Dr. Babasaheb Ambedkar Technological University
(Established as University of Technology in the State of Maharashtra)
(Under Maharashtra Act No. XXIX of 2014)
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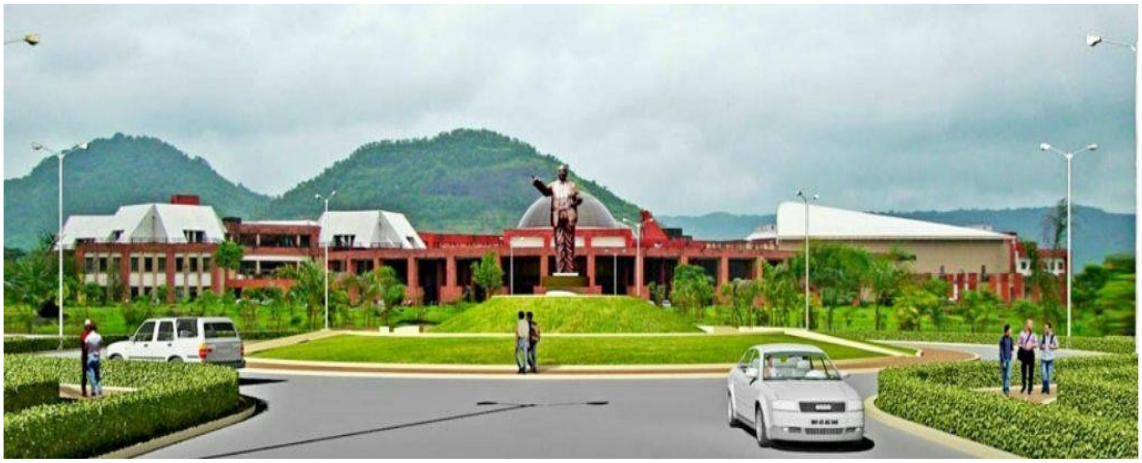
PROPOSED CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH

MECHANICAL ENGINEERING/MECHANICAL ENGINEERING(SANDWICH)

SECOND YEAR



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. Eligibility Criteria for Majors

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
BTMES404	Strength of Materials	(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
BTHM702	Industrial Engineering and Management	(3-1-0)4
	Constitution of India*	(1-0-0)1
Professional Core Course (PCC)		
BTMC302	Fluid Mechanics	(3-1-0)4
BTMC303	Thermodynamics	(3-1-0)4
BTMCL305	Machine Drawing and CAD Lab	(0-0-4)2
BTMCL306	Mechanical Engineering Lab - I	(0-0-4) 2
BTMC401	Manufacturing Processes – I	(3-1-0)4
BTMC402	Theory of Machines-I	(3-1-0)4
BTMCL406	Mechanical Engineering Lab-II	(0-0-4) 2
BTMC 501	Heat Transfer	(3-1-0)4
BTMC 502	Machine Design – I	(3-1-0)4
BTMC 503	Theory of Machines- II	(3-1-0)4
BTMC506	Applied Thermodynamics	(3-1-0)4
BTMCL 507	Mechanical Engineering Lab - III	(0-0-6) 3
BTMC 601	Manufacturing Processes- II	(3-1-0)4
BTMC 602	Machine Design-II	(3-1-0)4
BTMCL 606	Mechanical Engineering Lab – IV	(0-0-6) 3
BTMC701	Mechatronics	(3-1-0)4
BTMCL706	Mechanical Engineering Lab –V	(0-0-6) 3
Professional Elective Course (PEC)		
BTMPE405A	Numerical Methods in Engineering	(3-1-0) 4
BTMPE405B	Sheet Metal Engineering	(3-1-0) 4
BTMPE405C	Fluid Machinery	(3-1-0) 4
BTMPE504A	Refrigeration and Air conditioning	(3-0-0)3
BTMPE504B	Steam and Gas Turbines	(3-0-0)3
BTMPE504C	Engineering Tribology	(3-0-0)3
BTAPE504A	Automobile Design	(3-0-0)3
BTAPE504D	Automobile Engineering	(3-0-0)3
BTMPE603A	IC Engines	(3-0-0)3
BTMPE603B	Mechanical Vibrations	(3-0-0)3

BTMPE603C	Machine Tool Design	(3-0-0)3
BTMPE603D	Engineering Metrology and Quality Control	(3-0-0)3
BTAPE603D	Automobile Body Design (Pre-requisite: Automobile Design)	(3-0-0)3
BTAPE603E	E – Vehicles	(3-0-0)3
BTMPE604A	Process Equipment Design	(3-0-0)3
BTMPE604B	Product Life Cycle Management	(3-0-0)3
BTMPE604C	Finite Element Method	(3-0-0)3
BTMPE604D	Robotics	(3-0-0)3
BTAPE604B	Computational Fluid Dynamics	(3-0-0)3
BTMPE703A	Design of Air Conditioning Systems	(3-0-0)3
BTMPE703B	Biomechanics	(3-0-0)3
BTMPE703C	Non-conventional Machining	(3-0-0)3
BTMPE703D	Advanced IC Engines	(3-0-0)3
BTMPE703E	Additive Manufacturing	(3-0-0)3
BTMPE703F	Surface Engineering	(3-0-0)3
BTPPE703D	Processing of Polymers	(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
BTMOE605A	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

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
BTMI 407	IT – 2 Evaluation	(0-0-0) 1
BTMS 607	B Tech Seminar	(0-0-2)1
BTMP 608	Mini Project (TPCS)	(0-0-2)2
BTMI609	IT – 3 Evaluation	(0-0-0)1
Project (MP)		
BTAP801/ BTAI801	Project work/ Internship	(0-0-24)12

Course Structure for Semester III
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (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	BTMC302	Fluid Mechanics	3	1	-	20	20	60	100	4
PCC2	BTMC303	Thermodynamics	3	1	-	20	20	60	100	4
ESC10	BTMES304	Materials Science and Metallurgy	3	1	-	20	20	60	100	4
PCC3	BTMCL305	Machine Drawing and CAD Lab	-	-	4	60	-	40	100	2
PCC4	BTMCL306	Mechanical Engineering Lab – I	-	-	4	60	-	40	100	2
PROJ-2	BTES209P	IT – 1 Evaluation	-	-	-	-	-	100	100	1
		Total	**12**	**4**	**8**	**200**	**80**	**420**	**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

Course Structure for Semester IV
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (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 5	BTMC401	Manufacturing Processes – I	3	1	-	20	20	60	100	4
PCC 6	BTMC402	Theory of Machines-I	3	1	-	20	20	60	100	4
HSSMC3	BTHM403	Basic Human Rights	3	-	-	20	20	60	100	3
ESC11	BTMES404	Strength of Materials	3	1	-	20	20	60	100	4
PEC 1	BTMPE405A-C	Elective-I	3	-	-	20	20	60	100	3
PCC7	BTMCL406	Mechanical Engineering Lab-II	-	-	4	60	-	40	100	2
PROJ-3	BTMI407	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**	**160**	**100**	**340**	**600**	**20**

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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HSSMC = Humanities and Social Science including Management Courses

Elective I

Sr. No	Course code	Course Name
1	BTMPE405A	Numerical Methods in Engineering
2	BTMPE405B	Sheet Metal Engineering
3	BTMPE405C	Fluid Machinery

Course Structure for Semester V
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) (2022-23)

Semester V										
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				No. of Credits
			L	T	P	CA	MSE	ESE	Total	
PCC 8	BTMC 501	Heat Transfer	3	1	-	20	20	60	100	4
PCC 9	BTMC 502	Machine Design – I	3	1	-	20	20	60	100	4
PCC 10	BTMC 503	Theory of Machines- II	3	1	-	20	20	60	100	4
PEC 2	BTMPE 504A-C BTAPE504A,D	Elective-II	3	-	-	20	20	60	100	3
OEC 1	BTMOE 505A-D	Open Elective-I	3	-	-	20	20	60	100	3
PCC 11	BTMC 506	Applied Thermodynamics	3		-	20	20	60	100	3
PCC12	BTMCL 507	Mechanical Engineering Lab – III	-	-	6	60	-	40	100	3
PROJ-3	BTMI 408	IT – 2 Evaluation	-	-	-	-	-	100	100	1
Total			**18**	**3**	**6**	**180**	**120**	**500**	**800**	**25**

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	BTMPE504A	Refrigeration and Air conditioning
2	BTMPE504B	Steam and Gas Turbines
3	BTMPE504C	Engineering Tribology
4	BTAPE504A	Fundamentals of Automobile Design
5	BTAPE504D	Automobile Engineering

Open Elective I

Sr.No.	Course code	Course Name
1	BTMOE505A	Solar Energy
2	BTMOE505B	Renewable Energy Sources
3	BTMOE505C	Human Resource Management
4	BTMOE505D	Product Design Engineering

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Course Structure for Semester VI
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich)
(2022-23)

Semester VI										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC12	BTMC 601	Manufacturing Processes-II	3	1	-	20	20	60	100	4
PCC13	BTMC 602	Machine Design-II	3	1	-	20	20	60	100	4
PEC3	BTMPE 603A-C BTAPE 603C,E	Elective-III	3		-	20	20	60	100	3
PEC4	BTMPE 604A-D BTAPE 604B	Elective-IV	3		-	20	20	60	100	3
OEC2	BTMOE 605A-E	Open Elective-II	3	-	-	20	20	60	100	3
PCC14	BTMCL 606	Mechanical Engineering Lab – IV	-	-	6	60	-	40	100	3
PROJ-4	BTMS607	B Tech Seminar	-	-	2	60		40	100	1
PROJ-5	BTMP 608	Mini Project (TPCS)	-	-	2	60	-	40	100	1
PROJ-6	BTMI 609 (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**	**280**	**100**	**420**	**800**	**22**

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 III:

Sr.No	Course code	Course Name
1	BTMPE603A	IC Engines
2	BTMPE603B	Mechanical Vibrations
3	BTMPE603C	Machine Tool Design
4	BTMPE603D	Engineering Metrology and Quality Control
5	BTAPE603C	Advance Automobile Design
6	BTAPE603E	E – Vehicles

Elective IV:

SrNo	Course code	Course Name
1	BTMPE604A	Process Equipment Design
2	BTMPE604B	Product Life Cycle Management
3	BTMPE604C	Finite Element Method
4	BTMPE604D	Robotics
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

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 Network analysis.
2. Transforms such as Fourier transform, Laplace transform and applications to Communication systems and Signal processing.
3. Vector differentiation and integration required in Electro-magnetic and Wave theory.
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 ($\frac{6u}{6t} = c^2 \frac{6^2u}{6x^2}$), and one-dimensional wave equation (i.e. $\frac{6^2y}{6t^2} = c^2 \frac{6^2y}{6x^2}$).

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 Knowledge ware, 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.

Fluid Mechanics

BTMC302	PCC 1	Fluid Mechanics	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:

Course Outcomes	Content	Level
CO1	Explain basic properties of fluid, fluid statics, kinematics and dynamics.	**Understanding**
CO2	Identify various types of flow, flow patterns and their significance.	**Understanding**
CO3	Explain concepts of flow through pipes, boundary layer theory, forces on immersed bodies and dimensionless parameters.	**Understanding**
CO4	Derive various equations in fluid mechanics such as Euler's, Bernoulli's, Momentum, Continuity etc.	**Apply**
CO5	Solve the problems related to properties of fluid, fluid kinematics, fluid dynamics, laminar flow, pipe flow, dimensional analysis, boundary layer theory, and forces on immersed bodies.	**Apply**

Mapping of course outcomes with program outcomes

Course Outcomes	Program Outcomes											
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
CO1	2											
CO2	2											
CO3	2											
CO4	2											
CO5	3	2										

Course Contents:

Unit 1: Fluid Properties and Fluid Statics: [07 Hours]

A) **Fluid Properties:** Definition of fluid, Fluid as a continuum, Properties of fluid, Viscosity, Types of fluid, Compressibility, Surface tension, Capillarity and vapor pressure.

B) **Fluid Statics:** Pascal's law, Hydrostatic law of pressure, Total Pressure, Centre of Pressure, Buoyancy, Meta center, Condition of Equilibrium of floating and submerged bodies (No Numerical Treatment on fluid Statics)

Unit 2: Fluid Kinematics and Dynamics [07 Hours]

A) **Fluid Kinematics**: Eulerian and Langragian approach of fluid flow ,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.

B) Fluid Dynamics: Euler's equation, Bernoulli's equation along a streamline for incompressible flow, Practical applications of Bernoulli's equation - Pitot tube, Venturi meter, Orifice meter

Unit 3: Laminar Flow and Turbulent Flow [07 Hours]

A) Laminar Flow: Introduction to flow of viscous fluid through circular pipes, two parallel plates derivation and numerical.

B) Turbulent Flow: Major and minor losses. Loss of energy due to friction (Darcy's and Chezy's equation). Minor energy losses in transition, expansion and contraction. Concept of HGL and TEL, flow through syphon, flow through pipes in series or compound pipes, equivalent pipe, parallel pipes, branched pipes, Power transmission through pipes. Moody's Diagram.

Unit 4: Forces on Immersed Bodies and Boundary Layer Theory [07 Hours]

A) Forces on Immersed Bodies: Lift and Drag, Drag on a flat plate and on aerofoil. Types of drags, Development of lift. (Magnus effect) stalling condition of aerofoil.

B) Boundary Layer Theory: Boundary layer thickness, its characteristics, laminar and turbulent boundary layers, separation, boundary layer control.

Unit 5: Dimensional analysis [07Hours]

Introduction to dimensional analysis, dimensional homogeneity, methods of dimensional analysis- Rayleigh's method, Buckingham's π-theorem, dimensionless numbers. (No numerical treatment)

Text Books:

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

References Books:

1) V. L. Streeter, K. W. Bedford and E. B. Wylie, "Fluid Dynamics", Tata McGraw-Hill,9thedition, 1998.
2) S. K. Som, G.Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGrawHill, 2ndedition, 2003

Thermodynamics

BTMC303	PCC2	Thermodynamics	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	Define the terms like system, boundary, properties, equilibrium, work, heat, ideal gas, entropy etc. used in thermodynamics.
CO2	Studied different laws of thermodynamics and apply these to simple thermal systems to study energy balance .
CO3	Studied Entropy, application and disorder.
CO4	Studied various types of processes like isothermal, adiabatic, etc. considering system with ideal gas and represent them on p-v and T-s planes.
CO5	Represent phase diagram of pure substance (steam) on different thermodynamic planes like p-v, T-s, h-s, etc. Show various constant property lines on them.

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Fundamental Concepts and Definitions [07 Hours]

Thermodynamic system and its type; Macroscopic vs. Microscopic viewpoint, properties, processes and cycles, point function, path function. Thermodynamic equilibrium, Quasi-static process.

Work and heat Transfer: Work transferred and other types of work, Heat transfer, temperature and its measurement (principle of measurement, various instruments etc.). Zeroth law of thermodynamics, specific heat and latent heat, relationship between C_P and C_V.

Unit 2: First Law of Thermodynamics [07 Hours]
First law of thermodynamics for a closed system undergoing a cycle and change of state, Energy, different forms of energy, Enthalpy, PMM-I control volume.
Application of first law of steady flow processes (nozzle, turbine, compressor, pump, boiler,throttle valve etc.)

Unit 3: Second Law of Thermodynamics [07 Hours]
Limitation of first law of thermodynamics, cycle heat engine, refrigerator and heat pump, Kelvin- Plank and Clausius statements and their equivalence, Reversibility and Irreversibility, Carnot cycle, Carnot theorem, Absolute thermodynamic temperature scale.
Entropy: Introduction, Clausius theorem, T-s plot, Clausius inequality, Entropy and Irreversibility, Entropy principle and its application, combined I and II law, Entropy and direction, Entropy and disorder.

Unit 4: Ideal gas [07 Hours]
Boyle's law, Charl's law, Avogadro's law, universal gas constant, ideal processes with question, other equation of states.

Unit 5:Properties of Pure Substance [07Hours]
Phase change phenomenon of pure substance, phase diagram of pure substance, p-v, T-s, and h-s diagrams properties of steam, critical point parameters, triple point, property table, representation of processes of steam on p-v, T-s, and other diagrams, Dryness fraction and its measurement.

Texts:

1. P. K. Nag, "Engineering Thermodynamics", Tata McGraw Hill, New Delhi, 3rd edition,2005.
2. Y. A. Cengel, M. A. Boles, "Thermodynamics - An Engineering Approach", Tata McGraw Hill, 5thedition, 2006.

References:

1. G. J. Van Wylen, R. E. Sonntag, "Fundamental of Thermodynamics", John Wiley and Sons, 5thedition, 1998.
2. J. Moran, H. N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley and Sons, 4th edition, 2004.

Material Science and Metallurgy

BTMES304	ESC10	Materials Science and Metallurgy	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	Study various crystal structures of materials
CO2	Understand mechanical properties of materials and calculations of same using appropriate equations
CO3	Evaluate phase diagrams of various materials
CO4	Suggest appropriate heat treatment process for a given application
CO5	Prepare samples of different materials for metallography
CO6	Recommend appropriate NDT technique for a given application

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	2	1									
CO2	3	2	2	3	2							
CO3	2	1	2	1	1							
CO4	1	2	2	1	2	1	2	1	1	1		
CO5	1	1	1	3	2		1		1			
CO6	1	1	2	2	2	1	2		1	1		

Course Contents:

Unit 1: Fundamentals

a) Structure of Materials **[07 Hours]**

Crystal structures, indexing of lattice planes, Imperfections in crystals-point defects, line defects, Mechanism of plastic deformation, plastic deformation of polycrystalline materials.

b) Mechanical Properties and their Testing

Tensile test, engineering stress-strain curve, true stress-strain curve, types of stress-strain curves, compression test, formability, hardness testing, and different hardness tests-Vickers, Rockwell, Brinnel, Impact test.

Unit 2: Equilibrium Diagrams **[07 Hours]**

Definitions of terms, rules of solid-solubility, Gibb's phase rule, solidification of a pure metal, plotting of equilibrium diagrams, lever rule, Iron-iron carbide equilibrium diagram, critical temperatures, solidification and microstructure of slowly cooled steels, non-equilibrium cooling of steels, classification and application of steels, specification of steels, TTT diagram, critical cooling rate, CCT diagram.

Unit 3: Heat Treatment **[07 Hours]**

Heat treatment of steels, cooling media, annealing processes, normalizing, hardening, tempering, quenching and hardenability, surface hardening processes-nitriding, carbo-nitriding, flame hardening, induction hardening.

Unit 4: Metallography **[07 Hours]**

Microscopy, specimen preparation, polishing abrasives and cloths, specimen mounting, electrolytic polishing, etching procedure and reagents, electrolytic etching, optical metallurgical microscope, Sulphur printing, flow line observations, examination of fractures, spark test, electron microscope.

Unit 5: Strengthening Mechanisms and Non-destructive Testing **[07 Hours]**

Refinement of grain size, cold working/strain hardening, solid solution strengthening, dispersion strengthening, Precipitation hardening. Magnetic particle inspection, dye Penetrant inspection, ultrasonic inspection, radiography, eddy current testing.

Texts:

1. V. D. Kodgire, S.V. Kodgire, "Material Science and Metallurgy for Engineers", EverestPublishing House, Pune, 24th edition, 2008.
2. W. D. Callister, "Materials Science and Engineering: An Introduction", John Wiley andSons, 5th edition,2001.
3. V. Raghvan, "Material Science Engineering", Prentice Hall of India Ltd., 1992.

References:

1. V. B. John, "Introduction to Engineering Materials", ELBS, 6thedition, 2001.
2. G. F. Carter, D. E. Paul, " Materials Science and Engineering", ASM International, 3rdedition, 2000.
3. T. E. Reed-Hill, R. Abbaschian, "Physical Metallurgy Principles", Thomson, 3rdedition

Machine Drawing and CAD Lab

BTMCL305	PCC3	Machine Drawing and CAD	0-0-4	2 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	Interpret the object with the help of given sectional and orthographic views.
CO2	Construct the curve of intersection of two solids
CO3	Draw machine element using keys, cotter, knuckle, bolted and welded joint
CO4	Assemble details of any given part. i. e. valve, pump , machine tool part etc.
CO5	Represent tolerances and level of surface finish on production drawings
CO6	Understand various creating and editing commands in Auto Cad

Mapping of course outcomes with program outcomes

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

List of Practical's/ Experiments/ Assignments (minimum six assignments should be completed)

1. One full imperial drawing sheet consisting the drawing/sketches of representation of standard components, symbols of pipe joints, weld joints, rivet joint etc., surface finish symbols and grades, limit, fit and tolerance sketches.
2. Two full imperial drawing sheets, one consisting of assembly and the other consisting of details of any one standard component such as valves, components of various machine tools, pumps, joints, engine parts, etc.
3. Two assignments of AutoCAD: Orthographic Projections of any one simple machine component such as bracket, Bearing Housing or Cast component for Engineers such as connecting rod, Piston, etc.; with dimensioning and detailing of three views of components.
4. 3-D model at least one simple machine component.

Texts:

1. N. D. Bhatt, “Engineering Drawing”, Charotar Publishing House, Anand, India.
2. N. D. Bhatt, “Machine Drawing”, Charotar Publishing House, Anand, India.
3. Ajeet Sing, “Working with AutoCAD 2000”, Tata McGraw Hill, New Delhi.
4. George Omura, “ABC of AutoLISP”, BPB Publications, New Delhi.

References:

1. Narayana, Kannaiah, Reddy, “Machine Drawing”, New Age International Publishers.
2. AutoCAD and Auto LISP manuals from Autodesk Corp. U.S.A.
3. IS Code: SP46-1988, Standard Drawing Practices for Engineering Institutes.

Mechanical Engineering Lab - I

BTMCL306	PCC4	Fluid Mechanics + Material Science and Metallurgy	0-0-4	2 Credit

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

Group A (Fluid Mechanics)

List of Practicals/Experiments/Assignments (Any Five from Group A)

1. Flow visualization technique: characteristics of laminar and turbulent flow patterns using Helleshaw Apparatus.
2. Verification of Bernoulli's theorem
3. Determination of Critical Reynolds number using Reynolds Apparatus
4. Determination of pressure drop in pipes of various cross-sections
5. Determination of pressure drops in pipes of various pipe fittings etc.
6. Viscosity measurement using viscometer(at least one type)
7. Verification of momentum equation using impact of jet apparatus
8. Determination of metacentric height of a floating body
9. Calibration of a selected flow measuring device and Bourdon pressure gauge
10. Gauge and differential pressure measurements using various types of manometers, Bourdon type pressure gauge.
11. Demonstration of measurement using these instruments Lab.
12. Experiment to study hydraulic jump.

Group B (Material Science and Metallurgy)

List of Practical's/Experiments/Assignments (Any Four from Group B

1. Brinell Hardness Test
2. Rockwell Hardness test
3. Erichson Cupping Test
4. Magnaflux Test
5. Dye Penetrant Test
6. Specimen Preparation for Microscopy
7. Sulphur Print Test
8. Spark Test
9. Study and drawing of microstructures of plain carbon steels of varying carbon percentage
10. Study and drawing of microstructures of heat treated steels
11. Jominy End Quench Test
12. Study and drawing of microstructures of cast irons

13. Study and drawing of microstructures of non-ferrous alloys
14. Hardening of steels of varying carbon percentage

IT – 1 Evaluation

BTES209P (Internship – 1)	Internship – 1 Evaluation	PROJ-2	0L-0T-0P	1 Credits

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

Semester IV
Manufacturing Processes-I

BTMC401	PCC 5	Manufacturing Processes-I	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	Identify castings processes, working principles and applications and list various defects in metal casting
CO2	Understand the various metal forming processes, working principles and applications
CO3	Classify the basic joining processes and demonstrate principles of welding, brazing and soldering.
CO4	Study center lathe and its operations including plain, taper turning, work holding devices and cutting tool.
CO5	Understand milling machines and operations, cutters and indexing for gear cutting.
CO6	Study shaping, planning and drilling, their types and related tooling's

Mapping of course outcomes with program outcomes

Course	Program Outcomes

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

Course Contents:

Unit 1: Introduction and Casting Processes [07 Hours]

What is manufacturing? Selection of manufacturing processes, Introduction to casting; solidification of metals: Pure metals, Alloys; fluid flow; fluidity of molten metal; heat transfer: Solidification time, Shrinkage; defects: Porosity; Metal casting processes: Introduction; sand casting, shell molding, investment casting; Permanent-mold casting, vacuum casting, die casting, centrifugal casting.

Unit 2: Metal Forming

a) Rolling and Forging Processes [07Hours]

Introduction to Rolling; Flat-rolling Process: Roll Force, Torque, and Power Requirements, Geometric Considerations; Flat-rolling Practice: Defects in Rolled Plates and Sheets; Rolling Mills; Various Rolling Processes and Mills.

Introduction to forging, Open-die forging; Impression-die and Closed-die forging; various forging Operations; Forging Defects; Forging Machines.

b) Extrusion and Drawing

Introduction; Extrusion Process; Hot Extrusion; Cold Extrusion: Impact extrusion, Hydrostatic Extrusion; Extrusion Defects; Extrusion Equipment; Drawing Process; Drawing Practice; Drawing Defects and Residual Stresses; Drawing Equipment.

Unit 3: Joining Processes [07Hours]

Oxy-fuel-gas Welding; Arc-Welding Processes: Non consumable Electrode; Arc-welding Processes: Consumable Electrode, Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding; Electrodes for Arc Welding; The Weld joint, Quality, and Testing: Weld Quality, Weldability, Testing of Welds.

Introduction to solid state welding, Friction Welding, Resistance Welding: Spot, Seam, Projection Welding. Introduction to brazing and soldering.

Unit 4: Machining Processes: Turning and Hole Making [07 Hours]

Introduction; The Turning Process; Lathes and Lathe Operations: Lathe Components, Work holding Devices and Accessories, Lathe Operations, Types of Lathes. Types of chips, Boring andBoring Machines; Drilling Machines: Drills, Drill Materials and Sizes, Drilling Practice, DrillingMachines, Reaming operation and Reamers; Tapping and Taps.

Unit 5: Machining Processes: Milling, Broaching and Gear Manufacturing [07 Hours]

Introduction, Milling and Milling Machines: Peripheral Milling, Face Milling, End Milling, Other Milling Operations and Milling Cutters, Tool holders, Milling Process Capabilities,

Milling Machines; Planning and Shaping; Broaching and Broaching Machines; Gear Manufacturing by Machining: Form Cutting, Gear Generating, Cutting Bevel Gears, Gear-finishing Processes.

Text:

1. Serope Kalpak Jain and Steven R. Schmid, "Manufacturing Engineering and Technology", Addison Wesley Longman (Singapore) Pte. India Ltd., 6th edition, 2009.

References:

1. Milkell P. Groover, " Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley and Sons, New Jersey, 4th edition, 2010.
2. Paul DeGarmo, J.T. Black, Ronald A. Kohser, "Materials and Processes in Manufacturing", Wiley, 10th edition, 2007.

Theory of Machines- I

BTMC402	PCC 6	Theory of Machines-I	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	Define basic terminology of kinematics of mechanisms
CO2	Classify planar mechanisms and calculate its degree of freedom
CO3	Perform kinematic analysis of a given mechanism using ICR and RV methods
CO4	Introduction of different types of lubrication system.
CO5	Perform kinematic analysis of slider crank mechanism using Klein's construction and analytical approach
CO6	Perform balancing of unbalance forces in rotating masses, different types of single/multi cylinder reciprocating engines in different positions.

Mapping of course outcomes with program outcomes

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

CO4	1											
CO5	1	1		3								2
CO6	1	1										2

Course Contents:

Unit 1: Velocity Acceleration Analysis [07 Hours]

Definition of link, pair, kinematics chain, inversions, inversions of single and double slider crank chain, kinematic diagrams of mechanisms, equivalent linkage of mechanism, degree of freedom. Study of various mechanisms such as straight line mechanisms, pantograph, Geneva mechanism, steering gear mechanisms. Instantaneous centre of rotation, body and space centrodes, Kennedy's theorem.

Velocity and acceleration analysis and its purpose, velocity and acceleration diagrams using relative velocity method, Corioli's component of acceleration.

Velocity and acceleration of slider crank mechanism by analytical method and Klein's construction.

Unit 2: Friction and Lubrication [07 Hours]

Dry friction, friction between nut and screw with different types of threads, Uniform wear theory and uniform pressure theory, Frication at pivot and collars, Friction in turning pair, Friction circle and friction axis, Friction in mechanisms.

Lubrication, Viscosity, Viscous flow, Boundary lubrication, Thick film lubrication, Hydrostatic and hydrodynamic lubrications.

Unit 3: Clutch, Brakes and Dynamometers [07 Hours]

Friction Clutches: Single plate and multi-plate clutch, Cone clutch, Centrifugal clutch, Torque transmitting capacity, Clutch operating mechanism.

Brakes: Shoe brake, Internal and external shoe brakes, Block brakes, Band brakes, Band and block brakes, Braking torque.

Dynamometers: Different types of absorption and transmission type dynamometers, Construction and working of eddy current dynamometer, Torque measurement.

Unit 4: Cams and Followers [07 Hours]

Types of cams and followers, Analysis of motion, Jump and ramp of cam, Determination of cam profiles for a given follower motion, Circular arc cam, Tangent cam, Cycloidal cam.

Unit 5: Balancing [07 Hours]

Balancing of rotating masses in one and several planes, balancing of reciprocating, masses in single and multi-cylinder engine viz., inclined, radial and v-type engines, Primary and secondary balancing analysis, Concept of direct and reverse cranks, Balancing of locomotive engines, Effect of partial balancing, Static and dynamic balancing.

Texts:

1. A. Ghosh, A. K. Malik, "Theory of Mechanisms and Machines", Affiliated East-West Press Pvt. Ltd., New Delhi.
2. S. S. Rattan, "Theory of Machines", Tata McGraw Hill, New Delhi.

References:
1. Thomas Beven, "Theory of Machines", CBS Publishers and Distributors, Delhi.
2. J. E. Shigely, J. J. Uicker, "Theory of Machines and Mechanisms", Tata McGraw Hill Publications, New York, International Student Edition, 1995.

Basic Human Rights

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

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/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	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	PO1
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 HumanDuties. Declaration of independence, Rights of citizen, Rights of working and exploited people Society, religion, culture, and their inter-relationship. Impact of social structure on humanbehavior.
Social Problems: Social and communal conflicts and social harmony, rural poverty, unemployment, bonded labor.

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

Strength of Materials

BTMES404	ESC11	Strength of Materials	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: Engineering Mechanics

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

CO1	State the basic definitions of fundamental terms such as axial load, eccentric load, stress, strain, E, μ, principle stresses, etc.
CO2	Analyze the stresses and strain energy in different load cases
CO3	Design the columns based on deflection
CO4	Design a beam based on bending and shafts based on torsion
CO5	Analyze given beam for calculations of SF and BM
CO6	Calculate slope and deflection at a point on cantilever /simply supported beam using double integration, Macaulay's , Area-moment and superposition methods

Mapping of course outcomes with program outcomes

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

Course Contents:

Unit 1: Simple Stresses and Strains **[07 Hours]**

Mechanical properties of materials, analysis of internal forces, simple stresses and strains, stress-strain curve, Hooke's law, modulus of elasticity, shearing, thermal stress, Hoop stress, Poisson's ratio, volumetric stress, bulk modulus, shear modulus, relationship between elastic constants.
Principal Stresses and Strains
Uni-axial stress, simple shear, general state of stress for 2-D element, ellipse of stress, principal stresses and principal planes, principal strains, shear strains, strain rosettes.

Unit 2: Strain energy, resilience and Combined Stresses

[10 Hours]

Strain energy, resilience: Load-deflection diagram, strain energy, proof resilience, stresses due to gradual, sudden and impact loadings, shear resilience, Combined axial and flexural loads, middle third rule, kernel of a section, eccentrically applied load.

Columns and Struts: Concept of short and long Columns, Euler and Rankine's formulae, limitation of Euler's formula, equivalent length, eccentrically loaded short compression members.

Unit 3: Stresses in Beams **[10 Hours]**

Moment of inertia of different sections, bending and shearing stresses in a beam, theory of simple bending, derivation of flexural formula, economic sections, horizontal and vertical shear stress, distribution shear stress for different geometrical sections-rectangular, solid circular, I-section, other sections design for flexure and shear.

Torsion

Introduction and assumptions, derivation of torsion formula, torsion of circular shafts, stresses and deformation indeterminate solid/homogeneous/composite shafts, torsional strain energy.

Unit 4: Shear Force and Bending Moment Diagram **[10 Hours]**

Introduction to different types of beams, different types of supports & loads. Concept and definition of shear force and bending moment in determinant beams due to concentrated loads, UDL, UVL and couple. Relation between SF, BM and intensity of loading, construction of shear force and bending moment diagram for cantilever, simple and compound beams, defining critical and maximum value and position of point of contra flexure. Construction of BMD and **load** diagram from SFD, Construction of load diagram and SFD from BMD.

Unit 5. Deflection of beams **[08 Hours]**

Differential equation of deflected beam, slope and deflection at a point, calculations of deflection for determinate beams by double integration, Macaulay's method, theorem of areamoment method (Mohr's theorems), moment diagram by parts, deflection of cantilever beams, deflection in simple supported beams, mid-span deflection, conjugate beam method, deflection by method of superstition.

Texts:

S. Ramamrutham, "Strength of Materials", Dhanpat Rai and Sons, New Delhi.
F. L. Singer, Pytle, "Strength of Materials", Harper Collins Publishers, 2002.
S. Timoshenko, "Strength of Materials: Part-I (Elementary Theory and Problems)", CBS Publishers, New Delhi.

References:

E. P.Popov, "Introduction to Mechanics of Solid", Prentice Hall, 2nd edition, 2005.
S. H. Crandall, N. C. Dahl, T. J. Lardner, "An introduction to the Mechanics of Solids", Tata McGraw Hill Publications, 1978.
S. B. Punmia, "Mechanics of Structure", Charotar Publishers, Anand.

Numerical Methods in Mechanical Engineering

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

Dr. Babasaheb Ambedkar Technological University, Lonere

Teaching Scheme:	Examination Scheme:
Lecture: 3 hrs/week Tutorial: 0 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 error sin computer programming.

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

Motivation, Bracketing methods: Bisection methods, Open methods: Newton Raphson method, Engineering applications.

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

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

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

Motivation, Newton's Cotes Integration Formulas: Trapezoidal Rule, Simpson's rule, 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' sand Modified Euler's Method, Hen's method, Runge–Kutta Method, engineering applications.

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 Mc Graw HillPublications,2010.
2. E. Balagurusamy, "Numerical Methods" Tata McGraw HillPublications,1999.

References:

1. V. Rajaraman, "Fundamental of Computers " Prentice Hall of India,NewDelhi,2003.
2. S. S. Sastri, "Introductory Methods of Numerical Methods", Prentice Hall of India, New Delhi,3rd edition,2003.
3. K. E. Atkinson, "An Introduction to Numerical Analysis", Wiley,1978.
4. M.J. Maron, "Numerical Analysis: A Practical Approach", Macmillan, New York, 1982

Sheet Metal Engineering

BTMPE405B	PEC 1	Sheet Metal Engineering	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 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	Recognize common manufacturing processes of Sheet Metal Fabrication
CO2	Understand the principles of design and fabricate of sheet metal products and recognize common material used in the industry
CO3	Distinguish Shearing, Drawing and Pressing etc. processes.
CO4	Know types of dies and formability.
CO5	Select mechanical or hydraulic presses for the given process

Mapping of course outcomes with program outcomes

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

CO5	3	2			3	3	2				1	3

Course Contents:

Unit1: Introduction [07 Hours]
Importance of sheet metal engineering, materials used, desirable properties of materials in sheet metal products

Unit2: Basic Applications [07 Hours]
Shearing processes like blanking, piercing, and punching.

Unit3: Drawing Processes [07 Hours]
Shallow and deep drawing of cylindrical and rectangular bodies, forming and bending including spring-back.

Unit4: Types of Dies and Mechanical Presses [07Hours]
Dies: Compound dies, progressive dies, and combination dies
Mechanical Presses
Mechanical and hydraulic presses, modern development sin press tools, formability.

Unit 5: Case Studies [07 Hours]
Case studies for manufacturing of sheet metal products in various engineering applications
Texts:
1. Donaldson al., "Tool Design", Tata McGraw-Hill Publications, New Delhi, 1998.

References:

1. P.N.Rao,"ManufacturingTechnology,Foundry,FormingandWelding",Vol.I,TataMcGrawHill PublishingCo.Ltd,NewDelhi,3rdedition, 2004.
2. ASMH and book, "Metal Forming", Vol. XV, ASM Publication, Metals Park, Ohio,10thedition,1989.
3. A. S. Deshpande, "Die Design Hand book", ASTME.
4. Sheet Metal Engineering Notes, IITBombay,1999.

Fluid Machinery

BTMPE405C	PEC 1	Fluid Machinery	3-0-0	3 Credits

Teaching Scheme:	**Examination Scheme:**
Lecture: 3 hrs/week Tutorial: 0 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	Understand and apply momentum equation
CO2	Understand and explain Hydrodynamic Machines
CO3	Explain difference between impulse and reaction turbines
CO4	Find efficiencies, draw velocity triangles
CO5	Explain governing mechanisms for hydraulic turbines
CO6	Explain working of various types of pumps, draw velocity diagrams, do simple Calculations
CO7	Design simple pumping systems

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	2	1									1
CO2	3		3				2					1

CO3	3	2										1
CO4	3	3	2									1
CO5			3									1
CO6	3	3	3	1	1							1
CO7	3	3		3								1

Course Contents:

Unit 1: Momentum Equation and its Applications **[07 Hours]**

Impulse momentum, Principle, Fixed and moving flat inclined plates, Curved vanes, Series of plates and vanes, Velocity triangle and their analysis, Water wheels. Hydrodynamic Machines: Classification, General theory, Centrifugal head, Fundamental equations, and Euler's equation, Degree of reaction, Head on machine, various efficiencies, Condition for maximum hydraulic efficiency.

Unit 2: Impulse and Reaction Turbines **[07 Hours]**

Impulse principle, Construction of Pelton wheel, Velocity diagrams and its analysis, Number of buckets, Jets, Speed ratio, Jet ratio.

Reaction Turbines: Constructional details of Francis, Kaplan and Propeller turbine, Deciaz turbine, and Draft tube types, Efficiencies, Cavitation.

Unit 3: Governing of Turbines **[07 Hours]**

Methods of governing, Performance characteristics, Safety devices, Selection of turbines, Unit quantities, Specific speed, Principles of similarity and model testing.

Unit 4: Centrifugal Pump **[07 Hours]**

Construction, Classification, Terminology related to pumps, Velocity triangle and their analysis, Cavitation, NPSH, Thoma's cavitation factor, Priming, Methods of priming, Specific speed, Performance characteristics, Actual thrust and its compensation, Troubleshooting.

Multistage Pumps: Pump H-Q characteristics and system H-Q Characteristics, Series and parallel operation of pumps, Systems in series and parallel, Principle of model testing and similarity.

Unit 5: Special Purpose Pumps **[07 Hours]**

Chemical pumps, nuclear pumps, Sewage pumps, Submersible deep well pumps, Pump installation, Energy efficient pumps.

Failure of Pumping System: Pump failures, Remedies, Source failure, Causes and remedies, Trouble shooting.

Miscellaneous Pumps: Reciprocating pump, Gear pump, Vane pump, Lobe pump, etc., Application field (no mathematical treatment).

Texts:

1. P. N. Modi, S. M. Seth, "Hydraulics and Fluid Mechanics including Hydraulic Machines", Standard Book House, Rajsons Publications Pvt. Ltd., 20th edition.
2. R. K. Bansal, "A Text Book of Fluid Mechanics and Hydraulic Machines", Lakshmi Publications Pvt. Ltd., 9th edition.

References:

1. Yunus A. Çengel, John M. Cimbala, Fluid Mechanics: Fundamentals and Applications", McGraw Hill, 3rd edition, 2014.

Mechanical Engineering Lab II

BTMCL406	PCC7	Manufacturing Processes Lab I+Theory of Machines Lab -I Strength of Materials Lab	0-0-4	2 Credit

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

Group A (Manufacturing Processes Lab I)

List of Practical's/Experiments/Assignments (Any Three from Group

A)

Making a job with a process plan involving plain, step and taper turning as well thread cutting as operations on a Centre lathe.

1. Preparation of process planning sheet for a job including operations such as milling, drilling and shaping.
2. Making a spur gear using universal dividing head on milling machine.
3. Making a simple component by sand casting using a split pattern.
4. Cutting of a steel plate using oxyacetylene flame cutting /plasma cutting.
5. Making a butt joint on two stainless steel plates using TIG/MIG Welding.
6. An experiment on shearing operation.
7. An experiment on blanking operation.
8. An experiment on drawing operation

Group B (Theory of Machines Lab - I)

List of Practical's/Experiments/Assignments (Any Three from Group B)

1. **Four sheets** (half imperial size)
   Graphical solution of problems on velocity, acceleration in mechanisms by relative velocity method, instantaneous center of rotation method and Klein's construction. At least one problem containing Corioli's component of acceleration.
2. **Experiments (any 2**
   a) Experimental determination of velocity and acceleration of Hooke's joint.
   b) Determination of displacement of slider-crank mechanism with the help of model and to plot velocity and acceleration curves from it.
   c) Experiment on Corioli's component of acceleration.
3. **Assignment**

Develop a computer program for velocity and acceleration of slider-crank mechanism.

Group C (Strength of Materials Lab)

List of Practical's/Experiments/Assignments (Any Three from Group C)

1. Tension test on ferrous and non-ferrous alloys (mid steel/cast iron/aluminum, etc.
2. Compression test on mild steel, aluminum, concrete, and wood
3. Shear test on mild steel and aluminum (single and double shear tests)
4. Torsion test on mild steel and cast-iron solid bars and pipes
5. Flexure test on timber and cast-iron beams
6. Deflection test on mild steel and wooden beam specimens
7. Graphical solution method for principal stress problems
8. Impact test on mild steel, brass, aluminum, and cast-iron specimens
9. Experiments on thermal stresses
10. Strain measurement in stress analysis by photo-elasticity
11. Strain measurement involving strain gauges/ rosettes
12. Assignment involving computer programming for simple problems of stress, strain Computations.