3
3.	CE6127	Pavement Management Systems	3	0	0	3

M. Tech. Elective – III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6128	Highway Geometric Design and Safety	3	0	0	3
2.	CE6129	Airport Engineering	3	0	0	3
3.	CE6130	Analytical Methods in Civil Engineering	3	0	0	3

M. Tech. Elective – IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CE6102	Sampling, Analytical Methods, and Statistics for Environmental Engineering	3	0	0	3

2.	CE6106	Soil Dynamics	3	0	0	3
3.	CE6107	Rock Slope Engineering	3	0	0	3
4.	CE6108	Constitutive Modelling in Geotechnics	3	0	0	3
5.	CE6111	Rock Mechanics	3	0	0	3
6.	CE6113	Pavement Geotechniques	3	0	0	3
7.	CE6114	Probalistic Methods in Geotechnical Engineering	3	0	0	3
8.	CE6116	Bridge Engineering and Design	3	0	0	3
9.	CE6122	Advanced Concrete Technology	3	0	0	3

(2.) B. Tech. – M. Tech. Dual Degree Programme from the Department of Computer Science & Engineering

(i.) B. Tech. – M. Tech. (Computer Science and Engineering)

Program Learning Objectives:	Program Learning Outcomes (PLO):
Program Goal 1: **Comprehensive Knowledge Acquisition:** To provide a strong foundation in both fundamental and advanced concepts of Computer Science and Engineering (CSE), integrating batchelor and master-level education.	**Program Learning Outcome 1:** **PLO-1:** Students will acquire and demonstrate a comprehensive understanding of core concepts in computing principles, data structure, algorithms, programming languages. **Program Learning Outcome 2:** **PLO-2:** Students will be able to understand problems computationally, design efficient algorithms, and implement software solutions.
Program Goal 2: **Training for Research and Industry:** To provide quality training for conducting fundamental and advanced research in Computer Science and Engineering and software development.	**Program Learning Outcome 3:** **PLO-3:** Students will develop the ability to apply the scientific method to computer science problems, including formulating hypotheses, designing experiments, and analyzing results. **Program Learning Outcome 4:** **PLO-4:** Students will demonstrate proficiency in software development, including the use of modern programming environments, operating systems, computer networks, version control, and collaborative development practices.
Program Goal 3: **Technical Expertise and Professional Skills:** To focus on skill enhancement in system development and security.	**Program Learning Outcome 5:** **PLO-5:** Students will be able to design, implement, and manage complex systems, computer architecture, networking, ensuring quality, and security.
Program Goal 4: **Communication Skill:** To develop various communication skills such as reading, listening, speaking, etc. This will help in expressing ideas and views clearly and effectively.	**Program Learning Outcome 6:** **PLO-6:** Students will develop the ability to communicate technical information effectively through written reports, oral presentations, and collaborative projects.
Program Goal 5: **Social Awareness:** To understand societal issues related to computer science and allied areas and develop methods and means to abate and create awareness in society.	**Program Learning Outcome 7:** **PLO-7:** Students will develop an awareness of ethical, social, and environmental issues related to computing, applying responsible practices in their professional activities. **Program Learning Outcome 8:** **PLO-8:** Students will learn to work effectively in teams, demonstrating leadership, collaboration, and project management skills.

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	CS41PQ	B. Tech. Elective – II	3	0	0	3
2.	CS41PQ	B. Tech. Elective – III	3	0	0	3
3.	XX41PQ	IDE-III	3	0	0	3
4.	HS41XX	HSS Elective - II	3	0	0	3
5.	CS4198	Summer Internship/ Summer Project*	0	0	12	3
6.	CS4199	Project - I	0	0	12	6
7.	CS5101	Design and Analysis of Algorithms	3	1	0	4
TOTAL			**15**	**1**	**24**	**25**

***Note :**

For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:

Note :
a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

SEMESTER VIII						
Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	CS5201	Advanced Artificial Intelligence	3	0	0	3
2.	CS5202	Theoretical Computer Science	3	0	0	3
3.	CS62XX	M. Tech. Elective – I	3	0	0	3
4.	RM6201	Research Methodology	3	1	0	4
5.	CS4299	Project II	0	0	12	6
		TOTAL	**12**	**1**	**12**	**19**

SEMESTER IX						
Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	CS61XX	M. Tech. Elective – II	3	0	0	3
2.	CS61XX	M. Tech. Elective – III	3	0	0	3
3.	CS61XX	M. Tech. Elective – IV	3	0	0	3
4.	CS6190	Project – III**	0	0	16	8
		TOTAL	**9**	**0**	**16**	**17**

SEMESTER X						
Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	CS6290	Project – IV**	0	0	36	18
		TOTAL	**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Grand Total (Semester I to X) : 208

ELECTIVE GROUPS

B. Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS4121	Pattern Recognition	3	0	0	3
2.	CS4122	Principles of Programming Languages	3	0	0	3
3.	CS4123	Social Networks	3	0	0	3
4.	CS4124	Multimedia System	3	0	0	3
5.	CS4125	Program Analysis and Verification	3	0	0	3

B. Tech. Elective - III						
1.	CS4117	Time Series Analysis	3	0	0	3
2.	CS4118	Computational Data Analysis	3	0	0	3
3.	CS4126	Graph Machine Learning	3	0	0	3
4.	CS4127	Bioinformatics	3	0	0	3
5.	CS4128	Graph Theory	3	0	0	3
6.	CS4129	Blockchain Technology	3	0	0	3

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6201	Artificial Internet of Things	3	0	0	3
2.	CS6202	Game Theory	3	0	0	3
3.	CS6203	Text Mining & Analytics	3	0	0	3
4.	CS6204	Knowledge Distillation	3	0	0	3
5.	CS6206	Selected Topics in Wireless Networks	3	0	0	3
6.	CS6207	Advanced Big Data Analytics	3	0	0	3
7.	CS6208	Quantum Machine Learning	3	0	0	3
8.	CS6210	Selective Topics in Generative AI	3	0	0	3
9.	CS6215	Quantum Cyber Security	3	0	0	3
10.	CS6211	Selected Topics in Cryptography	3	0	0	3
11.	CS6216	High Performance Computing	3	0	0	3

M. Tech. Elective – II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6101	Advanced Blockchain Technology	3	0	0	3
2.	CS6102	Advanced Cyber Security	3	0	0	3
3.	CS6104	Formal Methods in Program Analysis and Verification	3	0	0	3
4.	CS6109	Reinforcement Learning	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6106	Advanced Cloud Computing	3	0	0	3
2.	CS6107	Advanced Edge Computing	3	0	0	3
3.	CS6113	Cyber Physical Systems	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	CS6103	Advanced Pattern Recognition	3	0	0	3
2.	CS6108	Advanced Computational Data Analysis	3	0	0	3
3.	CS6110	Advanced Graph Machine Learning	3	0	0	3
4.	CS6111	Advanced Time Series Analysis	3	0	0	3

(3.) B. Tech. – M. Tech. Dual Degree Programme from the Department of Electrical Engineering

(i) B. Tech. [Electrical and Electronics Engineering (EEE)] - M. Tech. [Power and Control System]

Program Learning Objectives: (i) Specialized training in the field of Power and Control system. (ii) Develop an orientation towards industrial training on specialized field. (iii) Imparting world class training to develop the foundation for making world class researcher in this field of research. (iv) Work collaboratively in multidisciplinary teams, demonstrating effective teamwork and communication to solve complex engineering problems. (v) Recognize the importance of ongoing professional development, engaging in activities such as certifications, workshops, and conferences to stay updated of industry trends.	**Program Learning Outcomes:** The graduates of this program will have ● strong fundamentals in Power and Control system engineering. ● ability to analyze and synthesize engineering problems including design and conduct experiments, use standard test equipment and interpret experimental data. ● ability to design prototypes for real world problems. ● ability to work in a multidisciplinary team environment. ● ability to appreciate the complexities of professional environments, including taking responsibility for oneself, working effectively and professionally as a team member, and being mindful of ethical, economic, and contemporary concerns. ● ability to continue learning in Power and Control system field. ● ability to independently accomplish engineering tasks related to Power and Control research areas. ● ability to enter industry with the engineering techniques, skills, and tools required to be able to solve real-world problems in Power and Control system engineering.
Program Goal 1: Academic excellence by providing a curriculum that aligns with industry standards and encourages critical thinking in Power and Control system engineering**.**	**Program Learning Outcome 1a:** Highly skilled market ready manpower to serve the emerging electrical and electronic sectors **Program Learning Outcome 1b:** Skilled Human resource to cater the needs of next generation power systems and EV technologies.
Program Goal 2: A culture of research and innovation by promoting faculty and student involvement in innovative projects in Power and Control system technologies.	**Program Learning Outcome 2a:** Trained researchers for implementing research projects in line with national priorities such as Energy, EVs, Smart Grids, Green Technologies. **Program Learning Outcome 2b:** Design and develop innovative smart technologies/products in energy and EVs as per the societal need
Program Goal 3: To design dynamic and flexible course structures for UG and PG programs as per the changing requirement of the industries	**Program Learning Outcome 3a:** Industry relevant UG, PG, and research programs **Program Learning Outcome 3b:** Trained manpower as per the industry requirement.

Program Goal 4: To promote entrepreneurship among the students in the field of Power and Control system engineering	**Program Learning Outcome 4a:** Realization of working prototype towards product development **Program Learning Outcome 4b:** Promotion of in-house technology-based ventures catering societal needs.

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	EE41XX	B. Tech. Elective – I	3	0	0	3
2.	EE41XX	B. Tech. Elective – II	3	0	0	3
3.	HS41XX	HSS Elective - II	3	0	0	3
4.	XX41PQ	IDE - III	3	0	0	3
5.	EE4196	Summer Internship*	0	0	12	3
6.	EE4197	Project – I	0	0	12	6
7.	EE5101	Computer Aided Power System Analysis	3	0	2	4
TOTAL			**15**	**0**	**26**	**25**

***Note :**

For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	EE5201	Power System Dynamics, Control and Protection	3	0	2	4
2.	EE5202	Nonlinear Dynamical Systems	3	0	2	4
3.	XX52PQ/ XX62PQ	M. Tech. Elective – I	3	0	0	3
4.	EE4297	Project – II	0	0	12	6
5.	RM6201	Research Methodology	3	1	0	4
TOTAL			**12**	**1**	**16**	**21**

Sl. No.	Subject Code	SEMESTER IX	L	T	P	C
1.	XX52PQ/ XX62PQ	M. Tech. Elective – II	3	0	0	3
2.	XX52PQ/ XX62PQ	M. Tech. Elective – III	3	0	0	3
3.	XX52PQ/ XX62PQ	M. Tech. Elective – IV	3	0	0	3
4.	EE5197	Project – III**	0	0	16	8
TOTAL			**9**	**0**	**16**	**17**

Sl. No.	Subject Code	SEMESTER X	L	T	P	C
1.	EE5297	Project IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Grand TOTAL (Semester I to X) - 209

ELECTIVE GROUPS

B. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE4101	Electrical Traction and Propulsion	3	0	0	3
2.	EC4102	Deep Learning for Video Surveillance Systems	3	0	0	3
3.	EC4103	FPGA based System Design	3	0	0	3

B. Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC4101	Introduction to Quantum Computing	3	0	0	3
2.	EE4102	Power System Reliability	3	0	0	3
3.	EC4105	Digital Image Processing	3	0	0	3

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE6202	HVDC Transmission Systems	3	0	0	3
2.	EC6210	Advance FPGA Platform and System	3	0	0	3
3.	EE6212	Power System Optimization	3	0	0	3
4.	EE6213	Advance Electric Drives	3	0	0	3
5.	EE6214	Random Signals and Systems	3	0	0	3
6.	EE6215	Quantitative Feedback Theory	3	0	0	3
7.	EE6218	Optimal Control	3	0	0	3

M. Tech. Elective – II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5104	Renewable Energy Integration	3	0	0	3
2.	EE6101	Advanced Power System Reliability	3	0	0	3
3.	EE6102	Advanced State Estimation and Target Tracking	3	0	0	3
4.	EE6103	Multivariable Control System	3	0	0	3
5.	EC6105	CMOS Phase Locked Loops	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5105	Power System Deregulation	3	0	0	3
2.	EE6104	Advanced Power System Protection	3	0	0	3
3.	EE6105	Switched Mode Power Converters	3	0	0	3
4.	EE6106	Advanced Digital Control System	3	0	0	3
5.	EC5111	VLSI Architecture Design and Implementation	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5106	Energy Storage Systems	3	0	0	3
2.	EE6108	V2G and G2V Technology	3	0	0	3
3.	EC6108	Emerging Technologies for Beyond 5G	3	0	0	3

(ii) B. Tech. [Electronics and Communication Engineering (ECE)] – M. Tech. [Communication System and Signal Processing (CSSP)]

Program Learning Objectives:	**Program Learning Outcomes:**
1. Develop a solid foundation in electronics and communication engineering principles, including circuit analysis, electronic devices, signal processing, microprocessor/microcontroller systems, analog communication systems, digital communication, and RF circuits etc. 2. Develop electronics and communication project management skills, including the ability to plan, execute, and complete within specified timelines and budgets. 3. Work collaboratively in multidisciplinary teams, demonstrating effective teamwork and communication to solve complex engineering problems. 4. Recognize the importance of ongoing professional development, engaging in activities such as certifications, workshops, and conferences to stay updated of industry trends.	The graduates of this program will have 1. a successful career in an Academia/Industry/ Entrepreneur. 2. strong fundamentals in electronics and communications engineering. 3. ability to design prototypes for real world problems related to electronics, communications and interdisciplinary fields. 4. ability to develop soft skills such as effective communications in both verbal and written forms, body language, time management, problem-solving, leadership, work in both team as well as individual in a professional manner.
Program Goal 1: Academic excellence by providing a curriculum that aligns with industry standards and encourages critical thinking in the field of electronics and communication engineering.	**Program Learning Outcome 1a:** Highly skilled market ready man power to serve the emerging electronic sectors **Program Learning Outcome 1b:** Skilled Human resource to cater the needs of next generation communication sectors
Program Goal 2: A culture of research and innovation by promoting faculty and student involvement in cutting-edge projects in electronic and communication technologies.	**Program Learning Outcome 2a:** Trained researchers for implementing research projects in line with national priorities such as CPS, Semiconductors, Clean Energy, Green Technologies **Program Learning Outcome 2b:** Design and develop innovative smart electronics products as per the societal need.
Program Goal 3: To design dynamic and flexible course structures for UG and PG programs as per the changing requirement of the industries	**Program Learning Outcome 3a:** Industry relevant UG, PG, and research programs **Program Learning Outcome 3b:** Trained manpower as per the industry requirement
Program Goal 4: To promote entrepreneurship among the students in the field of electronics and communication engineering	**Program Learning Outcome 4a:** Realization of working prototype towards product development **Program Learning Outcome 4b:** Promotion of in house technology based ventures catering societal needs

Program Goal 5: Equip students with strong communication skills, enabling them to articulate technical concepts clearly and effectively in both written and oral forms.	**Program Learning Outcome 5a:** Man power with enhanced soft skills to support the vision of developed India **Program Learning Outcome 5b:** Responsible citizen for the holistic growth of the country
Program Goal 6: To equip students with technical skills necessary for the design, analysis, and implementation of communication system technologies and networks.	**Program Learning Outcome 6a:** Demonstrate proficiency in one or more specialized areas within communication system engineering, such as wireless communication, optical communication, microwave and millimeter wave technologies, digital signal processing, or network engineering. **Program Learning Outcome 6b:** Demonstrate advanced knowledge and understanding of communication engineering principles, theories, and concepts.
Program Goal 7: To foster research and development skills, enabling students to contribute to the advancement of communication technologies through innovation and problem-solving.	**Program Learning Outcome 7:** Conduct independent research, including literature review, experimentation, data analysis, and interpretation, to address communication engineering challenges and contribute to knowledge advancement in the field.
Program Goal 8: To prepare students for professional practice in communication engineering roles in industry, academia, research institutions, or government agencies.	**Program Learning Outcome 8:** Design, simulate, and implement communication systems and networks using appropriate tools, techniques, and methodologies.

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	EC41XX	B. Tech. Elective - I	3	0	0	3
2.	EC41XX	B. Tech. Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41PQ	HSS Elective - II	3	0	0	3
5.	EC4196	Summer Internship*	0	0	12	3
6.	EC4197	Project – I	0	0	12	6
7.	EC5101	Information Theory and Coding	3	1	0	4
TOTAL			**15**	**1**	**24**	**25**

***Note :**

For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	RM6201	Research Methodology	3	1	0	4
2.	EC5201	Wireless Communication	3	0	2	4
3.	EC5202	Advanced Communication Systems	3	0	2	4
4.	XX52PQ/ XX62PQ	M. Tech. Elective - I	3	0	0	3
5.	EC4297	Project - II	0	0	12	6
TOTAL			**12**	**1**	**16**	**21**

Sl. No.	Subject Code	SEMESTER IX	L	T	P	C
1.	XX52PQ/ XX62PQ	M. Tech. Elective - II	3	0	0	3
2.	XX52PQ/ XX62PQ	M Tech Elective - III	3	0	0	3
3.	XX52PQ/ XX62PQ	M Tech Elective - IV	3	0	0	3
4.	EC5197	Project III**	0	0	16	8
TOTAL			**9**	**0**	**8**	**17**

Sl. No.	Subject Code	SEMESTER X	L	T	P	C
1.	EC5297	Project IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host

institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

Grand Total (Semester I to X) : 210

ELECTIVE GROUPS

B. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC4101	Introduction to Quantum Computing	3	0	0	3
2.	EC4102	Deep Learning for Video Surveillance Systems	3	0	0	3
3.	EC4103	FPGA based System Design	3	0	0	3

B. Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC4104	Introduction to Information Theory	3	0	0	3
2.	EC4105	Digital Image Processing	3	0	0	3
3.	EC4106	Graph Signal Processing	3	0	0	3

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5205	Patterns Recognition and Machine Learning	3	0	0	3
2.	EC5206	Multimedia Communication	3	0	0	3
3.	EC5207	Optical Communication	3	0	0	3
4.	EC5209	Communication Networks	3	0	0	3

5.	EC5210	Advanced Biomedical Signal Processing	3	0	0	3
6.	EC5211	Silicon Photonics	3	0	0	3
7.	EC6201	RF and Microwave Measurement Techniques	3	0	0	3
8.	EC6202	Smart Antenna: From Theory to Practice	3	0	0	3
9.	EC6203	Adaptive filtering: From theory to practice	3	0	0	3
10.	EC6204	Antenna Design and Characterization	3	0	0	3
11.	EC6205	Statistical Signal Processing	3	0	0	3
12.	EC6206	Optimization Theory and Techniques for Electrical Engineering	3	0	0	3
13.	EC6207	Microwave and Millimetre Wave Integrated Circuits (MMIC)	3	0	0	3
14.	EC6208	Generative AI for Video Surveillance System	3	0	0	3
15.	EE6214	Random Signals and Systems	3	0	0	3

M. Tech. Elective – II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5107	RF and Microwave Active Circuits	3	0	0	3
2.	EC5108	Internet of Things (IoT) Networks	3	0	0	3
3.	EC5109	Radio Frequency Integrated Circuits	3	0	0	3
4.	EC6101	Advance Antenna and Microwave Devices	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5111	VLSI Architecture Design and Implementation	3	0	0	3
2.	EC5118	Bio Sensors and Circuits	3	0	0	3
3.	EC5119	Quantum Computing	3	0	0	3
4.	EC6103	Radio Frequency Design and Technology	3	0	0	3
5.	EC6104	VLSI Signal Processing	3	0	0	3
6.	EC6106	Computer Vision	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EE5106	Energy Storage Systems	3	0	0	3
2.	EE6108	V2G and G2V Technology	3	0	0	3
3.	EC6108	Emerging Technologies for Beyond 5G	3	0	0	3

(iii) B. Tech. [Electronics and Communication Engineering (ECE)] - M. Tech. [VLSI and Embedded Systems]

Program Learning Objectives:	**Program Learning Outcomes:**
1. Develop a solid foundation in electronics and communication engineering principles, including circuit analysis, electronic devices, signal processing, microprocessor/ microcontroller systems, analog communication systems, digital communication, and RF circuits etc. 2. Develop electronics and communication project management skills, including the ability to plan, execute, and complete within specified timelines and budgets. 3. Work collaboratively in multidisciplinary teams, demonstrating effective teamwork and communication to solve complex engineering problems. 4. Recognize the importance of ongoing professional development, engaging in activities such as certifications, workshops, and conferences to stay updated of industry trends.	The graduates of this program will have 1. a successful career in an Academia/Industry/Entrepreneur. 2. strong fundamentals in electronics and communications engineering. 3. ability to design prototypes for real world problems related to electronics, communications and interdisciplinary fields. 4. ability to develop soft skills such as effective communications in both verbal and written forms, body language, time management, problem-solving, leadership, work in both team as well as individual in a professional manner.
Program Goal 1: Academic excellence by providing a curriculum that aligns with industry standards and encourages critical thinking in the field of electronics and communication engineering.	**Program Learning Outcome 1a:** Highly skilled market ready man power to serve the emerging electronic sectors **Program Learning Outcome 1b:** Skilled Human resource to cater the needs of next generation communication sectors
Program Goal 2: A culture of research and innovation by promoting faculty and student involvement in cutting-edge projects in electronic and communication technologies.	**Program Learning Outcome 2a:** Trained researchers for implementing research projects in line with national priorities such as CPS, Semiconductors, Clean Energy, Green Technologies **Program Learning Outcome 2b:** Design and develop innovative smart electronics products as per the societal need
Program Goal 3: To design dynamic and flexible course structures for UG and PG programs as per the changing requirement of the industries	**Program Learning Outcome 3a:** Industry relevant UG, PG, and research programs **Program Learning Outcome 3b:** Trained manpower as per the industry requirement
Program Goal 4: To promote entrepreneurship among the students in the field of electronics and communication engineering	**Program Learning Outcome 4a:** Realization of working prototype towards product development **Program Learning Outcome 4b:** Promotion of in-house technology-based ventures catering societal needs

Program Goal 5: Equip students with strong communication skills, enabling them to articulate technical concepts clearly and effectively in both written and oral forms.	**Program Learning Outcome 5a:** Man power with enhanced soft skills to support the vision of developed India **Program Learning Outcome 5b:** Responsible citizen for the holistic growth of the country
Program Goal 6: Identify, formulate and solve engineering problems in the field of Embedded system and VLSI	**Program Learning Outcome 6a:** Graduates will be able to take up career in the field of design, testing and implementation of VLSI systems in any said domain in the real world. **Program Learning Outcome 6b:** Identify and apply appropriate Electronic Design Automation (EDA) tools to solve real world problems in VLSI and Embedded Systems domain to create innovative products and systems.
Program Goal 7: Apply knowledge, proper methodology and modern tools to analyze and solve the problems in the domain VLSI Design and Technology.	**Program Learning Outcome 7a:** Acquire in-depth knowledge of VLSI and Embedded systems in wider and global perspective, with an ability to discriminate, evaluate, analyze, synthesize and integrate for enhancement of knowledge. **Program Learning Outcome 7b:** Get exposure in domain from modern semiconductor devices to circuits and systems to address the issues and challenges in Chip Design and fabrication to meet the requirement of today's hardware systems for real time applications.
Program Goal 8: Acquire competency in areas of VLSI and Embedded Systems, IC Fabrication, Design, Testing, Verification and prototype development focusing on applications.	**Program Learning Outcome 8a:** Pursue career in research in VLSI Design and Embedded Systems domain through self-learning and self-directed on cutting edge technologies **Program Learning Outcome 8b:** Graduates will be able to achieve broad and in-depth knowledge of analysis and design of micro-electronic components which will support them to pursue research studies.
Program Goal 9: Acquire professional and intellectual integrity and ethics of research and recognize the need to engage in learning with a high level of enthusiasm and commitment to contribute to the community for sustainable development of society.	**Program Learning Outcome 9a:** Graduates will be able to asses, innovate, implement and serve the end users problems with cutting edge solutions to meet industry standards **Program Learning Outcome 9b:** Graduates will be able to work both as an individual and a team on multidisciplinary projects and excel in their career

SEMESTER VII

Sl. No.	Subject Code	Subject Name	L	T	P	C
1.	EC41PQ	B. Tech. Elective - I	3	0	0	3

2.	EC41PQ	B. Tech. Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41PQ	HSS Elective - II	3	0	0	3
5.	EC4194	Summer Internship*	0	0	6	3
6.	EC4195	Project – I	0	0	12	6
7.	EC5104	Digital VLSI System	3	0	2	4
TOTAL			**15**	**0**	**20**	**25**

*** For specific cases of internship after 6th Semester, extended over to 7th Semester:**

Note :

a) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between semester 6 and 7 that may be done in industry/R & D /Academic institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

b) (i) In the 7th semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b)(ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and/or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b)(iii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

SEMESTER VIII						
Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	RM6201	Research Methodology	3	1	0	4
2.	EC5203	Analog and Mixed Signal Integrated Circuits	3	0	2	4
3.	EC5204	High Performance Embedded Computing system	3	0	2	4
4.	EC52PQ	M. Tech. Elective - I	3	0	0	3
5.	EC4295	Project – II	0	0	12	6
TOTAL			**12**	**1**	**16**	**21**

SEMESTER IX						
Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	EC51PQ/ EC61PQ	M. Tech. Elective – II	3	0	0	3
2.	XX51PQ/ XX61PQ	M. Tech. Elective – III	3	0	0	3
3.	EC51PQ/ EC61PQ	M. Tech. Elective - IV	3	0	0	3
4.	EC5195	Project – III	0	0	16	8

TOTAL	**9**	**0**	**16**	**17**

SEMESTER X						
Sl. No.	**Subject Code**	**Subject Name**	**L**	**T**	**P**	**C**
1.	EC5295	Project – IV**	0	0	36	18
TOTAL			**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

GRAND TOTAL (Semester I to X) : 210

ELECTIVE GROUPS

B. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC4101	Introduction to Quantum Computing	3	0	0	3
2.	EC4102	Deep Learning for Video Surveillance Systems	3	0	0	3
3.	EC4103	FPGA based System Design	3	0	0	3

B. Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC4104	Introduction to Information Theory	3	0	0	3
2.	EC4105	Digital Image Processing	3	0	0	3
3.	EC4106	Graph Signal Processing	3	0	0	3

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5205	Patterns Recognition and Machine Learning	3	0	0	3
2.	EC5206	Multimedia Communication	3	0	0	3
3.	EC5214	VLSI Technology	3	0	0	3
4.	EC5215	Sensors and Actuators	3	0	0	3
5.	EC5216	Low Power VLSI	3	0	0	3
6.	EC5217	CAD VLSI	3	0	0	3
7.	EC5218	Silicon Photonics	3	0	0	3
8.	EC5219	Embedded System Integration	3	0	0	3
9.	EC5220	High Power Semiconductor Devices	3	0	0	3
10.	EE5203	Recent Trends in Optimization Techniques	3	0	0	3

M. Tech. Elective – II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5108	Internet of Things (IoT) Networks	3	0	0	3
2.	EC5111	VLSI Architecture Design and Implementation	3	0	0	3
3.	EC5114	Opto-Electronics Materials and Devices	3	0	0	3
4.	EC5115	Radio Frequency Integrated Circuits	3	0	0	3
5.	EC5116	Advanced Digital Image Processing	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC5117	VLSI Testing and Verification	3	0	0	3
2.	EC5118	Bio Sensors and Circuits	3	0	0	3
3.	EC5119	Quantum Computing	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	EC6105	CMOS Phase Locked Loops	3	0	0	3
2.	EC6106	Computer Vision	3	0	0	3
3.	EC6104	VLSI Signal Processing	3	0	0	3

(4.) B. Tech. – M. Tech. Dual Degree Programme from the Department of Mechanical Engineering

(i) B. Tech. (Mechanical Engineering) - M. Tech. (Mechatronics)

Program Learning Objectives:	Program Learning Outcomes:
• Develop a comprehensive understanding of fundamental principles and advanced concepts in both mechanical engineering and mechatronics disciplines. • Acquire proficiency in applying theoretical knowledge to design, analyze, and optimize mechanical and mechatronic systems and components. • Cultivate practical skills in utilizing modern tools, techniques, and software for modeling, simulation, and prototyping of complex mechanical and mechatronic systems. • Foster interdisciplinary problem-solving abilities to address real-world challenges at the intersection of mechanical engineering and mechatronics. • Encourage innovation and creativity in the design and development of novel mechanical and mechatronic solutions to meet evolving industry and societal needs.	**1. Comprehensive Understanding:** • Students will demonstrate a deep understanding of foundational principles and advanced concepts in mechanical engineering and mechatronics, including mechanics, dynamics, control systems, electronics, and robotics. **2. Application of Knowledge:** • Students will be able to apply theoretical knowledge to design, analyze, and optimize mechanical and mechatronic systems and components, demonstrating proficiency in problem-solving and critical thinking. **3. Practical Skills:** • Students will develop practical skills in using modern tools, techniques, and software for modeling, simulation, and prototyping of complex mechanical and mechatronic systems, effectively translating theoretical concepts into tangible solutions. **4. Interdisciplinary Problem-Solving:** • Students will demonstrate the ability to tackle interdisciplinary challenges by integrating knowledge and techniques from mechanical engineering and mechatronics to develop innovative solutions that address real-world problems. **5. Innovation and Creativity:** • Students will exhibit creativity and innovation in the design and development of novel mechanical and mechatronic solutions, showcasing originality and adaptability in addressing evolving industry and societal needs.

Sl. No.	Subject Code	SEMESTER VII	L	T	P	C
1.	ME41XX	B.Tech. Elective - I	3	0	0	3
2.	ME41XX	B.Tech. Elective - II	3	0	0	3
3.	XX41PQ	IDE - III	3	0	0	3
4.	HS41PQ	HSS Elective - II	3	0	0	3
5.	ME4198	Summer Internship*	0	0	12	3
6.	MH4199	Mechatronics Project-I	0	0	12	6
7.	MH5101	Fundamentals of Mechatronics	3	0	0	3
8.	EC5105	Embedded System	3	0	2	4
TOTAL			**18**	**0**	**26**	**28**

***Note :**

For specific cases of internship after VIth Semester, the performance evaluation would be made on joining the VIIth Semester and graded accordingly in the VIIth Semester:

Note :

a) (i) Summer internship (*) period of at least 60 days' (8 weeks) duration begins in the intervening vacation between Semester VI and VII that may be done in industry / R&D / Academic Institutions including IIT Patna. The evaluation would comprise **combined grading based on host supervisor evaluation, project internship report after plagiarism check and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the three components stated herein.

a) (ii) Further, on return from internship, students will be evaluated for internship work through combined grading based on host supervisor evaluation, project internship report after plagiarism check, and presentation evaluation by the parent department with equal weightage of each component.

b) (i) In the VIIth semester, students can opt for a semester long internship on recommendation of the DAPC and approval of the Competent Authority.

b) (ii) On approval of semester long internship, at the maximum two courses (properly mapped/aligned syllabus) at par with institute electives may be opted from NPTEL and / or SWAYAM and the other two more should be done at the institute through course overloading in any other semester (either before or after the internship) and/or during following summer semester.

b) (iii) The candidates opting two courses from NPTEL and / or SWAYAM would be required to appear in the examination at the Institute as scheduled in the Academic Calendar.

Sl. No.	Subject Code	SEMESTER VIII	L	T	P	C
1.	RM6201	Research Methodology	3	1	0	4
2.	MH5201	Sensors and Actuators	3	0	0	3
3.	MH5202	Modeling and Simulation of Mechatronics Systems	3	0	0	3
4.	XX62PQ	M. Tech. Elective – I	3	0	0	3
5.	MH4299	Project-II	0	0	12	6
		TOTAL	**12**	**1**	**12**	**19**

Sl. No.	Subject Code	SEMESTER IX	L	T	P	C
1.	ME51XX/ ME61XX	M. Tech. Elective - II	3	0	0	3
2.	ME51XX/ ME61XX	M. Tech. Elective - III	3	0	0	3
3.	ME51XX/ EC51XX	M. Tech. Elective - IV	3	0	0	3
4.	MH5199	Mechatronics Project-III**	0	0	16	8
	TOTAL		**9**	**0**	**16**	**17**

Sl. No.	Subject Code	SEMESTER X	L	T	P	C
1.	MH5299	Mechatronics Project-IV**	0	0	36	18
	TOTAL		**0**	**0**	**36**	**18**

****Note: M. Tech. Project outside the Institute**

In the IXth Semester, students can opt for a semester long M. Tech. project subject to confirmation from an Institution of repute for research project, on the assigned topic at any external Institution (Industry / R&D lab / Academic Institutions) based on recommendation of the DAPC provided:

(i.) The project topic is well defined in objective, methodology and expected outcome through an abstract and statement of the student pertaining to expertise with the proposed supervisor of the host institution and consent of the faculty member from the concerned department at IIT Patna as joint supervisor.

(ii.) The consent of both the supervisors (external and institutional) on project topic is obtained a priori and forwarded to the academic section through DAPC for approval by the competent authority for office record in the personal file of the candidate.

(iii.) Confidentiality and Non Disclosure Agreement (NDA) between the two organizations with clarity on intellectual property rights (IPR) must be executed prior to initiating the semester long project assignment and committing the same to external organization and vice versa.

(iv.) The evaluation in each semester at Institute would be mandatory and the report from Industry Supervisor will be given due weightage as defined in the Academic Regulation. Further, the final assessment of the project work on completion will be done with equal weightage for assessment of the host and Institute supervisors, project report after **plagiarism check.** The award of grade would comprise **combined assessment based on host supervisor evaluation, project report quality and seminar presentation at the Department (DAPC to coordinate)** with equal weightage of each of the components stated herein.

(v.) In case of poor progress of work and / or no contribution from external supervisor, the student need to revert back to the Institute essentially to fulfill the completion of M. Tech. project as envisaged at the time of project allotment. However, the recommendation of DAPC based on progress report and presentation would be mandatory for a final decision by the competent authority.

GRAND TOTAL (Semester I to X) : 210

ELECTIVE GROUPS

B. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME4101	Tribology and Surface Engineering	3	0	0	3
2.	ME4102	Basics of Computational Fluid Dynamics	3	0	0	3
3.	ME4104	Industrial Automation	3	0	0	3

B. Tech. Elective - II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME4104	Vehicle Dynamics	3	0	0	3
2.	ME4105	Mathematical Modelling of Computer Aided Design	3	0	0	3
3.	ME4106	Energy Engineering	3	0	0	3

M. Tech. Elective - I						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6208	Robot Motion Planning	3	0	0	3
2.	ME6209	Non-linear Systems Dynamics	3	0	0	3
3.	ME6215	Computer Numerical Controlled Machine Tools	3	0	0	3

M. Tech. Elective – II						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6105	Acoustics	3	0	0	3
2.	ME6106	Mobile Robotics	3	0	0	3
3.	ME6107	Digital Manufacturing and Industry 4.0	3	0	0	3

M. Tech. Elective - III						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	ME6103	Continuum Mechanics	3	0	0	3
2.	ME6109	Vehicle Dynamics and Multi-body Systems	3	0	0	3

M. Tech. Elective - IV						
Sl. No.	**Subject Code**	**Subject**	**L**	**T**	**P**	**C**
1.	~~EC5114~~ EC5116	Advanced Digital Image Processing	3	0	0	3
2.	EC6104	VLSI Signal Processing	3	0	0	3

List of PhD Courses with its credit structure detail for Academic Departments

(i) Department of Chemistry:

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	CH7101/CH7201	Sustainable Chemistry	3	1	0	4
2.	CH7102/CH7202	Solid State Chemistry	3	1	0	4
3.	CH7103/CH7203	Nanotechnology for Biomedical Applications	3	1	0	4
4.	CH7104/CH7204	Bioanalytical Techniques	3	1	0	4
5.	CH7105/CH7205	Advanced Medicinal Chemistry	3	1	0	4
6.	CH7106/CH7206	Organic and Organometallic Catalysis	3	1	0	4
7.	CH7107/CH7207	Advanced Optical Spectroscopy	3	1	0	4
8.	CH7108/CH7208	Chemistry of Heterocycles	3	1	0	4
9.	CH7109/CH7209	Syntheses and Applications of Industrial Polymers	3	1	0	4
10.	CH7110/CH7210	Chemistry and Applications of Nanostructured Materials	3	1	0	4
11.	CH7111/CH7211	Art in Organic Synthesis	3	1	0	4
12.	CH7112/CH7212	Spectroscopic Techniques in Chemistry	3	1	0	4
13.	CH7113/CH7213	Supramolecular Chemistry	3	1	0	4
14.	CH7114/CH7214	Reagents for Organic Synthesis	3	1	0	4
15.	CH7115/CH7215	Introduction to Computational Chemistry	3	0	2	4
16.	CH7116/CH7216	Application of Glycochemistry in Modern Technology	3	1	0	4

(ii) Department of Mathematics

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	MA7101/ MA7201	Advanced Optimization Techniques	3	0	0	3
2.	MA7102/ MA7202	Algebra	3	0	0	3
3.	MA7103/ MA7203	An Introduction to Computational Commutative Algebra	3	0	0	3
4.	MA7104/ MA7204	Analysis I	3	0	0	3
5.	MA7105/ MA7205	Analysis-II	3	0	0	3
6.	MA7106/ MA7206	Differential Equations	3	0	0	3
7.	MA7107/ MA7207	Mathematical Control Theory	3	0	0	3
8.	MA7108/ MA7208	Probability Theory and Statistical Inference	3	0	0	3
9.	MA7109/ MA7209	Topology	3	0	0	3

(iii) Department of Physics

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	PH7101/PH7201	Mathematical Physics and Numerical Methods	3	0	0	3
2.	PH7102/PH7202	Classical Mechanics and Electrodynamics	3	0	0	3
3.	PH7103/PH7203	Quantum Mechanics and Statistical Mechanics	3	0	0	3
4.	PH7104/PH7204	Experimental Techniques and Scientific Presentation	3	0	0	3
5.	PH7105/PH7205	Fourier Optics	3	0	0	3
6.	PH7106/PH7206	Advanced Course On Semiconductor Devices	3	0	0	3
7.	PH7107/PH7207	Magnetism And Superconductivity	3	0	0	3
8.	PH7108/PH7208	Physics Of Materials	3	0	0	3
9.	PH7109/PH7209	Introduction To The Physics Of Nonlinear Systems	3	0	0	3
10.	PH7110/PH7210	Theory And Applications Of Holography	3	0	0	3
11.	PH7111/PH7211	Photonics Science and Engineering	3	0	0	3
12.	PH6104/PH6204	General Relativity and Cosmology	2	2	0	4
13.	PH6105/PH6205	Quantum Optics & Quantum Information	2	2	0	4
14.	PH6109/PH6209	Ultrafast Optics and Spectroscopy	2	2	0	4
15.	PH6110/PH6210	Magnetism: Fundamentals to Application	2	2	0	4
16.	PH6112/PH6212	Materials for Engineering Applications	2	2	0	4
17.	PH6114/PH6214	Physics of Ultracold Atoms	2	2	0	4
18.	PH6115/PH6215	Scanning Probe Microscopy	2	2	0	4
19.	PH6116/PH6216	Biophotonics	2	2	0	4
20.	PH6117/PH6217	Magnetic Materials and Applications	2	2	0	4
21.	PH6118/PH6218	Fourier Optics and Holography	2	2	0	4
22.	PH6120/PH6220	Particle Physics	2	2	0	4
23.	PH6121/PH6221	Soft Matter Physics	2	2	0	4
24.	PH6122/PH6222	Quantum Materials	2	2	0	4
25.	PH6123/PH6223	Low Temperature Techniques	2	1	2	4
26.	PH6124/PH6224	Nanoscience and Nanocharecterization	2	2	0	4
27.	PH6125/PH6225	Quantum Transport in Mesoscopic Systems	2	2	0	4
28.	PH6126/PH6226	Introductory Biophysics	2	2	0	4
29.	PH6127/PH6227	Spintronics	2	2	0	4
30.	PH6128/PH6228	Advanced Computational Physics	2	1	2	4
31.	PH6129/PH6229	Advanced Quantum Theory of Collisions	2	2	0	4
32.	PH6130/PH6230	Condensed Matter Physics-II	3	1	0	4

*An upgraded version of M. Sc. 5 level electives for PhD students may be offered in the following way. The instructor taking such a 5-level course allows PhD students to attend lectures and tutorials and do the homework assignments (for evaluation) of the 5-level course. At the same time, PhD students are given additional lectures/content/assignment/miniproject and are evaluated. As such these courses for PhD students are advanced and may be given 6 level course number with an additional 1 credit with reference to corresponding 5-level course.

(iv) Department of CEE

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	CE6133/ CE6233	Advanced Engineering Behavior of Rocks	3	0	0	3
2.	CE6134/ CE6234	Advanced Geotechnical Exploration	3	0	0	3
3.	CE6135/ CE6235	Advanced Rock Engineering	3	0	0	3
4.	CE6136/ CE6236	Advanced Soil Mechanics Theory	3	0	0	3
5.	CE6137/ CE6237	Advanced Landslides and Avalanches	3	0	0	3
6.	CE6138/ CE6238	Advanced Analysis and Design of Underground Structures	3	0	0	3
7.	CE6139/ CE6239	Advanced Computational Geomechanics	3	0	0	3
8.	CE6140/ CE6240	Advanced Foundation Engineering Theory	3	0	0	3
9.	CE6141/ CE6241	Advanced Soil Behaviour	3	0	0	3

(v) Department of MME

Sl. No.	Subject Code	Course Name	L	T	P	C
1.	MM7101/MM7201	Rubber Science and Technology	3	0	0	3
2.	MM7102/MM7202	Flash Sintering of Ceramics	3	0	0	3
3.	MM7103/MM7203	Advanced Topics in Ceramic Processing	3	0	0	3

(vi) Department of HSS

List of PhD Electives						
Sl. No.	**Course Code**	**Course Name**	**L**	**T**	**P**	**C**
1.	HS7101	Representation of Gender in Literature	3	0	0	3
2.	HS7102	Organizational Behaviour	3	0	0	3
3.	HS7103	Population and Public Health	3	0	0	3
4.	HS7104	Literary Representation of the Post-Colonial Nation	3	0	0	3
5.	HS7105	Theories of Knowing in Contemporary Society	3	0	0	3
6.	HS7106	Econometrics	3	0	0	3
7.	HS7107	Growth, Development and Public Policy	3	0	0	3
8.	HS7201	ELT Methodology: Theory and Practice	3	0	0	3
9.	HS7202	Gender, Women and Society	3	0	0	3
10.	HS7203	Modern Short Fiction in English	3	0	0	3
11.	HS7204	Sourcing & Managing Talent	3	0	0	3
12.	HS7205	Trends in Applied Linguistics	3	0	0	3
13.	HS7206	Social Research Design and Practice	3	0	0	3
14.	HS7207	Sociology of Education	3	0	0	3
15.	HS7208	Globalization and Trade	3	0	0	3
16.	HS7209	Research Methodology	3	0	0	3
17.	HS7211	Technical Communication	2	2	0	4