Dr. Babasaheb Ambedkar Technological University
(EstablishedasUniversityofTechnologyintheStateofMaharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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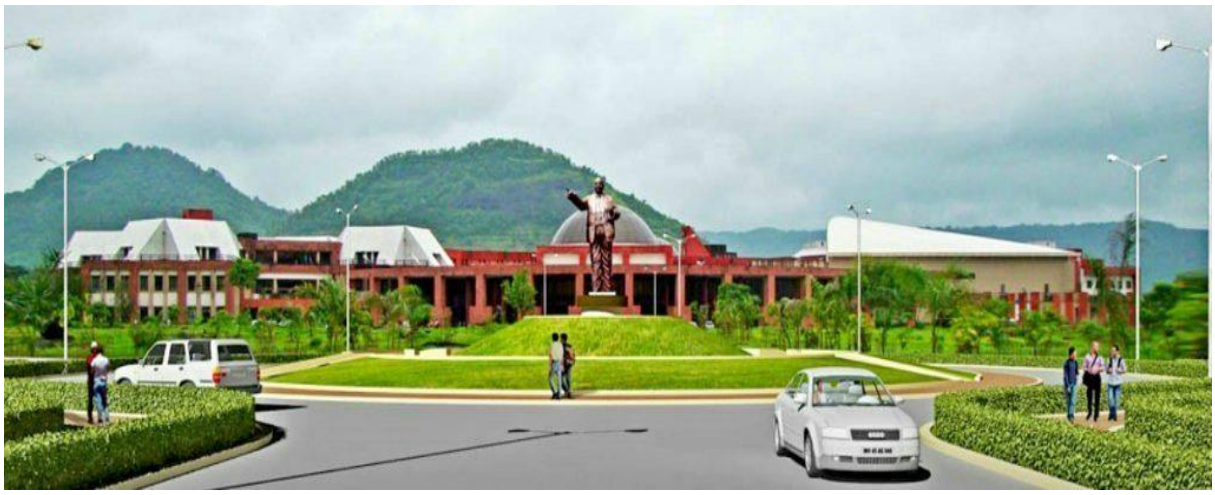
PROPOSED CURRICULUM

UNDER GRADUATE PROGRAMME

B. TECH.

MECHATRONICS ENGINEERING

WITH EFFECT FROM THE ACADEMIC YEAR
2021-2022



Vision

The vision of the department is to achieve excellence in teaching, learning, research and transfer of technology and overall development of students.

Mission

Imparting quality education, looking after holistic development of students and conducting need based research and extension.

Graduate Attributes

The Graduate Attributes are the knowledge skills and attitudes which the students have at the time of graduation. These Graduate Attributes identified by National Board of Accreditation are as follows:

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences.
3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Educational Objectives

PEO1	Graduates should excel in engineering positions in industry and other organizations that emphasize design and implementation of engineering systems and devices.
PEO2	Graduates should excel in best post-graduate engineering institutes, reaching advanced degrees in engineering and related discipline.
PEO3	Within several years from graduation, alumni should have established a successful career in an engineering-related multidisciplinary field, leading or participating effectively in interdisciplinary engineering projects, as well as continuously adapting to changing technologies.
PEO4	Graduates are expected to continue personal development through professional study and self-learning.
PEO5	Graduates are expected to be good citizens and cultured human beings, with full appreciation of the importance of professional, ethical and societal responsibilities.

Program Outcomes

At the end of the program the student will be able to:

PO1	Apply knowledge of mathematics, science and engineering to analyze, design and evaluate mechanical components and systems using state-of-the-art IT tools.
PO2	Analyze problems of production engineering including manufacturing and industrial systems to formulate design requirements.
PO3	Design, implement and evaluate production systems and processes considering public health, safety, cultural, societal and environmental issues.
PO4	Design and conduct experiments using domain knowledge and analyze data to arrive at valid conclusions.
PO5	Apply current techniques, skills, knowledge and computer based methods and tools to develop production systems.
PO6	Analyze the local and global impact of modern technologies on individual organizations, society and culture.
PO7	Apply knowledge of contemporary issues to investigate and solve problems with a concern for sustainability and eco-friendly environment.
PO8	Exhibit responsibility in professional, ethical, legal, security and social issues.
PO9	Function effectively in teams, in diverse and multidisciplinary areas to accomplish common goals.
PO10	Communicate effectively in diverse groups and exhibit leadership qualities.
PO11	Apply management principles to manage projects in multidisciplinary environment.
PO12	Pursue life-long learning as a means to enhance knowledge and skills.

Rules and Regulations

1. The normal duration of the course leading to B.Tech degree will be EIGHT semesters.
2. The normal duration of the course leading to M.Tech. degree will be FOUR semesters.
3. Each academic year shall be divided into 2 semesters, each of 20 weeks duration, including evaluation and grade finalization, etc. The Academic Session in each semester shall provide for at least 90 Teaching Days, with at least 40 hours of teaching contact periods in a five to six days session per week. The semester that is typically from Mid-July to November is called the ODD SEMESTER, and the one that is from January to Mid-May is called the EVEN SEMESTER. Academic Session may be scheduled for the Summer Session/Semester as well.For 1st year B. Tech and M. Tech the schedule will be decided as per the admission schedule declared by Government of Maharashtra.

4. The schedule of academic activities for a Semester, including the dates of registration, mid-semester examination, end-semester examination, inter-semester vacation, etc. shall be referred to as the Academic Calendar of the Semester, which shall be prepared by the Dean (Academic), and announced at least TWO weeks before the Closing Date of the previous Semester.
5. The Academic Calendar must be strictly adhered to, and all other activities including co-curricular and/or extra -curricular activities must be scheduled so as not to interfere with the Curricular Activities as stipulated in the Academic Calendar.

REGISTRATION:

1. Lower and Upper Limits for Course Credits Registered in a Semester, by a Full-Time Student of a UG/PGProgramme:

A full time student of a particular UG/PGprogramme shall register for the appropriate number of course credits in each semester/session that is within the minimum and maximum limits specific to that UG/PGprogramme as stipulated in the specific Regulations pertaining to that UG/PGprogramme.

2. Mandatory Pre-Registration for higher semesters:
   In order to facilitate proper planning of the academic activities of a semester, it is essential for the every institute to inform to Dean (Academics) and COE regarding details of total no. of electives offered (Course-wise) along with the number of students opted for the same. This information should be submitted within two weeks from the date of commencement of the semester as per academic calendar.
3. PhD students can register for any of PG/PhD courses and the corresponding rules of evaluation will apply.
4. Under Graduate students may be permitted to register for a few selected Post Graduate courses, in exceptionally rare circumstances, only if the DUGC/DPGC is convinced of the level of the academic achievement and the potential in a student.

Course Pre-Requisites:

1. In order to register for some courses, it may be required either to have exposure in, or to have completed satisfactorily, or to have prior earned credits in, some specified courses.
2. Students who do not register on the day announced for the purpose may be permitted LATE REGISTRATION up to the notified day in academic calendar on payment of late fee.

3. REGISTRATION IN ABSENTIA will be allowed only in exceptional cases with the approval of the Dean (Academic) / Principal.
4. A student will be permitted to register in the next semester only if he fulfills the following conditions:

(a) Satisfied all the Academic Requirements to continue with the programme of Studies without termination
(b) Cleared all Institute, Hostel and Library dues and fines (if any) of the previous semesters;
(c) Paid all required advance payments of the Institute and hostel for the current semester;
(d) Not been debarred from registering on any specific ground by the Institute.

EVALUATION SYSTEM:

1. Absolute grading system based on absolute marks as indicated below will be implementeds from academic year 2019-20,starting from I year B.Tech.

Perentage of marks	Letter grade	Grade point
91-100	EX	10.0
86-90	AA	9.0
81-85	AB	8.5
76-80	BB	8.0
71-75	BC	7.5
66-70	CC	7.0
61-65	CD	6.5
56-60	DD	6.0
51-55	DE	5.5
40-50	EE	5.0
<40	EF	0.0

2. Class is awdared based on CGPA of all eigth semster of B.Tech Program.

CGPA for pass is minimum 5.0	
CGPAupto<5.50	Pass class
CGPA ≥ 5.50 &<6.00	SecondClass
CGPA ≥ 6.00 &<7.50	First Class
CGPA ≥ 7.50	Distinction
[Percentage of Marks =CGPA*10.0]	

A total of 100 Marks for each theory course are distributed as follows:

	MidSemester Exam (MSE) Marks	20
	ContinuousAssesment Marks	20
	End SemesterExamination(ESE)Marks	60

4.A total of 100 Marks for each practical course are distributed as follows:

1.	Continuous Assesment Marks	60
2.	End Semester Examination (ESE)Marks	40

It is mandatory for every student of B.Tech. to score a minimum of 40 marks out of 100, with a minimum of 20 marks out of 60 marks in End Semester Examination for theory course.

This will be implemented from the first year of B.Tech starting from Academic Year 2019-20

5. Description of Grades:

EX Grade: An 'EX' grade stands for outstanding achievement.
EE Grade: The 'EE' grade stands for minimum passing grade.
The students may appear for the remedial examination for the subjects he/she failed for the current semester of admission only and his/her performance will be awarded with EE grade only.
If any of the student remain Absent for the regular examination due to genuine reason and the same will be verified and tested by the Dean (Academics) or committee constituted by the University Authority.
FF Grade: The 'FF' grade denotes very poor performance, i.e. failure in a course due to poor performance .The students who have been awarded 'FF' grade in a course in any semester must repeat the subject in next semester.

6. Evaluation of Performance:

1. Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA)

(A) Semester Grade Point Average (SGPA) The performance of a student in a semester is indicated by Semester Grade Point Average (SGPA) which is a weighted average of the grade points obtained in all the courses taken by the student in the semester and scaled to a maximum of 10. (SGPI is to be calculated up to two decimal places). A Semester Grade Point Average (SGPA) will be computed for each semester as follows:

$$SGPA = \frac{[\sum_{i=1}^{n} c_i\, g_i]}{[\sum_{i=1}^{n} c_i\,]}$$

Where
'n' is the number of subjects for the semester,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his performance as
per the above table.
-SGPA will be rounded off to the second place of decimal and recorded as such.

(B) Cumulative Grade Point Average (CGPA): An up to date assessment of the overall performance of a student from the time he entered the Institute is obtained by calculating Cumulative Grade Point Average (CGPA) of a student. The CGPA is weighted average of the grade points obtained in all the courses registered by the student since s/he entered the Institute. CGPA is also calculated at the end of every semester (upto two decimal places).Starting from the first semester at the end of each semester (S), a Cumulative Grade Point Average (CGPA) will be computed as follows:

$$CGPA = \frac{[\sum_{i=1}^{m} c_i\, g_i]}{[\sum_{i=1}^{m} c_i\,]}$$

Where
'm' is the total number of subjects from the first semester onwards up to and including the
semester S,
'ci' is the number of credits allotted to a particular subject, and
'gi' is the grade-points awarded to the student for the subject based on his/her performance as per the above table.

-CGPA will be rounded off to the second place of decimal and recorded as such.

Award of Degree of Honours

Major Degree

The concept of Major and Minors at B.Tech level is introduced , to enhance learning skills of students, acquisition of additional knowledge in domains other than the discipline being pursued by the student, to make the students better employable with additional knowledge and encourage students to pursue cross-discipline research.

A. <u>Eligibility Criteria for Majors</u>

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for majors has to register at the beginning of 5th Semester

3. The Student has to complete 5 additional advanced courses from the same discipline specified in the curriculum. These five courses should be of 4 credits each amounting to 20 credits. The students should complete these credits before the end of last semester.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded B.Tech (Honours) Degree.

B. Eligibility Criteria for Minors

1. The Student should have Minimum CGPA of 7.5 up to 4th Semester
2. Student willing to opt for minors has to register at the beginning of 5th Semester
3. The Student has to complete 5 additional courses from other discipline of their interest, which are specified in the respective discipline. These five courses should be of 4 credits each amounting to 20 credits.
4. Student may opt for the courses from NPTEL/ SWAYAM platform. (if the credits of NPTEL/ SWAYAM courses do not match with the existing subject proper scaling will be done)

Student complying with these criteria will be awarded with B.Tech Degree in -------Engineering withMinor in ------ --Engineering.
(For e.g.: B. Tech in Civil Engineering with Minor in Computer Engineering)

For applying for Honours and Minor Degree the student has to register themselves through the proper system.

ATTENDANCE REQUIREMENTS:

1. All students must attend every lecture, tutorial and practical classes.
2. To account for approved leave of absence (eg. representing the Institute in sports, games or athletics; placement activities; NCC/NSS activities; etc.) and/or any other such contingencies like medical emergencies, etc., the attendance requirement shall be a minimum of 75% of the classes actually conducted.

If the student failed to maintain 75% attendance, he/she will be detained for appearing the successive examination.

The Dean (Academics)/ Principal is permitted to give 10% concession for the genuine reasons as such the case may be.

In any case the student will not be permitted for appearing the examination if the attendance is less than 65%.

3. The course instructor handling a course must finalize the attendance 3 calendar days before the last day of classes in the current semester and communicate clearly to the students by displaying prominently in the department and also in report writing to the head of the department concerned.

4. The attendance records are to be maintained by the course instructor and he shall show it to the student, if and when required.

TRANSFER OF CREDITS

The courses credited elsewhere, in Indian or foreign University/Institutions/ Colleges/Swayam Courses by students during their study period at DBATU may count towards the credit requirements for the award of degree. The guidelines for such transfer of credits are as follows:

a) 20 % of the total credit will be considered for respective calculations.

b) Credits transferred will be considered for overall credits requirements of the programme.

c) Credits transfer can be considered only for the course at same level i.e UG, PG etc.

d) A student must provide all details (original or attested authentic copies)such as course contents, number of contact hours, course instructor /project guide and evaluation system for the course for which he is requesting a credits transfer. He shall also provide the approval or acceptance letter from the other side. These details will be evaluated by the concerned Board of Studies before giving approval. The Board of Studies will then decide the number of equivalent credits the student will get for such course(s) in DBATU. The complete details will then be forwarded to Dean for approval.

e) A student has to get minimum passing grades/ marks for such courses for which the credits transfers are to be made.

f) Credits transfers availed by a student shall be properly recorded on academic record(s) of the student.

g) In exceptional cases, the students may opt for higher credits than the prescribed.

Abbreviations

BSC: *Basic Science Course*

ESC: *Engineering Science Course*

PCC: *Professional Core Course*

PEC: *Professional Elective Course*

OEC: *Open Elective Course*

HSSMC: *Humanities and Social Science including Management Courses*

PROJ: *Project work, seminar and internship in industry or elsewhere*

Basic Science Course (BSC)		
BTBS101	Engineering Mathematics- I	(3-1-0)4
BTBS102	Engineering Physics	(3-1-0)4
BTBS107L	Engineering Physics Lab	(0-0-2)1
BTBS201	Engineering Mathematics-II	(3-1-0)4
BTBS202	Engineering Chemistry	(3-1-0)4
BTBS207L	Engineering Chemistry Lab	(0-0-2)1
BTBS301	Engineering Mathematics – III	(3-1-0)4
Engineering Science Course (ESC)		
BTES103	Engineering Graphics	(2-0-0)2
BTES105	Energy and Environment Engineering	(2-0-0)2
BTES106	Basic Civil & Mechanical Engineering	(2-0-0)Audit
BTES108L	Engineering Graphics Lab	(0-0-4)2
BTES203	Engineering Mechanics	(2-1-0)3
BTES204	Computer Programming	(3-0-0)3
BTES205	Basic Electrical and Electronics Engineering	(2-0-0)Audit
BTES206L	Workshop Practice	(0-0-4)2
BTES208L	Engineering Mechanics Lab	(0-0-2)1
BTMES304	Materials Science and Metallurgy	(3-1-0)4
Online course	Artificial Intelligence*	(3-0-0)3
Humanities and Social Science Including Management Courses (HSSMC)		
BTHM104	Communication Skills	(2-0-0)2
BTHM109L	Communication Skills Lab	(0-0-2)1
BTHM403	Basic Human Rights	(3-0-0)3
	Constitution of India*	(1-0-0)1
Professional Core Course (PCC)		
BTMXC302	Thermal & Fluids Engg.	**(3-1-0)4**
BTMXC303	Basic concepts of Mechatronics	**(3-1-0)4**
BTMXC304	Electrical Machines and Drives	**(3-1-0)4**
BTMXC305	Microprocessor and Microcontroller	**(3-1-0)4**
BTMXL306	Basic Mechatronics Lab	**(0-0-2)1**
BTMXL307	Electrical Machines Lab	**(0-0-2)1**
BTMXC401	Analog and Digital Electronics	**(3-1-0)4**
BTMXC402	Low cost Automation	**(3-1-0)4**
BTMXC404	Theory of Machines and Mechanisms	**(3-1-0)4**
BTMXL406	Analog and Digital Electronics Lab	**(0-0-2)1**
BTMXL407	Automation Lab	**(0-0-2)1**
BTMXC501	Metrology and Instrumentation	**(3-1-0)4**
BTMXC502	Manufacturing Technologies	**(3-1-0)4**
BTMXC503	Data Acquisition system	**(3-1-0)4**
BTMXL506	Metrology and Instrumentation Lab	**(0-0-2)1**
BTMXC507	Manufacturing Technologies Lab	**(0-0-2)1**
BTMXC601	Control System Engg	**(3-1-0)4**
BTMXC602	Design of Machine Elements	**(3-1-0)4**
BTMXL607	Computer Aided Design Lab	**(0-0-2)1**
BTMXL608	Control system Lab	**(0-0-2)1**
BTMXC701	Robotics	**(3-1-0)4**
BTMXC702	Digital Signal Processing	**(3-1-0)4**
BTMXL706	Robotics Lab	**(0-0-2)1**
BTMXL707	Computer Aided Manufacturing Lab	**(0-0-2)1**
Professional Elective Course (PEC)		
BTMPE405A	Numerical Methods in Engineering	(3-1-0) 4
BTMXE405A	Embeded systems	(3-1-0) 4

BTMXE405B	Signal & System	(3-1-0) 4
BTMXE504A	Data processing and Statistics	(3-0-0)3
BTMXE504B	MEMS/NEMS	(3-0-0)3
BTMXE504C	Python Programming	(3-0-0)3
BTMXE603A	Intelligent Systems and Control	(3-0-0)3
BTMXE603B	Adaptive and Predictive control of Mechatronics systems	(3-0-0)3
BTMXE603C	Virtual Instrumentation	(3-0-0)3
BTMXE604A	Computer integrated Manufacturing	(3-0-0)3
BTMPE604B	Product Life Cycle Management	(3-0-0)3
BTMPE604C	Finite Element Method	(3-0-0)3
BTAPE604B	Computational Fluid Dynamics	(3-0-0)3
BTMXE703A	Digital Image Processing	(3-0-0)3
BTMXE703B	Modeling and Control of Mechatronics systems	(3-0-0)3
BTMPE703C	Non-conventional Machining	(3-0-0)3
BTMPE703E	Additive Manufacturing	(3-0-0)3
Open Elective Course (OEC)		
BTMOE505A	Solar Energy	(3-0-0)3
BTMOE505B	Renewable Energy Sources	(3-0-0)3
BTMOE505C	Human Resource Management	(3-0-0)3
BTMOE505D	Product Design Engineering	(3-0-0)3
BTMXOE505A	Internet of Things and Cloud based manufacturing	(3-0-0)3
BTMXOE605A	Quantitative Techniques and Project Management	(3-1-0) 4
BTMOE605B	Nanotechnology	(3-1-0) 4
BTMOE605C	Energy Conservation and Management	(3-1-0) 4
BTMOE605D	Wind Energy	(3-1-0) 4
BTMOE605E	Introduction to Probability Theory and Statistics	(3-1-0) 4
BTMXOE605A	Industrial Engineering and startup	(3-1-0) 4
BTMOE704A	Sustainable Development	(3-0-0)3
BTMOE704B	Entrepreneurship Development	(3-0-0)3
BTMOE704C	Plant Maintenance	(3-0-0)3
BTMOE705A	Engineering Economics	(3-0-0)3
BTMOE705B	Biology for Engineers	(3-0-0)3
BTMOE705C	Intellectual Property Rights	(3-0-0)3
Seminar/Mini Project/ Internship		
BTES209P	IT – 1 Evaluation	(0-0-0)1
BTMXI 408	IT – 2 Evaluation	(0-0-0) 1
BTMXS 607	B Tech Seminar	(0-0-2)1
BTMXP 608	Mini Project 1 (TPCS)	(0-0-2)2
BTMXI609	IT – 3 Evaluation	(0-0-0)2
Project (MP)		
BTMXP801/ BTMXPI801	Project work/ Internship	(0-0-28)14

Suggested Plan of Study

Number of Courses	Semester							
	I	II	III	IV	V	VI	VII	VIII
1	BTBS101 Engineering Mathematics - I	BTBS201 Engineering Mathematics- II	BTBS301 Engineering Mathematics – III	BTMXC401 Analog and Digital Electronics	BTMXC 501 Metrology and Instrumentation	BTMXC 601 Control System Engineering	BTMXC701 Robotics	BTMXP801 / BTMXI801 Project Work
2	BTBS102 Engineering Physics	BTBS202 Engineering Chemistry	BTMXC302 Thermal and Fluids Engg	BTMXC402 Low Cost Automation	BTMXC 502 Manufacturing Technology	BTMXC 602 Design of Machine Elements	BTMXC702 Digital Signal Processing	--
3	BTES103 Engineering Graphics	BTES203 Engineering Mechanics	BTMXC303 Basic concepts of Mechatronics	BTHM403 Basic Human Rights	BTMXC 503 Data Acquisition System	BTMXPE 603A-C **(ElectiveIII)**	BTMXPE703A, B and BTMPE703C,E -F (Elective V)	--
4	BTHM104 Communicat ion Skills	BTES204 Computer Programming	BTMXC304 Electrical Machines and Drive	BTMXC404 Theory and Machines and Mechanisms	BTMXPE 504A-C Elective-II	BTMXPE 604A/ BTAPE 604B,C/BTAPE 604A (ElectiveIV)	BTMXOE704 A-C (Open Elective III)	--
5	BTES105 Energy and Environment Engineering	BTES205 Basic Electrical and Electronics Engineering	BTMXC305 Microprocess or and Microcontroll er	BTMXPE405A, B/BTMPE405A (Elective-I)	BTMOE 505A, B, D/BTMXOE50 5A (Open Elective I)	BTMOE605 A-E/BTMXOE60 5A (Open Elective II)	BTMXOE705A -C (Open Elective IV)	--
6	BTES106 Basic Civil and Mechanical Engineering	BTES206L Workshop Practice	BTMXCL306 Basic Mechatronics Lab	BTMXCL406 Analog and Digital Electronics Lab	BTMXL 506 Metrology and Instrumentation	BTMXCL 606 Computer Aided Design Lab	BTMXCL706 Robotics Lab	--
7	BTBS107L Engineering Physics Lab	BTBS207L Engineering Chemistry Lab	BTMXCL307 Electrical Machines Lab	BTMXCL407 Automation Lab	BTMXL 507 Manufacturing Technologies Lab	BTMXCL607 Control System Lab	BTMXL707 Computer Aided Manufacturing Lab	--
8	BTES108L Engineering Graphics Lab	BTES208L Engineering Mechanics Lab	**Constitution of India***	BTMXI408 (IT – 2)	BTMXI 408 (IT – 2 Evaluation)	BTMXS608 B Tech Seminar	BTMXP708 Mini Project 2	--
9	BTHM109L Communicat ion Skills Lab	BTES209P (IT - 1)	BTES209P (IT - 1) Evaluation	--	**Artificial Intelligence***	BTMXP609 Mini Project 1(TPCS)	BTMXI 610 (IT – 3) (IT – 3 Evaluation)	--
10	--	--	--	--	--	BTMXI 610 (IT – 3)	--	--

Degree Requirements:

Total Credits: 160

Sr. No.	Category	Number of Subjects in Each Category	Suggested Breakup of Credits by AICTE (Total 160)	Total
1	Humanities and Social Sciences including Management courses	3	12	**6**
2	Basic Science courses	7+1*	25	**22+3***
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	9	24	**15**
4	Professional core courses	24	48	**66**
5	Professional Elective courses relevant to chosen specialization/branch	5	18	**16**
6	Open subjects – Electives from other technical and /or emerging subjects	4	18	**12**
7	Project work, seminar and internship in industry or elsewhere	7	15	**23**
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	2+1*	NC	--
	Total	**61+2**	**160***	**160**

* over and above of 160 credits

Sr. No	Category	Suggested Breakup of Credits (Total 160)	First year		Second year		Third year		Final year		Total
			I	II	III	IV	V	VI	VII	VIII	
1	Humanities and Social Sciences including Management courses	6	03	--	--	03		--	---	--	**6**
2	Basic Science courses	22+3*	09	09	04		3*	--	--	--	**22+3***
3	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc.	15	06	09	---	---	--	--	--	--	**15**
4	Professional core courses	66	--	--	18	14	14	10	10	--	**66**
5	Professional Elective courses relevant to chosen specialization/branch	16	--	--	--	04	03	06	03	--	**16**

6	Open subjects – Electives from other technical and /or emerging subjects	12	--	--	--	--	03	03	06	--	**12**
7	Project work, seminar and internship in industry or elsewhere	23	--	--	01	--	01	03	4	14	**23**
8	Mandatory Courses [Environmental Sciences, Induction training, Indian Constitution, Essence of Indian Knowledge Tradition]	NC	--	--	--	--	--	--	--	--	--
	Semester wise credits		18	18	23	21	21 +3 *	22	23	14	**160**
	Total	**160**	**36**		**44**		**43**		**37**		

*over and above of 160 credits

Course Structure for Semester I
B. Tech in Mechatronics (w.e.f. 2020-21)

Semester I											
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**No. of Credits**
	Mandatory	***Induction Program***	***3-weeks duration in the beginning of the semester***							
BSC1	BTBS101	Engineering Mathematics- I	3	1	-	20	20	60	100	4
BSC2	BTBS102	Engineering Physics	3	1	-	20	20	60	100	4
ESC1	BTES103	Engineering Graphics	2	-	-	20	20	60	100	2
HSSMC1	BTHM104	Communication Skills	2	-	-	20	20	60	100	2
ESC2	BTES105	Energy and Environment Engineering	2	-	-	20	20	60	100	2
ESC3	BTES106	Basic Civil and Mechanical Engineering	2	-	-	50	-	-	50	Audit
BSC3	BTBS107L	Engineering Physics Lab	-	-	2	60	-	40	100	1
ESC4	BTES108L	Engineering Graphics Lab	-	-	3	60	-	40	100	2
HSSMC2	BTHM109L	Communication Skills Lab	-	-	2	60	-	40	100	1

	Total	**14**	**2**	**7**	**330**	**100**	**420**	**850**	**18**

Course Structure for Semester II
B. Tech in Mechatronics (w.e.f. 2021-22)

Semester II										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	**No. of Credits**
BSC4	BTBS201	Engineering Mathematics-II	3	1	-	20	20	60	100	4
BSC5	BTBS202	Engineering Chemistry	3	1	-	20	20	60	100	4
ESC5	BTES203	Engineering Mechanics	2	1	-	20	20	60	100	3
ESC6	BTES204	Computer Programming	3	-	-	20	20	60	100	3
ESC7	BTES205	Basic Electrical and Electronics Engineering	2	-	-	50	-	-	50	Audit
ESC8	BTES206L	Workshop Practice	-	-	4	60	-	40	100	2
BSC6	BTBS207L	Engineering Chemistry Lab	-	-	2	60	-	40	100	1
ESC9	BTES208L	Engineering Mechanics Lab	-	-	2	60	-	40	100	1
PROJ-1	BTES209P (IT– 1)	Field Training/Industrial Training (minimum of 4 weeks which can be completed partially in first semester and second Semester or in one semester itself)	-	-	-	-	-	-	-	To be evaluated in Sem III
	Mandatory	***NSS/NCC/Sports***	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**Audit**
		Total	**13**	**3**	**8**	**310**	**80**	**360**	**750**	**18**

Course Structure for Semester III
B. Tech in Mechatronics (w.e.f. 2022-23)

Semester III									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
BSC7	BTBS301	Engineering Mathematics – III	3	1	-	20	20	60	100	4
PCC1	BTMXC302	Thermal & Fluids Engg.	3	1	-	20	20	60	100	4
PCC2	BTMXC303	Basic Concepts of Mechatronics	3	1	-	20	20	60	100	4
PCC3	BTMXC304	Electrical Machines and Drives	3	1	-	20	20	60	100	4
PCC4	BTMXC305	Microprocessor and Microcontroller	3	1		20	20	60	100	4
PCC5	BTMXCL306	Basic Mechatronics Lab	-	-	2	60	-	40	100	1
PCC6	BTMXCL307	Electrical Machines Lab			2	60	-	40	100	1
PROJ-1	BTES209P	IT – 1 Evaluation	-	-	-	-	-	100	100	1
	CODE???	Constitution of India*								Audit
		Total	**15**	**5**	**4**	**220**	**100**	**480**	**800**	**23**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Course Structure for Semester IV
B. Tech in Mechatronics (w.e.f. 2022-23)

Semester IV										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 7	BTMXC 401	Analog and Digital Electronics	3	1	-	20	20	60	100	4
PCC 8	BTMXC 402	Low Cost Automation	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
PCC9	BTMXC404	Theory of Machines and Mechanisms	3	1	-	20	20	60	100	4
PEC 1	BTMXPE405A, B/ BTMPE405A	Elective-I	3	1	-	20	20	60	100	4
PCC10	BTMXCL406	Analog and Digital Electronics Lab	-	-	2	60	-	40	100	1
PCC11	BTMXCL407	Automation Lab			2	60		40	100	1
PROJ-2	BTMXI408	Field Training /Industrial Training (minimum of 4 weeks which can be completed partially in the third and fourth semester or in one semester itself)	-	-	-	-	-	-	-	Credits to be evaluated in Sem V
		Total	**15**	**4**	**4**	**220**	**100**	**380**	**700**	**21**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective I

Sr. No	Course code	Course Name
1	BTMPE405A	Numerical Methods in Engineering
2	BTMXPE405A	Embedded Systems
3	BTMXPE405B	Signals & Systems

Course Structure for Semester V
B. Tech in Mechatronics (w.e.f. 2023-24)

Semester V									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC 12	BTMXC 501	Metrology & Instrumentation	3	1	-	20	20	60	100	4
PCC 13	BTMXC 502	Manufacturing Technologies	3	1	-	20	20	60	100	4
PCC 14	BTMXC 503	Data Acquisition System	3	1	-	20	20	60	100	4
PEC 2	BTMXPE 504A-C	Elective-II	3	-	-	20	20	60	100	3
OEC 1	BTMOE 505A,B, D/BTMXOE505A	Open Elective-I	3	-	-	20	20	60	100	3
PCC15	BTMXL 506	Metrology & Instrumentation Lab	-	-	2	60	-	40	100	1
PCC16	BTMXL 507	Manufacturing Technologies Lab			2	60		40	100	1
PROJ-2	BTMXI408	IT – 2 Evaluation	-	-	-	-	-	100	100	1
	CODE????	Artificial Intelligence*	3							3*
		Total	**15+3**	**3**	**4**	**220**	**100**	**480**	**800**	**21+3***

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective II

Sr. No	Course code	Course Name
1	BTMXPE 504A	Data Processing and Statistics
2	BTMXPE 504B	MEMS/NEMS
3	BTMXPE 504C	Python Programming

Open Elective I

Sr.No.	Course code	Course Name
1	BTMOE505A	Solar Energy

2	BTMOE505B	Renewable Energy Sources
3	BTMOE505D	Product Design Engineering
4	BTMXOE 505A	Internet of Things and Cloud based Manufacturing

*over and above of 160 credits

Course Structure for Semester VI
B. Tech in Mechatronics (w.e.f. 2023-24)

Semester VI										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC17	BTMXC 601	Control System Engineering	3	1	-	20	20	60	100	4
PCC18	BTMXC 602	Design of Machine Elements	3	1	-	20	20	60	100	4
PEC3	BTMXPE 603A-C	Elective-III	3		-	20	20	60	100	3
PEC4	BTMXPE 604A/BTMPE604 B,C, BTAPE 604B	Elective-IV	3		-	20	20	60	100	3
OEC2	BTMOE 605A-E/ BTMXOE 605A	Open Elective-II	3		-	20	20	60	100	3
PCC19	BTMXCL 606	Computer Aided Design Lab			2	60		40	100	1
PCC20	BTMXCL 607	Control System Lab			2	60		40	100	1
PROJ-3	BTMXS S608	B Tech Seminar	-	-	2	60		40	100	1
PROJ-4	BTM BTMX P 609	Mini Project 1 (TPCS)	-	-	2	60	-	40	100	2
PROJ-5	BTMXI 610 (IT-3)	Field Training / Industrial Training (minimum of 4 weeks which can be completed partially in fifth semester and sixth semester or in one semester itself).	-	-	-	-	-	-	-	Credits to be evaluated in Sem VII
		Total	**15**	**2**	**10**	**460**	**100**	**500**	**1000**	**22**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
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Elective III:

Sr.No	Course code	Course Name
1	BTMXPE 603A	Intelligent Systems and Control
2	BTMXPE 603B	Adaptive and Predictive control of Mechatronics Systems
3	BTMXPE 603C	Virtual Instrumentation

Elective IV:

SrNo	Course code	Course Name
1	BTMXPE 604A	Computer Integrated Manufacturing
2	BTMPE604B	Product Life Cycle Management
3	BTMPE604C	Finite Element Method
5	BTAPE604B	Computational Fluid Dynamics

Open Elective II:

Sr.No	Course code	Course Name
1	BTMOE605A	Quantitative Techniques and Project Management
2	BTMOE605B	Nanotechnology
3	BTMOE605C	Energy Conservation and Management
4	BTMOE605D	Wind Energy
5	BTMOE605E	Introduction to Probability Theory and Statistics
6	BTMXOE 605A	Industrial Engineering and startup

Course Structure for Semester VII
C. Tech in Mechatronics (w.e.f. 2024-25)

Semester VII									
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
PCC21	BTMXC 701	Robotics	3	1	-	20	20	60	100	4
PCC22	BTMXC 702	Digital Signal Processing	3	1	-	20	20	60	100	4
PEC5	BTMXPE 703 A, B and BTMPE703C, E	Elective-V	3	-	-	20	20	60	100	3
OEC3	BTMXOE704A-C	Open Elective-III	3	-	-	20	20	60	100	3
OEC4	BTMXOE705A-C	Open Elective-IV	3	-	-	20	20	60	100	3
PCC23	BTMX L706	Robotics Lab	-	-	2	60	-	40	100	1
PCC24	BTMX L707	Computer Aided Manufacturing Lab			2	60		40	100	1
PRJ 6	BTMXP 708	Mini-project 2			4	60		40	100	2
PROJ-5	BTMXI609	IT – 3 Evaluation	-	-	-	-	-	100	100	2
		Total	**15**	**2**	**08**	**280**	**100**	**520**	**900**	**23**

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Elective V:

Sr. No	Course code	Course Name
1	BTMXPE 703A	Digital Image Processing
2	BTMXPE 703B	Modelling and Control of Mechatronic Systems
3	BTMPE703C	Non-conventional Machining
4	BTMPE703E	Additive Manufacturing

Open Elective III:

Sr. No	Course code	Course Name
1	BTMOE704A	Sustainable Development
2	BTMOE704B	Entrepreneurship Development
3	BTMOE704C	Plant Maintenance

Open Elective IV:

Sr.No	Course code	Course Name
1	BTMOE705A	Engineering Economics
2	BTMOE705B	Biology for Engineers
3	BTMOE705C	Intellectual Property Rights

BSC = Basic Science Course, ESC = Engineering Science Course, PCC = Professional Core Course
PEC = Professional Elective Course, OEC = Open Elective Course, LC = Laboratory Course
HSSMC = Humanities and Social Science including Management Courses

Course Structure for Semester VIII
B. Tech Mechatronics (w.e.f. 2024-25)

Semester VIII									
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**			**Credit**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PROJ-7	BTMXP 801/ BTMXPI801	Project Work/ Internship	-	-	28	60	-	40	100	14
		Total	**-**	**-**	**28**	**60**	**-**	**40**	**100**	**14**

Total Credits: 160

SEMESTER I

Guide to Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Precious little is done by most of the institutions, except for an orientation program lasting a couple ofdays.

We propose a 3-week long induction program for the UG students entering the institution, right at the start. Normal classes start only after the induction program is over. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awarness, sensitivity and understanding of the self, people around them, society at large, and nature.

The time during the Induction Program is also used to rectify some critical lacunas, for example, English background, for those students who have deficiency in it.

The following are the activities under the induction program in which the student would be fully engaged throughout the day for the entire duration of the program.

- **Physical Activity** This would involve a daily routine of physical activity with games and sports. It would start with all students coming to the field at 6 am for light physical exercise or yoga. There would also be games in the evening or at other suitable times according to the local climate. These would help develop team work. Each student should pick one game and learn it for three weeks. There could also be gardening or other suitably designed activity where labour yields fruits from nature.
- **Creative Arts** Every student would chose one skill related to the arts whether visual arts or performing arts. Examples are painting, sculpture, pottery, music, dance etc. The student would pursue it everyday for the duration of the program. These would allow for creative expression. It would develop a sense of aesthetics and also enhance creativity which would, hopefully, flow into engineering designlater.
- **Universal Human Values:** It gets the student to explore oneself and allows one to experience the joy of learning, stand up to peer pressure, take decisions with courage, be aware of relationships with colleagues and supporting staff in the hostel and department, be sensitive to others, etc. Need for character building has been underlined earlier. A module in Universal Human Values provides the base. Methodology of teaching this content is extremely important. It must not be through do's and dont's, but get students to explore and think by engaging them in a dialogue. It is best taught through group discussions and real life activities rather than lecturing. The role of group discussions, however, with clarity of thought of the teachers cannot be over emphasized. It is essential for giving exposure, guiding thoughts, and realizing values. The teachers must come from all the departments rather than only one department like HSS or from outside of the Institute. Discussions would be conducted in small groups of about 20 students with a faculty mentor each. It is to open thinking towards the self. Universal Human Values discussions could even continue for rest of the semester as a normal course, and not stop with the induction program. Besides drawing the attention of the student to larger issues of life, it would build relationships between teachers and students which last for their entire 4-year stay and possiblybeyond.
- **Literary** Literary activity would encompass reading, writing and possibly, debating, enacting a play etc.
- **Proficiency Modules:** This period can be used to overcome some critical lacunas that students might have, for example, English, computer familiarity etc. These should run like crash courses, so that when normal courses start after the induction program, the student has overcome the lacunas substantially. We hope that problems arising due to lack of English skills, wherein students start lagging behind or failing in several subjects, for no fault of theirs, would, hopefully, become a thing of the past.
- **Lectures by Eminent People** This period can be utilized for lectures by eminent people, say, once a week. It would give the students exposure to people who are socially active or in publiclife.

 Visits to Local Area A couple of visits to the landmarks of the city, or a hospital or orphanage could be organized. This would familiarize them with the area as well as expose them to the under privileged.

 Familiarization to Dept./Branch & Innovations : The students should be told about different method of study compared to coaching that is needed at IITs. They should be told about what getting into a branch or department means what role it plays in society, through its technology. They should also be shown the laboratories, workshops & otherfacilties.

Schedule

The activities during the Induction Program would have an ***Initial Phas***e, a ***Regular Phase*** and a ***Closing Phase***. The Initial and Closing Phases would be two days each.

Initial Phase

Time	Activity
Day 0	
Whole day	Students arrive - Hostel allotment. (Preferably do preallotment)
Day 1	
9.00 AM to 3.00 PM	Academic Registration
4.30 PM to 6.00 PM	Ori Orientation
Day 2	
9.00 AM to 10.00 AM	Diagnostic test (for English etc.) Visi
10.15 AM to 12.25 PM	Visits to Respective Departments
12.30 to 2.00	Lunch time
2.00 PM to 3.00 PM	Director's Speech
3.00 PM to 4.00 PM	Interaction with Parents
4.00 PM to 5.30 PM	Mentor-Mentee groups- Introduction within group

Regular Phase

After two days is the start of the Regular Phase of induction. With this phase there would be regular program to be followed every day.

Daily Schedule

Some of the activities are on a daily basis, while some others are at specified periods within the Induction Program. We first show a typical daily timetable.

Session	Time	Activity	Remark
Day 3 Onwards			
I	9.00 AM to 11.00 AM	Creative Arts / Universal Human Values	Half the groups will do creative arts
II	11.00 AM to 1.00 PM	Universal Human Values/ Creative Arts	Complementary Alternate
Lunch Time			
IV	2.00 PM to 4.00 PM	Afternoon Session	See below
V	4.00 PM to 5.00 PM	Afternoon Session	See below

Sundays are off. Saturdays have the same schedule as above or have outings.

Afternoon Activities (Non-Daily) : The following five activities are scheduled at different times of the Induction Program, and are not held daily foreveryone:
1. Familiarization to Dept./Branch &Innovations
2. Visits to LocalArea
3. Lectures by EminentPeople
4. Literary
5. Proficiency Modules

Closing Phase

Time	Activity
Last But one day	
9.00 AM to 12.00 PM	Discussions and finalizations of presentations within each group
2.00 PM to 5.00 PM	Presentation by each group in front of 4 other groups besides their own (about 100 students)
Last Day	
Whole day	Examinations if any

Follow Up after Closure

A question comes up as to what would be the follow up program after the formal 3-week Induction Program is over? The groups which are formed should function as mentor- mentee network. A student should feel free to approach his faculty mentor or the student guide, when facing any kind of problem, whether academic or financial or psychological 6etc. (For every 10 undergraduate first year students, there would be a senior student as a student guide, and for every 20 students, there would be a faculty mentor.) Such a group should remain for the entire 4-5 year duration of the stay of the student. Therefore, it would be good to have groups with the students as well as teachers from the same department/discipline Here we list some important suggestions which have come up and which have been experimentedwith.

 Follow Up after Closure – Same Semester: It is suggested that the groups meet with their faculty mentors once a month, within the semester after the 3-week Induction Program is over. This should be a scheduled meeting shown in the timetable. (The groups are of course free to meet together on their own more often, for the student groups to be invited to their faculty mentor's home for dinner or tea, nature walk,etc.)
 Follow Up – Subsequent Semesters: It is extremely important that continuity be maintained in subsequent semesters. It is suggested that at the start of the subsequent semesters (upto fourth semester), three days be set aside for three full days of activities related to follow up to Induction Program. The students be shown inspiring films, do collective art work, and group discussions be conducted. Subsequently, the groups should meet at least once amonth.

Summary

Engineering institutions were set up to generate well trained manpower in engineering with a feeling of responsibility towards oneself, one's family, and society. The incoming undergraduate students are driven by their parents and society to join engineering without understanding their own interests and talents. As a result, most students fail to link up with the goals of their own institution. The graduating student must have values as a human being, and knowledge and meta-skills related to his/her profession as an engineer and as a citizen. Most students who get demotivated to study engineering or their branch, also lose interest inlearning.
The Induction Program is designed to make the newly joined students feel comfortable, sensitize them towards exploring their academic interests and activities, reducing competition and making them work for excellence, promote bonding within them, build relations between teachers and students, give a broader view of life, and building of character.

The Universal Human Values component, which acts as an anchor, develops awareness and sensitivity, feeling of equality, compassion and oneness, draw attention to society and 4
We are aware that there are advantages in mixing the students from different depts. However, in mixing, it is our experience that the continuity of the group together with the faculty mentor breaks down soon after. Therefore, the groups be from the same dept. but hostel wings have the mixed students from different depts. For example, the hostel room allotment should be in alphabetical order irrespective of dept. 7nature, and character to follow through. It also makes them reflect on their relationship with their families and extended family in the college (with hostel staff and others). It also connects students with each other and with teachers so that they can share any difficulty they might be facing and seekhelp.

References:

Motivating UG Students Towards Studies, Rajeev Sangal, IITBHU Varanasi, Gautam Biswas, IIT Guwahati, Timothy Gonsalves, IIT Mandi, Pushpak Bhattacharya, IIT Patna, (Committee of IIT Directors),
31 March 2016, IIT Directors' Secretariat, IIT Delhi.

BTBS101 Engineering Mathematics – I

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Contents:

Unit 1: Linear Algebra- Matrices

Inverse of a matrix by Gauss-Jordan method; Rank of a matrix; Normal form of a matrix ; Consistency of non- homogeneous and homogeneous system of linear equations ; Eigen values and eigen vectors ; Properties of eigen values and eigen vectors(without proofs); Cayley-Hamilton's theorem (without proof) and its applications. **[06 Hours]**

Unit 2: Partial Differentiation

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables. **[06 Hours]**

Unit 3: Applications of Partial differentiation

Jacobians - properties; Taylor's and Maclaurin's theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange's method of undetermined multipliers. **[06 Hours]**

Unit 4: Reduction Formulae and Tracing of Curves

Reduction formulae for $\int_0^{\frac{\pi}{2}} sin^n x\, dx$, $\int_0^{\frac{\pi}{2}} cos^n x\, dx$, $\int_0^{\frac{\pi}{2}} sin^m x\, cos^n x\, dx$; Tracing of standard curves given in Cartesian, parametric & polar forms.**[06 Hours]**

Unit 5:Multiple Integrals

Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral; Applications of multiple integrals to find area as double integral , volume as triple integral and surface area. **[08 Hours]**

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.

2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

3. A course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.

4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

The tutorial classes in Engineering Mathematics-I are to be conducted batchwise. Each class should be divided into three batches for the purpose.

The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

The minimum number of assignments should be eight covering all topics.

BTBS102 Engineering Physics

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Objectives:

1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technologicalproblems.

2. To understand and study the Physics principles behind the developments of engineering materials.

Course Contents:

Unit I:
Oscillation, Ultrasonic andDielectricMaterials: (06 Hrs) Free oscillation, damped oscillation, Forced oscillation and Resonance, differential wave equation, Ultrasonic waves, production of ultrasonic (Piezoelectric effect, Magneto striction effect) and its applications.
Dielectric parameters (Dielectric constant, Electric displacement, Polarization & Polarizability), Types of polarization, temperature and frequency dependences of dielectric materials.

Unit II:
Optics, Fibre Opticsand Laser: (06 Hrs)
Interference of light in thin film, wedge shaped film , Newton's rings, polarization of light, methods for production of polarized light(Reflection, Refraction& Double refraction), Huygen's theory of double refraction, Laurent's half shade Polarimeter, Principle and structure of optical fibre, acceptance angle, acceptance cone, numerical aperture.
Principle of laser, Einstein's coefficients, Typesof laser – Ruby and He-Ne laser and their applications.

Unit III:
Electron Optics, Nuclear Physics andQuantumMechanics: (06 Hrs)
Measurement of 'e/m' by Thomson's method, Determination of electronic charge by Millikan's oil drop method, Bainbridge massspectrograph, GM counter, Heisenberg's uncertainty principle, Schrödinger's time dependent and time independent wave equations, physical significance of wavefunction.

Unit IV
Crystal Structure, X-raysandElectro dynamics: (06 Hrs)
Unit cell, Bravais lattice, cubic system, number of atoms per unit cell, coordination number, atomic radius, packing density, relation between lattice constant and density, lattice planes and Miller indices, Interplaner spacing for cubic system, Bragg's law, X-ray diffraction, Line and Continuous Spectrum of X-ray, Mosley's law. Introduction of Maxwell equations(no derivation), Electromagnetic wave in free space.

Unit V
Magnetic, Superconducting andSemiconductingmaterials: (06 Hrs)
Types of magnetic materials(Ferrimagnetic & Antiferromagnetic, Ferrites & Garnets), B-H curve, Classical free electron theory-electrical conductivity, resistivity and its temperature dependence, microscopic Ohm's law, Superconductivity, types of superconductors, Meissner effect and Applications. Band theory of solids, conductivity of semiconductors, Halleffect.
Expected Outcome:-
1. The student will be able to understand Engineering problems based on the principle of

Oscillation, Ultrasonics, Optics, Laser, Fibre optics, Nuclear physics, Quantum mechanics.

2. The student will be able to understand Fundamental of Electrodynamics, Semiconductor, Dielectric, Magnetic and Superconducting materials which forms the base of many modern devices andtechnologies.

Text books:

1. Engineering Physics M.N. Avadhanulu and P.G. Kshirsagar. S.Chand and Company LTD.
2. Engineering Physics – Dr. L. N. Singh. SynergyKnowledgeware-Mumbai.
3. Engineering Physics - R.K. Gaur and S. L. Gupta. Dhanpat Rai Publications Pvt. Ltd.-NewDelhi.
4. Fundamental of Physics - Halliday and Resnik. Willey EasternLimited.

Reference books:

1. Introduction to Electrodynamics –David R.Griffiths.
2. Concept of Modern Physics – Arthur Beizer.TataMcGraw-Hill Publishing Company Limited.
3. Optics – Ajoy Ghatak.MacGraw Hill Education (India) Pvt.Ltd.
4. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan. New Age InternationalPvt.Ltd.
5. Solid State Physics – A.J. Dekker. McMillan India–Limited.
6. The Feynman Lectures on Physics VolI,II,III.
7. Introduction to solid state physics – Charles Kittel. John Willey andSons

BTBES103 Engineering Graphics

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks (Duration 04 hrs)

Course Contents:

Unit 1: Drawing standards andgeometricalconstruction: 4hrs
Drawing standard SP: 46, Type of lines, lettering, dimensioning, scaling conventions. Geometrical construction: Dividing a given straight line into any number of equal parts, bisecting a given angle, drawing a regular polygon given one side, special methods of constructing a pentagon and a hexagon.

Unit 2: Orthographic Projections and ProjectionsofPoints: 4hrs
Introduction to orthographic projection, drawing of orthographic views of objects from their isometric views. Projection of points lying in four quadrants.

Unit 3: Projections of Straight Lines and Planes and theirTraces: 4hrs
Projections of lines parallel and perpendicular to one or both planes, projections of lines inclined to one or both planes. Traces oflines.Projections of planes parallel and perpendicular to one or both planes, projection of planes inclined to one or both planes.

Unit 4: ProjectionsofSolids 4hrs
Types of solids, projections of solids with axis perpendicular and parallel to HP and VP, solids with axis inclined to one or both the planes. Projections of spheres touching each other.

Unit 5: Sectioning of Solids,IsometricProjections 4hrs
Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Isometric projections: Isometric scale, drawing of isometric projections from given orthographicviews.

Reference/Text Books:

1. N. D. Bhatt, *Engineering Drawing*, Charotar Publishing House, 46th Edition,2003.
2. K. V. Nataraajan, *A text book of Engineering Graphic*, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, *Engineering Graphics*, New Age International (P) Ltd, 2008.
4. DhananjayA.Jolhe,*EngineeringDrawingwithanIntroductiontoAutocad*,McGrawHill Education, 2017.

BTHM104 Communication Skills

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Contents:

Unit 1: Communication andCommunicationProcesses (04 hrs)
Introduction to Communication, Forms and functions of Communication, Barriers to Communication and overcoming them, Verbal and Non-verbalCommunication
Reading: Introduction to Reading, Barriers to Reading, Types of Reading: Skimming, Scanning, Fast Reading, Strategies for Reading, Comprehension.
Listening: Importance of Listening, Types of Listening, and Barriers toListening.

Unit 2: Verbal &Non-verbalCommunication (04 hrs)
Use of Language in Spoken Communication, Principles and Practice of Group Discussion, Public Speaking (Addressing Small Groups and Making Presentation), Interview Techniques, Appropriate Use of Non-verbal Communication, Presentation Skills, Extempore,Elocution.

Unit 3: Study of SoundsinEnglish (02 hrs)
Introduction to phonetics, Study of Speech Organs, Study of Phonemic Script, Articulation of Different Sounds in English.

Unit 4:EnglishGrammar (05 hrs)
Grammar: Forms of Tenses, Articles, Prepositions, Use of Auxiliaries and Modal Auxiliaries, Synonyms and Antonyms, Common Errors.

Unit 5: Writing Skills, Reading Skills &ListeningSkills (04 hrs)
Features of Good Language, Difference between Technical Style and Literary Style, Writing Emails, Formal and Informal English, Technical Reports: Report Writing: Format, Structure and Types
Letter Writing: Types, Parts, Layouts, Letters and Applications, Use of Different Expressions and Style, Writing Job Application Letter and Resume.

Text book:

1. Mohd. Ashraf Rizvi, *Communication Skills for Engineers*, Tata McGraw Hill

Reference Books:

1) Sanjay Kumar, Pushp Lata, *Communication Skills*, Oxford University Press,2016
2) Meenakshi Raman, Sangeeta Sharma, *Communication Skills*, Oxford University Press,2017
3) Teri Kwal Gamble, Michael Gamble, *Communication Works*, Tata McGraw Hill Education, 2010
4) Anderson, Kenneth. Joan Maclean and Tossny Lynch. Study Speaking: A Course inSpoken English for Academic Purposes. Cambridge: CUP, 2004.
5) Aswalthapa, K. *Organisational Behaviour*, Himalayan Publication, Mumbai(1991).
6) Atreya N and Guha, *Effective Credit Management*, MMC School of Management, Mumbai (1994).
7) Balan,K.R. and Rayudu C.S., *Effective Communication*, Beacon New Delhi(1996).
8) Bellare, Nirmala. *Reading Strategies*. Vols. 1 and 2. New Delhi. Oxford University Press, 1998.
9) Bhasker, W. W. S & Prabhu, N. S.: *English through Reading*, Vols. 1 and 2. Macmillan, 1975.
10) Black, Sam. *Practical Public Relations*, E.L.B.S. London(1972).
11) Blass, Laurie, Kathy Block and Hannah Friesan. *Creating Meaning*. Oxford: OUP,2007.
12) Bovee Courtland,L and Thrill, John V.*Business Communication*, Today McGraw Hill, New York, Taxman Publication(1989).

BTES105 Energy and Environment Engineering

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Contents:

Unit 1

Conventional Power Generation: Steam power station, Nuclear power plant – Gas turbine power plant- Hydro power station: Schematic arrangement, advantages and disadvantages, Thermo electric and thermionic generators, Environmental aspects for selecting the sites and locations of power plants. [**4hrs]**

Unit 2

Renewable Power Generation: Solar, Wind, Biogas and Biomass, Ocean Thermal energy conversion (OTEC), Tidal, Fuel cell, Magneto Hydro Dynamics (MHD): Schematic arrangement, advantagesanddisadvantages. [**4 hrs]**

Unit 3

Energy conservation: Scope for energy conservation and its benefits Energy conservation Principle– Maximum energy efficiency, Maximum cost effectiveness, Methods and techniques of energy conservation in ventilation and air conditioners, compressors, pumps, fans and blowers, Energy conservation in electric furnaces, ovens and boilers.,lightingtechniques.[**4 hrs]**

Unit 4

Air Pollution: Environment and Human health - Air pollution: sources- effects- control measures - Particulate emission, air quality standards, and measurement ofairpollution. [**4 hrs]**

Unit 5

Water Pollution: Water pollution- effects- control measures- Noise pollution –effects and control measures, Disposal of solid wastes, Bio-medical wastes-Thermal pollution – Soil pollution -Nuclear hazard. [**4hrs]**

Reference/Text Books:

1. A Chakrabarti, M. L Soni, P. V. Gupta, U. S. Bhatnagar, A Text book of Power System Engineering, Dhanpat Rai Publication.
2. Rai. G. D., Non-Conventional Energy Sources, Khanna Publishers, Delhi,2006.
3. Rao S., Parulekar B.B., Energy Technology-Non conventional, Renewable and Conventional, Khanna Publishers, Delhi,2005.
4. Glynn Henry J., Gary W. Heinke, Environmental Science and Engineering, Pearson Education, Inc,2004.
5. J. M. Fowler, Energy and the Environment, McGraw-Hill, 2 nd Edition,1984.
6. Gilbert M. Masters, Introduction to Environmental Engineering and Science, 2nd Edition, Prentice Hall,2003.

BTES106 Basic Civil and Mechanical Engineering

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 50 Marks (Audit)

Course Contents:

Part I Basic Civil Engineering

Unit 1: Introduction tocivilengineering (4hrs)

Various Branches, role of civil engineer in various construction activities, basic engineering properties and uses of materials: earth, bricks, timber, stones, sand, aggregates, cement, mortar, concrete, steel, bitumen, glass, FRP, composite materials.

Unit 2: Building Components &BuildingPlanning (4hrs)

Foundation and superstructure, functions of foundation, types of shallow and deep foundations, suitability in different situation, plinth, walls, lintels, beams, columns, slabs, roofs, staircases, floors, doors, windows, sills, Study of Building plans, ventilation, basics of plumbing and sanitation

Unit3:Surveying (4hrs)

Principles of survey, elements of distance and angular measurements, plotting of area, base line and offsets, introduction to Plane table surveying, introduction to levelling, concept of bench marks, reduced level, contours

Part II Basic Mechanical Engineering

Unit 4: Introduction to Mechanical Engineering, Introduction to Laws of Thermodynamics with simple examples pertaining to respective branches, IC Engines: Classification, Applications, Basic terminology, 2 and 4 stroke IC engine working principle, Power Plant: Types of Power plant; Gas power plant, Thermal power plant, Nuclear power plant, Automobiles: Basic definitions and objective (**4hrs)**

Unit 5: Design Basics, Machine and Mechanisms, Factor of safety, Engineering Materials: types and applications, basics of Fasteners Machining and Machinability, Introduction to Lathe machine, Drilling machine, Milling machine, basics of machining processes such as turning, drilling and milling, Introductiontocasting (**4 hrs)**

Text Books

1. Anurag Kandya, “Elements of Civil Engineering”, Charotar Publishing,Anand
2. M. G. Shah, C. M. Kale, and S. Y. Patki, “Building Drawing”, Tata McGrawHill
3. Sushil Kumar, “Building Construction”, Standard PublishersDistributors
4. M. S. Palani Gamy, “Basic Civil Engineering”, Tata Mc-Graw Hill Publication
5. Kanetkar T. P. and Kulkarni S. V., “Surveying and Levelling”, Vols. I, II and III, Vidyarthi Gruh Prakashan,Pune
6. B. C. Punmia, “Surveying”, Vol.- I, Vol.-II, Vol.-III, Laxmi Publications
7. G. K. Hiraskar, “Basic Civil Engineering”, Dhanpat RaiPublications
8. Gopi Satheesh, “Basic Civil Engineering”, PearsonEducation
9. P. K. Nag “Engineering Thermodynamics”, Tata McGraw Hill, New Delhi 3rd ed.2005
10. A. Ghosh, A K Malik, “Theory of Mechanisms and Machines”, Affiliated East West Press Pvt. Ltd. NewDelhi.
11. Serope Kalpakaji and Steven R Schimd “ Amanufacturing Engineering and Techology” Addision Wsley Laongman India 6th Edition2009
12. V. B. Bhandari, “ Deisgn of Machine Elements”, Tata McGraw Hill Publications, NewDelhi.

BTBS107L Engineering Physics Lab

Practical Scheme:	Examination Scheme:
Practical: 2 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Course Contents:

At least 10 experiments should be performed from the following list.

1. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
2. Wedge Shaped film - Determination of thickness of thin wire
3. Half shade Polarimeter - Determination of specific rotation of optically activematerial
4. Laser - Determination of wavelength of He-Ne laserlight
5. Magnetron Tube - Determination of 'e/m' ofelectron
6. G.M. Counter - Determination of operating voltage of G.M.tube
7. Crystal Plane – Study of planes with the help of models related MillerIndices
8. Hall Effect - Determination of HallCoefficient
9. Four Probe Method - Determination of resistivity ofsemiconductor
10. Measurement of Band gap energy of Semiconductors
11. Study of I-V characteristics of P-N junctiondiode
12. Experiment on fibreoptics
13. UltrasonicsInterferometer
14. B-H CurveExperiment
15. Susceptiblity measurementexperiment

BTES108L Engineering Graphics Lab

Practical Scheme:	Examination Scheme:
Practical: 3 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Course Contents:

List of Practical:

1. Lines, lettering and dimensioning.
2. Geometrical Constructions. (AutoCAD)
3. Orthographic projections. (AutoCAD)
4. Projections of points. (AutoCAD)
5. Projections of straight lines. (AutoCAD)
6. Projections of planes.
7. Projections of solids.
8. Section of solids.
9. Isometric Projections. (AutoCAD)

BTHM109L Communication Skills Lab

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Course Contents:

List of Practical's (Any 10 PR sessions can be conducted)

1) How to introduce oneself? (02hrs)
2) Introduction to Phonemic symbols (02hrs)
3) Articulation of sounds in English with proper manner (02 hrs)
4) Practice and exercises on articulation of sounds (02hrs)
5) Read Pronunciations/transcriptions from the dictionary (02 hrs)
6) Practice and exercises on pronunciations of words (02hrs)
7) Introduction to stress and intonation (02hrs)
8) Rapid reading sessions (02hrs)
9) Know your friend (02hrs)
10) How to introduce yourself (02hrs)
11) Extempore (02 hrs)
12) Group discussion (02hrs)
13) Participating in a debate (02hrs)
14) Presentation techniques (02hrs)
15) Interview techniques (02hrs)

Semester II
BTBS201 Engineering Mathematics II

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 1 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Content:

Unit 1: Complex Numbers

Definition and geometrical representation ; De-Moivre's theorem(without proof) ; Roots of complex numbers by using De-Moivre's theorem ; Circular functions of complex variable – definition ; Hyperbolic functions ; Relations between circular and hyperbolic functions ; Real and imaginary parts of circular and hyperbolic functions ; Logarithm of Complex quantities. **[09 Hours]**

Unit 2: Ordinary Differential Equations of First Order and First Degree and Their Applications

Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations ; Applications to orthogonal trajectories , mechanical systems and electrical systems.**[09 Hours]**

Unit 3: Higher Order Linear Differential Equations with Constant Coefficients

Introductory remarks - complementary function, particular integral ; Rules for finding complementary functions and particular integrals ; Method of variation of parameters ; Cauchy's homogeneous and Legendre's linear equations.**[09 Hours]**

Unit 4: Fourier Series

Introductory remarks- Euler's formulae ; Conditions for Fourier series expansion - Dirichlet's conditions ; Functions having points of discontinuity ; Change of interval ; Odd and even functions - expansions of odd and even periodic functions ; Half -range series. **[09 Hours]**

Unit 5: Vector Calculus

Scalar and vector fields:Gradient , divergence and curl ; Solenoidal and irrotational vector fields; Vector identities (statement without proofs) ; Green's lemma , Gauss' divergence theorem and Stokes' theorem (without proofs) . **[09 Hours]**

Text Books

Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
A course in Engineering Mathematics (Vol II) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. , Singapore.
Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

The tutorial classes in Engineering Mathematics-II are to be conducted batchwise. Each class should be divided into three batches for the purpose.

The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.

The minimum number of assignments should be eight covering all topics.

BTBS202 Engineering Chemistry

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Practical: 2 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Unit 1: Water Treatment **(7L)**

Introduction , Hard and Soft water, Disadvantages of hard water –In Domestic use, In Industrial use, Softening of water – Zeolite process, Ion exchange process, Hot Lime –Soda process, water characteristics- Hardness and its determination by EDTA method, Dissolved oxygen (DO) and its determination by Winkler's method.

Unit 2: Phase Rule **(6L)**

Phase Rule, statement, Explanation of the terms – Phase, Component, Degrees of freedom. One component system–Water and Sulphur, Reduced Phase rule equation, Two component alloy system- Phase diagram of Silver- Lead alloy system.

Unit 3: Corrosion and its Control **(7L)**

Introduction, Fundamental reason of corrosion, Electrochemical Corrosion, Mechanism of Electrochemical corrosion: a) Hydrogen Evolution Mechanism b) Absorption of Oxygen Mechanism, Direct Chemical Corrosion(Dry corrosion), Factors affecting the rate of corrosion, Methods to minimise the rate of corrosion: Proper designing , Cathodic and Anodic protection method.

Unit 4: Fuels and Lubricants **(7L)**

Fuels: Introduction, Classification of fuel, Calorific value of a fuel, Characteristics of a good fuel, solid fuel- Coal and Various types of Coal, Analysis of coal- Proximate and Ultimate analysis, Liquid fuel- Refining of Petroleum.

Lubricants: Introduction, Classification of lubricants - Solid, Semi–solid and Liquid Lubricants, Properties of lubricants: Physical properties – Viscosity, Viscosity index, Surface tension, Flash point and Fire point. Chemical properties - Acidity, Saponification.

Unit 5: Electrochemistry **(7L)**

Introduction –**Basic Concepts:** Definition and units of Ohm's Law, Specific Resistance, Specific Conductance, Equivalent Conductance, Molecular Conductance. Method of conductance measurement by Wheatstone bridge method, Cell constant, Conductometric titrations, Glass electrode, Nernst equation and its application for the calculation of half-cell potential, Fuel cell(H_2-O_2 fuel cell), Advantages of fuel cell, Ostwald's theory of acid- base indicator.

Text books:

1. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai & Sons, Delhi, 1992.
2. Bhal & Tuli, Text book of Physical Chemistry, S. Chand & Company, New Delhi.
3. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015.

Reference books:

1. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
2. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
3. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
4. S.S.Dara, Engineering Chemistry,McGraw Hill Publication, New Delhi.

BTES203 Engineering Mechanics

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week Tutorial: 1 hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Content:

Unit 1:BasicConcepts (7Lectures)
Objectives of Engineering Analysis and Design, Idealization of Engineering Problems, Simplification of real 3D problems to 2-D and 1-D domain, Basis of Assumptions, types of supports, types of load, free body diagram, Laws of Motion, Fundamental principles, Resolution and composition of a forces, Resultant, couple, moment, Varignon's theorem, force systems, Centroid of composite shapes, moment of inertia of planer sections and radius of gyration

Unit2: Equilibrium (7Lectures)
Static equilibrium, analytical and graphical conditions of equilibrium, Lami's theorem, equilibrium of coplanar concurrent forces, coplanar non concurrent forces, parallel forces, beams reactions Simple trusses (plane and space), method of joints for plane trusses, method of sections for plane trusses
Friction: Coulomb law, friction angles, wedge friction, sliding friction and rolling resistance

Module3: Kinematics (7Lectures)
Types of motions, kinematics of particles, rectilinear motion, constant and variable acceleration, relative motion, motion under gravity, study of motion diagrams, angular motion, tangential and radial acceleration, projectile motion, kinematics of rigid bodies, concept of instantaneous center of rotation, concept of relativevelocity.

Module4: Kinetics (6Lectures)
Mass moment of inertia, kinetics of particle, D'Alembert's principle: applications in linear motion, kinetics of rigid bodies, applications in translation, applications in fixed axisrotation

Module5: Work, Power, Energy (6Lectures)
Principle of virtual work, virtual displacements for particle and rigid bodies, work done by a force, spring, potential energy, kinetic energy of linear motion and rotation, work energyequation, conservation of energy, power, impulse momentum principle, collision of elasticbodies.

Text Books

1. S. Timoshenko, D. H. Young, "Engineering Mechanics", McGraw Hill,1995.
2. Tayal A. K., "Engineering Mechanics", Umesh Publications,2010.
3. Bhavikatti S. S., Rajashekarappa K. G., "Engineering Mechanics", New Age International Publications, 2ndEdition.
4. Beer, Johnston, "Vector Mechanics for Engineers", Vol. 1: Statics and Vol. 2: Dynamics, McGraw Hill Company Publication, 7th edition,1995.
5. Irving H. Shames, "Engineering Mechanics - Statics and Dynamics", Pearson Educations, Fourth edition, 2003.
6. McLean, Nelson, "Engineering Mechanics", Schaum's outline series, McGraw Hill Book Company, N. Delhi, Publication.
7. Singer F. L., "Engineering Mechanics - Statics & Dynamics", Harper and Row Pub.York.
8. Khurmi R. S., "Engineering Mechanics", S. Chand Publications, N.Delhi

BTES204 Computer Programming

Teaching Scheme:	Examination Scheme:
Lecture: 3hrs/week	Internal Assessment: 20 Marks Mid Term Test: 20 Marks End Semester Exam: 60 Marks

Course Content:

Unit 1

Process of programming: Editing, Compiling, Error Checking, executing, testing and debugging of programs. IDE commands. Eclipse for C Program development, Flowcharts, Algorithms. **(4 Lectures)**

Unit 2

Types, Operators and Expressions: Variable names, Data types, sizes, constants, declarations, arithmetic operators, relational and logical operators, type conversions, increment and decrement operators, bitwise operators, assignment operators and expressions, conditional expressions precedence
and order of evaluation. **(4 Lectures)**

Unit 3

Control Flow: Statements and Blocks. If-else, else-if switch Loops while and for, do-while break and continue goto and Labels. Functions and Program Structure: Basic of functions, functions returning nonintegers external variables scope rules. **4 Lectures)**

Unit 4

Arrays in C: Initializing arrays, Initializing character arrays, multidimensional arrays. **(4 Lectures)**

Unit 5

Structures C: Basics of structures, structures and functions arrays of structures.**(4 Lectures)**
Pointer in C. Pointers to integers, characters, floats, arrays, structures.
Special Note: Topic of Pointers in C is only for lab exercises and not for end semester examinations.

Reference/Text Books:

1. Brain W. Kernighan & Dennis Ritchie, The C Programming Language, Prentice Hall, 2 nd
   Edition, 1988.
2. R. S. Bichkar, Programming with C, Orient Blackswan, 1 st Edition, 2012.
3. Herbert Schildit, C the Complete Reference, McGraw-Hill Publication, 2000.
4. Balguruswamy, Programming in C, PHI.
5. Yashwant Kanitkar, Let Us C, PHI

BTES205Basic Electrical and Electronics Engineering

Teaching Scheme:	Examination Scheme:
Lecture: 2 hrs/week	Internal Assessment: 50 Marks (Audit)

Course Content:

Unit 1 (4Lectures)

Elementary Electrical Concepts:

Fundamental of Electrical system Potential difference, Ohm's law, Effect of temperature on resister, resistance temperature coefficient, Electrical wiring system: Study of different wire gauges and their applications in domestic and industry. Energy Resources and Utilization: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization,Advantages & Disadvantages of AC & DC transmission. Concept of Supply Demand, Power Factor, Need of unityfactor.

Unit 2 (4Lectures)

Measurement of Electrical Quantities:

Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Study of Energy meters. Study of Electrical Storage devices: Batteries such as Nickel-cadmium (NiCd), Lithium-ion (Li-ion), Lithium Polymer (Li-pol.) batteries. Study of circuit breakers & Actuators (MCB & MPCB, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays)

Unit 3 (4Lectures)

Diodes and Circuits:

The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for I_{DC} V_{DC} V_{RMS}, I_{RMS}, Efficiency and Ripple Factor for each configuration. Filters: Capacitor Filter, Choke Input Filter, Capacitor InputFilter(Π Filter), Zener Diode, Characteristics, Specifications, Zener Voltage Regulator, Types of Diodes: LED,Photodiode

Unit 4 (4Lectures)

Semiconductor Devices and Applications:

Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of BJT in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.

Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean

Postulates, De-Morgan Theorems

Reference/Text Books:

1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-HillPublication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledgeware Mumbai, 2017.ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition,2011.
4. Boylstad, Electronics Devices and Circuits Theory, PearsonEducation.
5. Edward Hughes, Electrical Technology, PearsonEducation.
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication,2011.
7. B. L. Theraja, Basic Electronics, S. Chand Limited,2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication,2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design &Technology,WalterC. Bosshart, McGraw-Hill Publication.

Note: Students are advised to use internet resources whenever required

BTES206L Workshop Practice

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Instruction to Students:

Each student is required to maintain a „workshop diary" consisting of drawing / sketches of the jobsand a brief description of tools, equipment, and procedure used for doing thejob.

List of Practical:

1. Wood sizing exercises in planning, marking, sawing, chiseling and grooving to make half lap joint and cross lapjoint.
2. A job involving cutting, filing to saw cut, filing all sides and faces, corner rounding, drilling and tapping on M. S.plates.
3. A job on use of plumbing tools and preparation of plumbing line involving fixing of water tap and use of elbow, tee, union and coupling, etc.
4. Making a small parts using GI sheet involving development, marking, cutting, bending, brazing and soldering operations- i)Tray ii) Funnel and similararticles.
5. Exercise in Arc welding (MMAW) to make a square buttjoint.
6. Exercise in Resistance (Spot) welding to make a lap joint.
7. Ajobusingpower operated tools related to sheet metal work, Welding, Fitting, Plumbing,

Carpentry and patternmaking.

8. A job on turning of a Mild Steel cylindrical job using center lathe.

Contents:

a) **Carpentry:** Technical Terms related to wood working, Types of wood, Joining materials, Types of joints - Mortise and Tenon, Dovetail, Half Lap, etc., Methods of preparation and applications, Wood working lathe, safety precautions.

b) **Welding:** Arc welding - welding joints, edge preparation, welding tools and equipment, Gas welding - types of flames, tools and equipment, Resistance welding - Spot welding, joint preparation, tools and equipment, safety precautions.

c) **Fitting and Plumbing:** Fitting operation like chipping, filing, right angle, marking, drilling, tapping etc., Fitting hand tools like vices, cold chisel, etc. Drilling machine and its operation, Different types of pipes, joints, taps, fixtures and accessories used in plumbing, safetyprecautions.

d) **Sheet Metal Work:** Simple development and cutting, bending, Beading, Flanging, Lancing and shearing of sheet metal, Sheet metal machines - Bending Machine, Guillotine shear, Sheet metal joints, Fluxes and their use.

e) **Machine shop**: Lathe machine, types of lathes, major parts, cutting tool, turning operations, safety precautions

R**eference/Text Books:**

1. K. C. John, Mechanical Workshop Practice, Prentice Hall Publication, New Delhi,2010.
2. Hazra and Chaudhary, Workshop Technology-I, Media promoters & Publisher private limited.

BTBS207L Engineering Chemistry Lab

ENGINEERING CHEMISTRY (Practical)

List of Experiments: (Perform any 8 - 10 Experiments)

1. Determination of Hardness of water sample by EDTA method.
2. Determination of Chloride content in water sample by precipitation titration method.
3. Determination of Dissolved Oxygen in water by Iodometric method.
4. Determination of Percent purity of Bleaching Powder.
5. pH – metric Titration (Acid Base titration)
6. Conductometric Titration (Acid Base titration)
7. Surface tension
8. Viscosity
9. To determine Acidity of water sample.
10. To determine Calorific value of a fuel.
11. Determination of Acid value of an oil sample.
12. Determination of Saponification value of an oil sample.
13. Experiment on water treatment by using Ion exchange resins.
14. To find out P-T curve diagram of steam.
15. To determine Alkalinity water sample.
16. Determination of rate of corrosion of metal.

Reference Books:

1. Systematic experiments in Chemistry, A. Sethi, New Age International Publication, New Delhi.
2. Practical Inorganic Chemistry, A. I. Vogel, ELBS Pub.
3. Practical in Engineering Chemistry, S. S. Dara.

BTES208L Engineering Mechanics Laboratory

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Internal Assessment: 60 Marks External Exam: 40 Marks

Students are expected to satisfactorily complete any ten experiments listed below.

List of Practical's/Experiments/Assignments

1. Polygon law of coplanarforces.
2. Centroid of irregular shapedbodies.
3. Bell crank lever.
4. Support reaction forbeam.
5. Problems on beam reaction by graphics staticsmethod.
6. Simple / compound pendulum.
7. Inclined plane (to determine coefficient offriction).
8. Collision of elastic bodies (Law of conservation ofmomentum).
9. Moment of Inertia of flywheel.
10. Verification of law of Machine using Screwjack
11. Verification of law of Machine using Worm and WormWheel
12. Verification of law of Machine using Single and Double GearCrab.
13. Assignment based on graphics staticssolutions
14. Application of Spreadsheet Program for concepts like law of moments, beam reactions, problems in kinematics, etc.
15. Any other innovative experiment relevant to EngineeringMechanics.

Semester III

Engineering Mathematics-III

BTBS301	Engineering Mathematics-III	BSC 7	3L-1T-0P	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to:

1. Linear differential equations of higher order using analytical methods and numerical methods applicable to Control systems and Networkanalysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signalprocessing.
3. Vector differentiation and integration required in Electro-magnetics and Wavetheory.
4. Complex functions, conformal mappings, contour integration applicable to Electrostatics, Digital filters, Signal and Image processing.

Course Outcomes:

On completion of the course, students will be able to:

- Solve higher order linear differential equation using appropriate techniques for modeling and analyzing electrical circuits.
- Solve problems related to Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
- Obtain Interpolating polynomials, numerically differentiate and integrate functions, numerical solutions of differential equations using single step and multi-step iterative methods used in modern scientific computing.
- Perform vector differentiation and integration, analyze the vector fields and apply to Electromagnetic fields.
- Analyze conformal mappings, transformations and perform contour integration of complex functions in the study of electrostatics and signal processing.

Course Contents:

Unit 1: Laplace Transform [09 Hours]

Definition – conditions for existence ; Transforms of elementary functions ; Properties of Laplace transforms - Linearity property, first shifting property, second shifting property, transforms of functions multiplied by t^n, scale change property, transforms of functions divided by t, transforms of integral of functions, transforms of derivatives ; Evaluation of integrals by using Laplace transform ; Transforms of some special functions- periodic function, Heaviside-unit step function, Dirac delta function.

Unit 2: Inverse Laplace Transform [09 Hours]

Introductory remarks ; Inverse transforms of some elementary functions ; General methods of finding inverse transforms ; Partial fraction method and Convolution Theorem for finding inverse Laplace transforms ; Applications to find the solutions of linear differential equations and simultaneous linear differential equations with constant coefficients

Unit 3: Fourier Transform [09 Hours]

Definitions – integral transforms ; Fourier integral theorem (without proof) ; Fourier sine and cosine integrals ; Complex form of Fourier integrals ; Fourier sine and cosine transforms ; Properties of Fourier transforms ; Parseval's identity for Fourier Transforms.

Unit 4: Partial Differential Equations and Their Applications[09 Hours]

Formation of Partial differential equations by eliminating arbitrary constants and functions; Equations solvable by direct integration; Linear equations of first order (Lagrange's linear equations); Method of separation of variables – applications to find solutions of one dimensional heat flow equation $\left(\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial x^2}\right)$, and one dimensional wave equation (i.e.$\frac{\partial^2 y}{\partial t^2} = c^2 \frac{\partial^2 y}{\partial x^2}$).

Unit 5: Functions of Complex Variables [09 Hours]

Analytic functions; Cauchy- Riemann equations in Cartesian and polar forms; Harmonic functions in Cartesian form; Cauchy's integral theorem; Cauchy's integral formula; Residues; Cauchy's residue theorem (All theorems without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, New Delhi.
2. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.
3. A course in Engineering Mathematics (Vol III) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.

Reference Books

1. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, New York.
2. A Text Book of Engineering Mathematics by Peter O' Neil, Thomson Asia Pte Ltd. ,Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.
4. Integral Transforms and their Engineering Applications by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
5. Integral Transforms by I. N. Sneddon, Tata McGraw-Hill , New York.

General Instructions:

1. The tutorial classes in Engineering Mathematics-III are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Thermal and Fluid Engg.

BTMXC302	PCC 1	Thermal and Fluid Engg.	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	
CO7	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												

Course Contents:

Unit 1: Thermodynamics

Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process. temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, First law of thermodynamics for a closed system undergoing a cycle and change of state, SFEE, Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Carnot cycle

Unit 2: Fluid properties & Hydrostatic

Fluid properties & its definitions, definition of fluid, Viscosity, Bulk modulus of elasticity, Vapour pressure, Surface tension, Capillarity, Manometers (No numerical on manometers), Pascal's law, Hydrostatic law its derivation, Total pressure & Centre of pressure on vertical,

horizontal, inclined, curved surface its derivation, Concept Of buoyancy & flotation Meta centre, metacentric height its derivation. Stability, unstability, equilibrium of floating & submerged body

Unit 3: Fluid Kinematics and Dynamics

Types of flow, Definition of steady, Unsteady, Uniform, Non uniform, Laminar, Turbulent, Compressible, incompressible, rotational, Irrotational flow, 1D-2D flows, Stream line, Streak line, Path line, concept of Velocity, potential & stream function flow net (no numerical treatment), Continuity equation for steady, Unsteady, Uniform, Non uniform, Compressible incompressible,2D Euler's equation, Bernoulli's equation along a stream line for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter.

Unit 4: Viscous Flow and Turbulent Flow

Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.

Turbulent Flow**:** Reynolds's experiment, frictional loss in pipe flow, shear stress in turbulent flow, major and minor losses.

Unit 5: Dimensional Analysis and Flow through Pipes

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment), Loss of energy in pipes, loss of energy due to friction, minor energy losses, concept of HGL and TEL, flow through syphon, flow trough pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes, Power transmission through pipes. Water hammer phenomenon (No numerical on water hammer)

Texts:

1. P. N. Modi, S. M. Seth, "Fluid Mechanics and Hydraulic Machinery", Standard Book House, 10^{th} edition,1991.
2. Robert W. Fox, Alan T. McDonald, "Introduction to Fluid Mechanics", John Wile and Sons, 5^{th}edition.
3. Fluid mechanics and Hydraulic machines, Dr. R. K. Bansal , Laxmi Publication, Delhi, 2005
4. Thermodynamics, P. K. Nag, TMH

References:

1. V. L. Streeter, K. W. Bedfordand E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill, 9^{th}edition, 1998.
2. S. K. Som, G.Biswas, " Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill, 2^{nd}edition, 2003.

Basic Concepts of Mechatronics

BTMXC303	PCC2	Basic Concepts of Mechatronics	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Contents:

Unit I: Introduction: Definition of Mechanical Systems, Philosophy and approach; Systems and Design: Mechatronic approach, Integrated Product Design, Modeling, Analysis and Simulation, Man-Machine Interface.

Unit II: Sensors and transducers: classification, Development in Transducer technology, Opto-Electronics-Shaft encoders, CD Sensors, Vision System, etc.

Unit III: Drives and Actuators: Hydraulic and Pneumatic drives, Electrical Actuators such as servo motor and Stepper motor, Drive circuits, open and closed loop control; Embedded Systems: Hardware Structure, Software Design and Communication, Programmable Logic Devices, Automatic Control and Real Time Control Systems

Unit IV: Smart materials: Shape Memory Alloy, Piezoelectric and Magnetostrictive Actuators: Materials, Static and dynamic characteristics, illustrative examples for positioning, vibration

isolation, etc.

Unit V: Micromechatronic systems: Microsensors, Microactuators; Micro-fabrication techniques LIGA Process: Lithography, etching, Micro-joining etc. Application examples; Case studies Examples of Mechatronic Systems from Robotics Manufacturing, Machine Diagnostics, Road vehicles and Medical Technology.

Text/Reference Books:

1. Mechatronics System Design, Devdas Shetty & Richard A. Kolk, PWS Publishing Company (Thomson Learning Inc.).
2. Mechatronics: A Multidisciplinary Approach, William Bolton, Pearson Education
3. A Textbook of Mechatronics, R.K. Rajput, S. Chand & Company Private Limited
4. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering, William Bolton, Prentice Hall.

Electrical Machines and Drives

BTMXC304	PCC3	Electrical Machines and Drives	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												

CO6												

Course Contents:

Unit I: DC Machines-I: Basic construction of a DC machine, magnetic structure - stator yoke, stator poles, pole-faces or shoes, air gap and armature core, visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil. Armature winding and commutation - Elementary armature coil and commutator, lap and wave windings, construction of commutator, linear commutation Derivation of back EMF equation, armature MMF wave, derivation of torque equation, armature reaction, air gap flux density distribution with armature reaction.

Unit II: DC Machines –II: Motoring and generation Armature circuit equation for motoring and generation, Types of field excitations - separately excited, shunt and series. Open circuit characteristic of separately excited DC generator, back EMF with armature reaction, voltage build-up in a shunt generator, critical field resistance and critical speed. V-I characteristics and torque-speed characteristics of separately excited shunt and series motors. Speed control through armature voltage. Losses, load testing and back-to back testing of DC machines.

Unit III: Induction Machines: Construction, Types (squirrel cage and slip-ring), Torque Slip Characteristics, Starting and Maximum Torque. Equivalent circuit. Phasor Diagram, Losses and Efficiency. parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, frequency). Methods of starting, braking and speed control for induction motors. Generator operation. Self-excitation. Doubly-Fed Induction Machines.

Unit IV: Single-phase induction motors: Constructional features, double revolving field theory, equivalent circuit, determination of parameters. Split-phase starting methods and applications.

Unit V: Synchronous machines: Constructional features, cylindrical rotor synchronous machine - generated EMF, equivalent circuit and phasor diagram, armature reaction, synchronous impedance, voltage regulation. Operating characteristics of synchronous machines, V-curves. Salient pole machine - two reaction theory, analysis of phasor diagram, power angle characteristics. Parallel operation of alternators - synchronization and load division.

Text/Reference Books:

1. A. E. Fitzgerald and C. Kingsley, “Electric Machinery”, McGraw Hill Education, 2013.
2. M. G. Say, “Performance and design of AC machines”, CBS Publishers, 2002.
3. P. S. Bhimbhra, “Electrical Machines”, Khanna Book Publishing House, 2018.
4. I. J. Nagrath and D. P. Kothari, “Electric Machines”, McGraw Hill Education, 2010.
5. A. S. Langsdorf, “Alternating current Machines”, McGraw Hill Education, 1984.
6. P. C. Sen, “Principles of Electric Machines and Power Electronics”, John Wiley & Sons, 2007.
7. P. S. Bhimbhra, “Power Electronics”, Khanna Publishers, 2017.

Alternative NPTEL/SWAYAM Course

Microprocessor and Microcontroller

BTMXC305	PCC4	Microprocessor and Microcontroller	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 4 hrs/week	Continuous Assessment: 60 Marks External Exam: 40 Marks

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Unit I: 8085 MICROPROCESSOR: History and Evolution of Microprocessor and their Classification, Architecture of 8085 Microprocessor, Address / Data Bus multiplexing and demultiplexing. Status and Control signal generation, Instruction set of 8085 Microprocessor, Classification of instructions, addressing modes, timing diagram of the instructions.

Unit II: Hardware Interfacing with 8085: Methods of data Transfer and Interrupts of 8085 microprocessors: Classification of interrupts, Programming using interrupts, Direct Memory Access, Serial and parallel data transfer, Interfacing of Memory Chips with 8085 Microprocessor, Interfacing of 8085 with 8155/8156 (RAM), 8355/8755 (ROM). Interfacing of Programmable Devices with 8085 Microprocessor, 8279 programmable Keyboard/Display interface, 8255A programmable Parallel interface, 8254 programmable Interval Timer, 8259A programmable Interrupt Controller, Assembly language programming.

Unit III: 16-bit low power MCU: Introduction to microcontrollers and embedded systems, Von Neumann (Princeton) and Harvard architecture, RISC and CISC machine, Architecture, Programming Techniques, Addressing Modes, Programming System registers and configuration I/O ports pull up/down registers concepts, Low Power aspects of MSP430: low

power modes, Active vs Standby current consumption.

Unit IV: Configuring Peripherals in MSP430: External interrupts and software interrupt, interrupt programming, Watchdog timer, Clock Tree in MSP430, Timer/ counter interrupt, Programming MSP430 timer, counter programming, Real Time Clock (RTC), PWM control, timing generation and measurements. Analog interfacing and data acquisition: ADC and Comparator in MSP430, data transfer using DMA.

Unit V: Serial Communication Interfaces in MSP430: Basics of serial communication, mode of serial communication, RS232, serial communication issue, Serial port programming. Implementing and programming UART, I2C, SPI interface using MSP430, interfacing external devices, external memory, keyboards, display devices, DAC/ADC, DC Motor, Stepper Motor, Servomotor, power management, Sensor Interfacing and signal conditioning. Case Study: MSP430 based embedded system application using the interface protocols for communication with external devices: "A Low- Power Battery less Wireless Temperature and Humidity Sensor with Passive Low Frequency RFID.

Text Books:

1. Ramesh Gaonkar, "Microprocessor Architecture, Programming, and Applications with the 8085", Penram International Publication (India) Pvt. Ltd. AICTE Model Curriculum for UG Degree Course in Mechatronics 121

2. DV Hall, "Microprocessors Interfacing", Tata McGraw Hill Publication.

3. N. Senthil Kumar, M. Saravanan, S. Jeevananthan, "Microprocessors and Microcontrollers", Oxford University Press Publication.

3. Getting Started with the MSP430 Launchpad by Adrian Fernandez, Dung Dang, Newness publication ISBN-13: 978-0124115880 5. MSP430 microcontroller basics 1st Edition by John H. Davies (Author), Newnes Publication ISBN-13: 978-0750682763

References:

1. http://processors.wiki.ti.com/index.php/MSP430_LaunchPad_Low_Power_Mode.

2.http://processors.wiki.ti.com/index.php/MSP430_16-t_Ultra Low_Power_MCU_Training.

3. AK Roy & KM Bhurchandi, "Advance Microprocessor and Peripherals (Architecture, Programming & Interfacing)", Tata McGraw Hill Publication..

Basic Mechatronics Lab

BTMXCL306	PCC5	Basic Mechatronics Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments:

1. Identification and familiarization of the following components: resistors, inductors, capacitors, diodes, transistors, LED's.
2. Familiarization with the following components: CRO, transformer, function generator, Multimeter, power supply.
3. Familiarization with the following electrical machines: Induction motors, DC motors, synchronous motors, single phase motors.
4. Familiarization with the following mechanical components: gears, gear train, bearings, couplings, tachometer
5. To study and design the PN junction diode and its use as half wave and full wave rectifier.
6. To design a voltage regulator using zener diode. Discuss the behavior of the regulator for various loads.
7. To verify truth tables of various logic gates and flip flops.
8. To study various sensors and transducers and compare with ideal characteristics.
9. To measure the characteristics of LVDT using linear displacement trainer kit.

Text/Reference Books:

1. Bolton, "Mechatronics", Pearson, Singapore.
2. Mahalik, "Principles, concepts and applications Mechatronics", TMH.
3. Ramesh Gaonkar, "Introduction to 8085-PENRAM", International Publishing.
4. Muzumdar, "Pneumatics" –Tata McGraw-Hill Education.

Electrical Machines Lab

BTMXCL307	PCC6	Electrical Machines Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments:

1 Performance characteristics of a D.C. Shunt motor.
2. Speed control of dc shunt motor by varying armature circuit and field circuit method.
3. Load test of D.C. shunt motor.
4. Perform an open circuit test and block rotor test on a 3 phase IM to draw equivalent circuit.

5. Perform load test on a universal motor and determine the performance with dc/ac supply voltage.
6. Speed control of 3 phase Induction Motor.
7. Determination of the performance characteristics of a three-phase induction motor by load test.
8. Obtain a circle diagram of the given three-phase induction motor by conducting no load and blocked motor test and to determine the maximum torque, maximum power output.

Text/Reference Books:

1. A. E. Fitzgerald and C. Kingsley, "Electric Machinery", McGraw Hill Education, 2013.
2. M. G. Say, "Performance and design of AC machines", CBS Publishers, 2002.
3. P. S. Bhimbhra, "Electrical Machinery", Khanna Publishers, 2011.
4. I. J. nagrath and D. P. Kothari, "Electric Machines", McGraw Hill Education, 2010.
5. A. S. Langsdorf, "Alternating current Machines", McGraw Hill Education, 1984.
6. P. C. Sen, "Principles of Electric Machines and Power Electronics", John Wiley & Sons, 2007.

IT – 1 Evaluation

BTES209P (IT – 1)	IT– 1 Evaluation	PROJ-1	0L-0T-0P	1 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: --	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

Semester IV
Analog and Digital Electronics

BTMXC401	PCC 7	Analog and Digital Electronics	3-1-0	4 Credits

Pre-Requisites: None

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	

CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit-I: Field Effect Transistors: Junction Field Effect Transistors, MOSFETs, Differences between JFETs and MOSFETs, Biasing MOSFETs, FET Applications, CMOS Devices. Wave-Shaping Circuits: Integrated Circuit(IC) Multi vibrators. Introduction to Operational Amplifier: Ideal v/s practical Op Amp, Performance Parameters, Operational Amplifier Application Circuits: Peak Detector Circuit, Comparator, Active Filters, Non Linear Amplifier, Relaxation Oscillator, Current-To-Voltage Converter, Voltage-To Current Converter.

Unit-II: The Basic Gates: Review of Basic Logic gates, Positive and Negative Logic, Introduction to HDL. Combinational Logic Circuits: Sum-of-Products Method, Truth Table to Karnaugh Map, Pairs Quads, and Octets, Karnaugh Simplifications, Don't-care Conditions, Product-of-sums Method, Product-of-sums simplifications, Simplification by Quine-McClusky Method, Hazards and Hazard covers, HDL Implementation Models.

Unit-III: Data-Processing Circuits: Multiplexers, Demultiplexers, 1-of-16 Decoder, BCD to Decimal Decoders, Seven Segment Decoders, Encoders, Exclusive-OR Gates, Parity Generators and Checkers, Magnitude Comparator, Programmable Array Logic, Programmable Logic Arrays, HDL Implementation of Data Processing Circuits. Arithmetic Building Blocks, Arithmetic Logic Module.

Unit-IV: Flip- Flops: FLIP-FLOP Timing, JK Master-slave FLIP-FLOP, Switch Contact Bounce Circuits, Various Representation of FLIP-FLOPs, HDL Implementation of FLIP FLOP. Registers: Types of Registers, Serial In - Serial Out, Serial In - Parallel out, Parallel In - Serial Out, Parallel In - Parallel Out, Universal Shift Register, Applications of Shift Registers, Register implementation in HDL.

Unit-V: Counters: Decade Counters, Preset table Counters, Counter Design as a Synthesis problem, A Digital Clock, Counter Design using HDL. D/A Conversion and A/D Conversion:

Variable, Resistor Networks, Binary Ladders, D/A Converters, D/A Accuracy and Resolution, A/D Converter-Simultaneous Conversion, A/D Converter-Counter Method, Continuous A/D Conversion, A/D Techniques, Dual slope A/D Conversion, A/D Accuracy and Resolution.

Text/Reference Books:

1. A.K. Main & Nakul Maini, Analog Electronics, Khanna Book Publishing House (2018).
2. A.S. Sedra & K.C.Smith, Microelectronics Circuits, Oxford University Press (1997).
3. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications.
4. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory.
5. William Kleitz, Digital Electronics, Prentice Hall International Inc

Low Cost Automation

BTMXC402	PCC 8	Low cost Automation	3-1-0	4 Credits

Pre-Requisites: None

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Basic Human Rights

BTHM403	HSSMC3	Basic Human Rights	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week	Credit Course

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	Understand the history of human rights.
CO2	Learn to respect others caste, religion, region and culture.
CO3	Be aware of their rights as Indian citizen.
CO4	Understand the importance of groups and communities in the society.
CO5	Realize the philosophical and cultural basis and historical perspectives of human rights.
CO6	Make them aware of their responsibilities towards the nation.

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1						2						
CO2												
CO3												
CO4									3			
CO5								2		2		
CO6												1

Course Contents:

Unit 1: The Basic Concepts, Fundamental Rights and Economic Program [07 Hours]

Individual, group, civil society, state, equality, justice.Human Values, Human rights and Human Duties.Declaration of independence, Rights of citizen, Rights of working and exploited people

Society, religion, culture, and their inter-relationship.Impact of social structure on human behavior.

Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labour.

Unit 2: Workers and Human Rights [07 Hours]

Migrant workers and human rights violations, human rights of mentally and physically challenged. State, Individual liberty, Freedom and democracy.

Unit 3: NGOs and Human Rights in India [07 Hours]

Land, Water, Forest issues.

Unit 4: Human Rights in Indian Constitution and Law **[07 Hours]**

i) The constitution of India: Preamble
ii) Fundamental rights.
iii) Directive principles of state policy.
iv) Fundamental duties.
v) Some other provisions.

Unit 5: UDHR and Indian Constitution **[07 Hours]**

Universal declaration of human rights and provisions of India; Constitution and law; National human rights commission and state human rights commission.

References:

1. Shastry, T. S. N., "India and Human Rights: Reflections", Concept Publishing Company India (P Ltd.), 2005.
2. C. J. Nirmal, "Human Rights in India: Historical, Social and Political Perspectives (Law in India)", Oxford India.

Theory of Machines and Mechanisms

BTMXC404	PCC 9	Theory of Machines and Mechanisms	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												

CO2												
CO3												
CO4												
CO5												
CO6												

Course Contents:

Unit I: Classification of mechanisms- Basic kinematic concepts and definitions Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.

Unit II: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centres, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics.

Unit III: Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation.

Unit IV: Classification of cams and followers- Terminology and definitions Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers. Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Unit V: Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication- friction clutches- belt and rope drives- friction in brakes.

Text Books:

1. Thomas Bevan, Theory of Machines, 3rdedition, CBS Publishers & Distributors,2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press,2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGrawHill,2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East- West Pvt. Ltd, New Delhi

Numerical Methods in Mechanical Engineering

BTMPE405A	PEC 1	Numerical Methods in Engineering	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks(Duration 03 hrs)

Course Outcomes: At the end of the course, students will be able to:

CO1	Describe the concept of error
CO2	Illustrate the concept of various Numerical Techniques
CO3	Evaluate the given Engineering problem using the suitable Numerical Technique
CO4	Develop the computer programming based on the Numerical Techniques

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3		1	3							
CO2	3	3		1	3							
CO3	3	3		1	3							
CO4	3	3		1	3							

Course Contents:

Unit1: Error Analysis **[07 Hours]**

Significant figures, round-off, precision and accuracy, approximate and true error, truncation error and Taylor series, machine epsilon, data uncertainties, error propagation, importance of errors in computer programming.

Unit2: Roots of Equations **[07 Hours]**

Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineeringapplications.

Unit3: Numerical Solution of Algebraic Equations **[07 Hours]**

Motivation, Cramer'srule, Gauss- Elimination Method, pivoting, scaling, engineering applications.

Unit4: Numerical Integration and Differentiation **[07 Hours]**

Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson'srule, engineering applications Numerical differentiation using Finite divide Difference method

Unit5: Curve, Fitting and Interpolation and Computer Programming **[07 Hours]**

Motivation, Least Square Regression: Linear Regression, Polynomial regression.
Interpolation: Newton's Divide Difference interpolation, engineering applications.
Solution to Ordinary Differentiation Equations: Motivation**,** Euler's and Modified Euler's Method, Heun'smethod, Runge–KuttaMethod,engineeringapplications.

Computer Programming
Overview of programming language, Development of at least one computer program based on each unit.

Texts:

1. Steven C Chapra, Reymond P. Canale, "Numerical Methods for Engineers",Tata McGraw Hill Publications,2010.
2. E.Balagurusamy, "NumericalMethods",TataMcGraw HillPublications,1999.

References:

1. V. Rajaraman, "FundamentalofComputers",PrenticeHallofIndia,NewDelhi,2003.
2. S. S. Sastri,"IntroductoryMethodsofNumericalMethods",PrenticeHallofIndia,NewDelhi, 3rd edition,2003.
3. K. E. Atkinson, "AnIntroductionto NumericalAnalysis",Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

Embedded System

BTMXE405A	PEC 1	Embedded System	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												

CO3												
CO4												
CO5												

Course Contents:

Unit 1: The concept of embedded systems design, embedded microcontroller cores, embedded memories. Examples of embedded systems,

Unit 2: Technological aspects of embedded systems: interfacing between analog and digital blocks, signal conditioning, digital signal processing.

Unit 3: Sub-system interfacing, interfacing with external systems, user interfacing.

Unit 4: Design trade-offs due to process compatibility, thermal considerations, etc.,

Unit 5: Software aspects of embedded systems: real time programming languages and operating systems for embedded systems.

Text/Reference Books

1. J.W. Valvano, "Embedded Microcomputer System: Real Time Interfacing", Brooks/Cole, 2000.
2. Jack Ganssle, "The Art of Designing Embedded Systems", Newness, 1999.
3. V.K. Madisetti, "VLSI Digital Signal Processing", IEEE Press (NY, USA), 1995.
4. David Simon, "An Embedded Software Primer", Addison Wesley, 2000.
5. K.J. Ayala, "The 8051 Microcontroller: Architecture, Programming and Applications", Penram Intl, 1996.

Signals & Systems

BTMXE405B	PEC 1	Signals & Systems	3-1-0	4 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 1 hr/week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hrs)

Pre-Requisites: None

Course Outcomes: At the end of the course, students will be able to:

CO1	
CO2	
CO3	
CO4	
CO5	
CO6	

CO7	

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1												
CO2												
CO3												
CO4												
CO5												
CO6												
CO7												

Course Contents:

Unit I: Basic definitions, Classification of signals and systems. Signal operations and properties. Basic continuous time signals, signal sampling and quantization, is cretization of continuous time signals, discrete time signals. Basic system properties, Representation of digital signals. Case study of different signals form communication and biomedical field.

Unit II: Impulse response characterization and convolution integral for CT- LTI system, signal responses to CT-LTI system, properties of convolution, LTI system response properties from impulse response. (*Review of Laplace transform with reference to CT signals and systems.)

Unit III: Impulse response characterization and convolution sum, Causal signal response to DT-LTI systems. Properties of convolution summation, Impulse response of DT-LTI system. DT-LTI system properties from Impulse response. System analysis from difference equation model

Unit IV: Representation of periodic functions, Fourier series, Frequency spectrum of a periodic signals, Fourier Transform, Relation between Laplace Transform and Fourier Transform and its properties. Introduction to DTFT and DFT

Unit V: The z-Transform, Convergence of z-Transform, Basic z-Transform, Properties of z-Transform, Inverse z-Transform and Solving difference equation using z-Transform

Text/Reference Books:

1. Signals and Systems by Alan V. Oppenheim, Alan S. Wilsky and Nawab, Prentice Hall.
2. Signals and Systems by K. Gopalan, Cengage Learning (India Edition).
3. Signals and Systems by Michal J. Roberts and Govind Sharma, Tata Mc-Graw Hill Publications.
4. Signals and Systems by Simon Haykin and Bary Van Veen, Wiley- India Publications.
5. Linear Systems and Signals by B.P.Lathi, Oxford University Press.
6. Signal, Systems and Transforms by Charles L. Philips, J. M. Parr and E. A. Riskin, Pearson Education.

7. Digital Signal Processing Fundamentals and Applications by Li Tan, Elsevier, Academic Press. 8. Signal and Systems by Anand Kumar, 3rd Edition, PHI

Analog and Digital Electronics Lab

BTMXCL406	PCC10	Analog and Digital Electronics Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments: (Any Six Experiments)

1. a. Design and construct a Schmitt trigger using Op-Amp for given UTP 1 and LTP values and demonstrate its working. b. Design and implement a Schmitt trigger using Op-Amp using a simulation package for two sets of UTP and LTP values and 3 demonstrate its working.

2. a. Design and construct a rectangular waveform generator (Op-Amp 5 relaxation oscillator) for given frequency. b. Design and implement a rectangular waveform generator (Op-Amp relaxation oscillator) using a simulation package and observe the change in frequency when all resistor values are doubled.

3. Design and implement a stable multivibrator circuit using 555 timers for a given frequency and duty cycle.

4. Design and implement Half adder, Full Adder, Half Subtractor, Full Subtractor using basic gates.

5. a. Given any 4-variable logic expression, simplify using Entered 16 Variable Map and realize the simplified logic expression using 8:1 multiplexer IC. b. Write the Verilog /VHDL code for an 8:1 multiplexer. Simulate 18 and verify it's working.

6. a) Design and implement code converter I) Binary to Gray II) Gray to Binary Code using basic gates.

7. Design and verify the Truth Table of 3-bit Parity Generator and 4-bit Parity Checker using basic logic gates with an even parity bit.

8. a. Realize a J-K Master/Slave Flip-Flop using NAND gates and verify its truth table. b. Write the Verilog/VHDL code for D Flip-Flop with positive-edge triggering. Simulate and verify it's working.

Text Books:

Sedra Adel S and Smith Kenneth Carless, Microelectronic Circuits, 5th Edition, Oxford University Press, 2004.

Reference Books:

1. A.K. Main & Nakul Maini, Analog Electronics, Khanna Book Publishing House (2018).
2. A.S. Sedra & K.C.Smith, Microelectronics Circuits, Oxford University Press (1997)
3. A.P. Malvino, Electronic Principles, Tata Mcgraw Hill Publications
4. Robert L. Boylestad & Louis Nashelsky, Electronic Devices & Circuit Theory
5. William Kleitz, Digital Electronics, Prentice Hall International Inc

Automation Lab

BTMXCL407	PCC11	Automation Lab	0-0-2	1 Credit

Practical Scheme:	**Examination Scheme:**
Practical: 2 hrs/batch	Continuous Assessment: 60 Marks External Exam: 40 Marks

List of Experiments: (Any Eight Experiments)

1. Study hardware and software used in PLC.
2. Implementation of logic gates in PLC.
3. Implementation of arithmetic instruction.
4. Implementation of on and off delay timers.
5. Study, understand and perform experiments on timers and counters.
6. Study and simulate analog function blocks.
7. Logic implementation for traffic control application.
8. Logic implementation for bottle filling application.
9. Direct control of double acting cylinder.
10. Indirect control of double acting cylinder.
11. Hydraulic pump/characteristic curve of variable displacement pump.
12. Single-rod cylinder/pressure intensification.