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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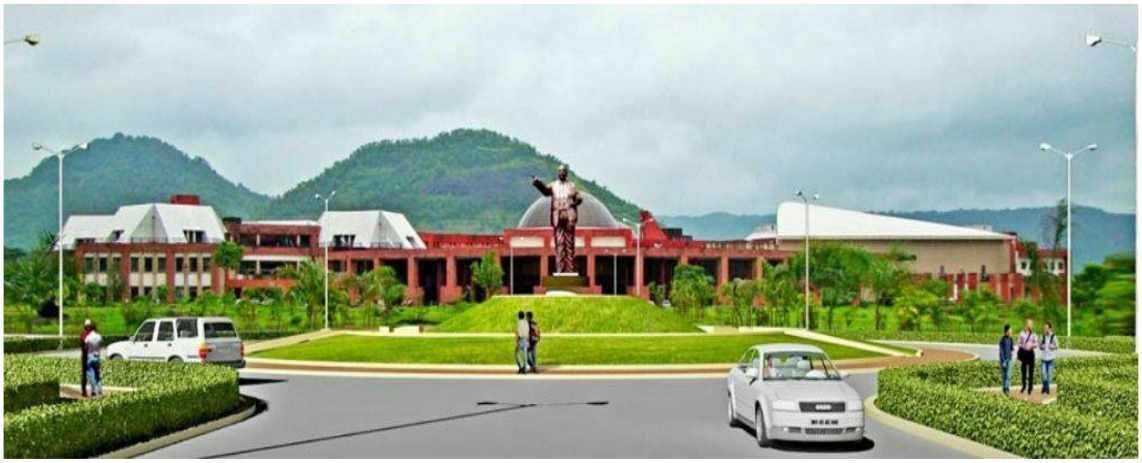
PROPOSED CURRICULUM

UNDER GRADUATE PROGRAMME

B.TECH

MECHANICAL ENGINEERING/MECHANICAL ENGINEERING(SANDWICH)

FINAL 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 VII
B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich)
(2023-24)

Semester VII										
Course Category	**Course Code**	**Course Title**	**Teaching Scheme**			**Evaluation Scheme**				**No. of Credits**
			L	**T**	**P**	**CA**	**MSE**	**ESE**	**Total**	
PCC15	BTMC701	Mechatronics	3	-	-	20	20	60	100	3
HSSMC4	BTHM702	Industrial Engineering and Management	3	-	-	20	20	60	100	3
PEC5	BTMPE703A-G BTPPE703D	Elective-V	3	-	-	20	20	60	100	3
OEC3	BTMOE704A-C	Open Elective-III	3	-	-	20	20	60	100	3
OEC4	BTMOE705A-C	Open Elective-IV	3	-	-	20	20	60	100	3
PCC16	BTMCL706	Mechanical Engineering Lab –V	-	-	4	60	-	40	100	2
PROJ-6	BTMP 707	Mini Project			6	30		20	50	3
PROJ-7	BTMI609	IT – 3 Evaluation	-	-	-	-	-	100	100	1
		Total	**15**	**-**	**10**	**190**	**100**	**460**	**750**	**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 V:

Sr. No	Course code	Course Name
1	BTMPE703A	Design of Air Conditioning Systems
2	BTMPE703B	Biomechanics
3	BTMPE703C	Non-conventional Machining
4	BTMPE703D	Advanced IC Engines
5	BTMPE703E	Additive Manufacturing
6	BTMPE703F	Surface Engineering
7	BTPPE703D	Processing of Polymers
8	BTMPE703G	Stress Analysis

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

Course Structure for Semester VIII

B. Tech in Mechanical Engineering / B. Tech. in Mechanical Engineering (Sandwich) 2023-24

Semester VIII									
Course Category	Course Code	Course Title	Teaching Scheme			Evaluation Scheme				Credit
			L	T	P	CA	MSE	ESE	Total	
		Choose any two subjects from ANNEXURE-A#				20	20	60	100	3
						20	20	60	100	3
PROJ-8	BTMP801/ BTMI801	Project OR Internship	-	-	16	60	-	40	100	08
		Total	**-**	**-**	**16**	**100**	**40**	**160**	**300**	**14**

ANNEXURE-A# (Provisional)
Recommendations of 8th Semester Courses in Self-study Mode from NPTEL/ SWYAM Platform,
THE LIST MAY ALTER AND MODIFY AS PER THE AVAILABILITY OF THE SUBJECTS ON THE NPTEL/ SWYAM Platform AND USEFULNESS, EVERY YEAR

Sr No	Course Code	Course Name	Duration (Weeks)	Institute Offering Course	Name of Professor
1	BTMEC801A	Fundamentals of Automotive Systems	12 Weeks	IITM	Prof. C. S. Shankar Ram
2	BTMEC801B	Mechanics of Fiber Reinforced Polymer Composite Structures	12 Weeks	IITG	Prof. Debabrata Chakraborty
3	BTMEC801C	Explosions and Safety	12 Weeks	IITM	Prof. K. Ramamurthi
4	BTMEC801D	Material Characterization	12 Weeks	IITM	Prof. Sankaran.S
5	BTMEC801E	Dealing with materials data : collection, analysis and interpretation	12 Weeks	IISc	Prof. M P Gururajan
6	BTMEC801F	Non-Conventional Energy Resources	12 Weeks	IITM	Prof. Prathap Haridoss

Six months of Internship in the industry

 # These subjects are to be studied on self –study mode using SWAYAM/NPTEL/Any other source

 # Student doing project in Industry will give NPTEL Examination/Examination conducted by the University i.e. CA/MSE/ESE

 # Students doing project in the Institute will have to appear for CA/MSE/ESE

Total Credits: 161 (Batch 20-24)

Dr. Babasaheb Ambedkar Technological University, Lonere

Semester - VII

Mechatronics

BTMC701	PCC15	Mechatronics	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	Define sensor, transducer and understand the applications of different sensors and transducers
CO2	Explain the signal conditioning and data representation techniques
CO3	Design pneumatic and hydraulic circuits for a given application
CO4	Write a PLC program using Ladder logic for a given application
CO5	Understand applications of microprocessor and micro controller
CO6	Analyse PI, PD and PID controllers 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	1	1	1	3	2				2	1		1
CO2	3	2			3	3	2				1	3
CO3	1	1		3	3	2	1		3		1	3
CO4	3	3	1	1	3		1	1	1			
CO5	3			1	3	2	3					2
CO6		3	3		3	3	1	1	3			2

Course Contents:

Unit 1: Introduction **[07 Hours]**

Introduction to Mechatronic systems, elements, advantages; practical examples of Mechatronic systems.

Sensors and Transducers: Various types of sensors and transducers used in Mechatronic system such as pressu sensors, temperature sensors, velocity sensors, Acceleration sensors, proximity sensors, position sensors, force senso Optical encoders, Capacitive level sensor, tactile sensors, Selection of sensors.

Unit 2: Signal Conditioning and Data Representation **[07 Hours]**

Types of electronic signals, Need for signal processing,Operational amplifiers: Types, classification and applicatio Opto-isolators, Protection devices, Analogue to Digital and Digital to Analog Converters, Interfacing devices, Electr magnetic Relays.

Data representation systems, Displays, Seven segment displays, LCD displays, Printers, Data loggers, Da Acquisition Cards/Systems

Unit 3: Drives **[07 Hours]**

Electrical Drives: Types of Electrical Motors, AC and DC motors, DC servomotors, Stepper motors, linear moto

etc.

Pneumatics and Hydraulics: Components of Pneumatic systems, actuators, direction control valves, pneumatic preparation, FRL unit, methods of actuation of valves, Sequencing of Pneumatic cylinders using Cascade and sh register methods. Electro-pneumatic valves, Electro- pneumatic circuits using single and double solenoid methods. Hydraulic cylinders, design of cylinder, Design of Piston and piston rod, Valves, poppet valve, house pipes and desi of tubing, Meter-in and Meter-out circuits.

Unit 4: Microprocessor and Microcontroller [07 Hours]

8085 microprocessor: architecture, various types of registers and their functions in 8085µP, Instruction se interfacing, applications. 8081 microcontroller: architecture, Instruction sets, various pins and their functio interfacing, applications.

Programmable Logic Controller: Introduction, Architecture, Types of inputs/outputs, Specifications, guidelines f Selection of PLCs, Programming: Ladder logic and FBD

Unit 5: Control Systems and its Stabilty [07 Hours]

Open and closed loop system; block diagram manipulation/reduction, Transfer function, modeling of Mechanic Systems using Spring, Dashpot and Mass equivalence.

Stability of Systems

On/Off controller, Proportional Control, Integral control, Derivative Control; PI, PD and PID Controllers, Introducti to control using state variable system models, Bode Plots and stability criteria.

Texts:

1. HMT Limited, "Mechatronics", Tata McGraw Hill Publications, 1998.
2. W. Bolton, "Mechatronics; Electronic Control System in Mechanical Engineering", Pearson Education Asia, 199
3. Raven, "Automatic Control Engineering", Tata McGraw Hill Publications, New York, 1986.

References:

1. R. K. Rajput, "A textbook of Mechatronics", S. Chand and Co., 2007.
2. Michael B. Histand, David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", Tata McGr Hill International Editions, 2000.
3. D. A. Bradley, D. Dawson, N. C. Buru, A. J. Loader, "Mechatronics", Chapman and Hall, 1993

Industrial Engineering and Management

BTHM702	HSSMC4	Industrial Engineering and Management	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	Impart fundamental knowledge and skill sets required in the Industrial Management and Engineering profession, which include the ability to apply basic knowledge ofmathematics, probability and statistics, and the domain knowledge of IndustrialManagement and Engineering
CO2	Produce ability to adopt a system approach to design, develop, implement and innovate

	integrated systems that include people, materials, information, equipment and energy.
CO3	Understand the interactions between engineering, businesses, technological and environmental spheres in the modern society.
CO4	Understand their role as engineers and their impact to society at the national and global context.

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	1
CO2									2	2	2	
CO3								2				
CO4								2				2

Course Contents:

Unit 1: Introduction **[07 Hours]**
Managing and managers, management- science, theory and practice, functions of management, evolution management theory, contributions of Taylor, Fayol and others.
Planning: The nature and purpose of planning, objectives, strategies, policies and planning premises, decision makir
Organizing: The nature and purpose of organizing, departmentation, Line/ staff authority and decentralizatio effective organizing and organizational culture.

Unit 2: Human Resource Management **[07 Hours]**
Staffing: Human resource management and selection, orientation, apprentice training and Apprentice Act (196 performance appraisal and career strategy, job evolution and merit rating, incentive schemes.
Leading: Managing and human factor, motivation, leadership, morale, team building, and communication.
Controlling: The system and process of controlling control techniques, overall and preventive control.

Unit 3: Production/Operations Management **[07 Hours]**
Operations management in corporate profitability and competitiveness, types and characteristics of manufacturi systems, types and characteristics of services systems.
Operations planning and Control: Forecasting for operations, materials requirement planning, operatio scheduling.

Unit 4: Design of Operational Systems **[07 Hours]**
Product/process design and technological choice, capacity planning, plant location, facilities layout, assembly li balancing, and perspectives on operations systems of the future.

Unit 5: Introduction to Industrial Engineering and Ergonomics **[07 Hours]**
Scope and functions, history, contributions of Taylor, Gibreth, Gantt and others.
Work Study and Method Study: Charting techniques, workplace design, motion economy principles.
Work Measurement: Stopwatch time study, micromotion study, predetermined time system (PTS), work sampling.
Ergonomics
Basic principles of ergonomics
Concurrent Engineering: Producibility, manufacturability, productivity improvement.
Total Quality Management: Just in time (JIT), total quality control, quality circles, six sigma.

Texts:

1. H. Koontz, H. Weirich, "Essentials of Management", Tata McGraw Hill book Co., Singapore, Internation Edition, 5th edition, 1990.
2. E. S. Buffa, R. K. Sarin, "Modern Production/Operations Management", John Wiley and Sons, New Yo International Edition, 8th edition, 1987.
3. P. E. Hicks, "Industrial Engineering and Management: A New Perspective", Tata McGraw Hill Book C Singapore, International Edition, 2nd edition, 1994.

References:

1. J. L. Riggs, "Production Systems: Planning, Analysis and Control", John Wiley & Sons, New York, Internation Edition, 4th edition, 1987.
2. H. T. Amrine, J. A. Ritchey, C. L. Moodie, J. F. Kmec, "Manufacturing Organization and Management", Pears Education, 6th edition, 2004.

International Labour Organization (ILO), "Introduction to Work Study", International Labour Office, Geneva, 3rd edition, 1987.

Elective V

Design of Air-Conditioning Systems

BTMPE703A	PEC5	Design of Air-Conditioning Systems	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: Basic Air conditioning

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

CO1	Understand the cooling load calculation
CO2	Explain concept of ventilation and its implementation
CO3	Learn duct design applied to real life situation
CO4	Learn and differentiate the various modern air conditioning systems/units

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	2		2	1	1	1			1	
CO2	3	3				1	2					
CO3	3	3	3	2	2	1	1	1			2	
CO4		1	1	1		1	1	1				

Course Contents:

Unit1: Introduction **[07 Hours]**

Moist Air properties, Psychrometry of various air condition processes, SHF, dehumidified air quantity, HVA Equipment

Unit2: Human Comfort **[07 Hours]**

Human comfort, environment comfort indices, clothing resistance, metabolisms, indoor air quali

ventilationair,insidedesignconditions, outsidedesign conditions.

Unit3: Heat Flow **[07 Hours]**

Heat Flow in Buildings, Building Heat Transfer, Cooling Load Calculation, Ventilation load, Effective sensible he factor and selection of air conditioning apparatus.

Unit4: Air Diffusion **[07 Hours]**

Room air diffusion, filtration, duct design, pressure drop, air distribution design, outlets

Unit 5: Air Conditioning Systems and its equipment **[07 Hours]**

Air conditioning systems; constant volume, VAV, terminal reheat systems, single zone and multi zone systems, du duct system, fan coil unit, noise control.

Air Conditioning Equipment: Fans, pumps and blowers, performance & selection

Texts:

1. W. F. Stoecker, J. P. Jones, "Principles of Refrigeration and Air Conditioning", Tata McGraw Hill Publications.
2. C. P. Arora, "Refrigeration and Air Conditioning",Tata McGraw Hill Publications.
3. Manohar Prasad, "Refrigeration and Air Conditioning", New Age International, 3rd edition, 2011.
4. R. C. Arora, "Refrigeration and Air Conditioning", PHI Learning Pvt. Ltd., 2010.

References:

1. "Handbook of Air Conditioning System Design", Carrier Air Conditioning Co., 1965.
2. W. P. Jones,"AirConditioning Engineering",EdwardArnoldPublishersLtd., London,1984.
3. JamesL. Threlkeld, "ThermalEnvironmentalEngineering",PrenticeHall, New York, 1970.

Biomechanics

BTMPE703B	PEC 5	Biomechanics	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	Explain various forces and mechanisms and define Newton's law of motion, work and energy, moment of inertia
CO2	Describe forces and stresses in different human joints
CO3	Discuss bio fluid mechanics in cardiovascular and respiratory system in human body
CO4	Differentiate between hard tissues and soft tissues
CO5	Understand concepts of implants and Identify different techniques used in biomechanics implants

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			1	1	1	1		1	1
CO2	2	2	2			1	2		1		1	1
CO3	2	2	2			1	1	1	1			1
CO4	1	1	1				1	1	1			1
CO5	1	1	2				1	1			1	1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Review of principle of mechanics, vector mechanics-resultant forces of coplanar and non-coplanar and concurrent a non-concurrent forces, parallel forces in planes, equilibrium of coplanar forces, Newton's law of motion, work a energy, moment of inertia.

Unit 2: Biomechanics of Joints **[07 Hours]**
Skeletal joints, forces and stresses in human joints, type of joints, biomechanical analysis of elbow, shoulder, spi column, hip knee and ankle.

Unit 3: Bio-fluid Mechanics **[07 Hours]**
Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, cardiovascular a respiratory system.

Unit 4: Hard Tissues **[07 Hours]**
Bone structure and composition, Mechanical properties of bones, cortical and cancellous bones, visco-elas properties, Maxwell and Vigot model – Anisotropy

Unit 5: Soft Tissues and Biomechanics of Implant **[07 Hours]**
Structure and functions of soft tissue: cartilage, tendon, ligament and muscle, Material properties of cartilage, tend and ligament and muscle

Biomechanics of Implant: Specification for prosthetic joints, biocompatibility, requirement of biomateri characterization of different type of biomaterials, fixation of implants.

Texts/References:
1. Y. C. Fung, "Biomechanics: Mechanical properties of living tissues", Springer-Verlag, 2nd edition, 1993.
D. J. Schneck, J. D. Bronzino, "Biomechanics: Principle and Applications", CRC Press, 2nd edition, 2000.

Non-conventional Machining

BTMPE703C	PEC5	Non-conventional Machining	3-0-0	3Credits

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: Manufacturing Processes

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

CO1	Classify Non-conventional machining processes.
CO2	Understand working principle and mechanism of material removal in various non-conventional machining processes.
CO3	Identify process parameters their effect and applications of different processes.
CO4	Summarized merits and demerits of non-conventional machining processes.
CO5	Explain the mechanism to design hybrid processes such as ELID grinding, EDCG, EDCM, etc.
CO6	Understand mechanism and working principle of micro machining using non-conventional processes.

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

Course Contents:

Unit 1: Introduction to Non-Conventional Machining Processes [07 Hours]

An overview, Trends in manufacturing, Classification of Non-Conventional Machining processes.

Unit 2: Chemical and Electrochemical Processes [07 Hours]

Introduction, Types: CHM, ECM, Electrochemical grinding, electrochemical deburring, electrochemical honi Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooling (maskants a etchants), Advantages, applications and limitations.

Unit 3: Thermo-Electrical Processes [07 Hours]

Electrical discharge machining, Electron beam machining, Ion beam machining, Plasma arc machining, H machining, Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooli Advantages, applications and limitations.

Unit 4: Mechanical Processes[07 Hours]

Ultrasonic machining, Abrasive jet machining, Abrasive flow machining, Water Jet cutting, Mechanism of mater removal, Process characteristics, Process parameters, Equipment and Tooling, Advantages, applications a limitations.

Unit 5: Laser Based Machining Processes and Hybrid Processes [07 Hours]

Types of lasers, Laser beam generation, Equipment and machining procedure, Process characteristics, Proc parameters, Advantages and limitations of LBM, Applications.

Hybrid Processes

Concept, Mechanism of material removal, Process characteristics, Process parameters, Equipment and Tooli classification, applications, advantages, Shaped tube electrolytic machining, Electrical discharge wire cutting, EL grinding, Micro machining: Micro EDM, Micro ECM, Electro discharge chemical grinding (EDCG).

Texts:
1. P. C. Pande, H. S. Shan, "Modern Machining Process", Tata McGraw-Hill Publications, New Delhi, 1980.
2. V. K. Jain, "Advanced Machining Processes", Allied Publishers Pvt. Ltd., New Delhi, 2002.
3. P. K. Mishra, "Non-Conventional Machining", Narosa Publishing House, New Delhi, 2007

References:
1. P. C. Wellar, "Non-Traditional Machining Processes", SME, Michigan, 1984.
2. Gary F. Benedict, "Non-traditional Manufacturing Processes", Marcel Dekker, 1987.

Advanced IC Engines

BTMPE703D	PEC 5	Advanced IC Engines	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: IC Engines

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

CO1	Define and Distinguish between Spark ignition and Compression ignition system. Describe Air- fuel supply systems in ic engines.
CO2	Identify and Demonstrate normal and abnormal combustion in combustion chambers of IC engines. According to which able to analyse and Design combustion chambers.
CO3	Recognize and discuss engine emissions formation, effects and various methods to reduce emissions and their measuring equipment's.
CO4	Understand combustion and emission characteristics of an alternative energy sources and suggest appropriate applications of alternative fuels such as bio diesels, natural gas, LPG, hydrogen, etc. and their Engine modifications for using these fuels.
CO5	Apply and interpret with the recent trends IC engine techniques such as HCCI, CRDI, GDI, etc. with latest measuring equipments.

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

Course Contents:

Unit 1: Spark Ignition Engines **[07 Hours]**

Mixture requirements, Fuel injection systems, Monopoint, Multipoint & Direct injection, Stages of combustio
Normal and Abnormal combustion, Knock: Factors affecting knock, Combustion chambers.

Unit 2: Compression Ignition Engines **[07 Hours]**
Diesel Fuel Injection Systems, Stages of combustion, Knocking, Factors affecting knock, Direct and Indirect injecti systems, Combustion chambers, Fuel Spray behaviour, Spray structure and spray penetration, Air motion, Introducti to Turbo charging.

Unit 3: Pollutant Formation and Control **[07 Hours]**
Pollutant, Sources, Formation of Carbon Monoxide, Unburnt hydrocarbon, Oxides of Nitrogen, Smoke and Particul matter, Methods of controlling Emissions, Catalytic converters, Selective Catalytic Reduction and Particulate Tra Methods of measurement, Emission norms and Driving cycles.

Unit 4: Alternative Fuels and Multi-fuel Engines **[07 Hours]**
Alcohol, Hydrogen, Compressed Natural Gas, Liquefied Petroleum Gas and Bio Diesel: Properties, Suitability, Mer and Demerits, Engine Modifications.
Multi-fuel Engines: Multi-fuel engines, HCCI, GDI, and Exhaust after processing devices.

Unit 5: Recent Trends/Developments **[07 Hours]**
Air assisted Combustion, Homogeneous charge compression ignition engines, Variable Geometry turbocharge Common Rail Direct Injection Systems, Hybrid Electric Vehicles – NOxAdsorbers, Onboard Diagnostics.

Unit 6: Multi-fuel Engines

Texts:
1. V. Ganesan, "Internal Combustion Engines", TMH, 2nd edition, 2002.
2. R. B. Mathur, R. P. Sharma, "Internal Combustion Engines", DhanpatRai& Sons 2007.
3. E. F. Obert, “Internal Combustion Engines”.

References:
1. Duffy Smith, "Auto Fuel Systems", The Good Heart Willcox Company, Inc., 1987.
2. Eric Chowenitz, "Automobile Electronics", SAE Publications, 1995.

Additive Manufacturing

BTMPE703E	PEC5	Additive Manufacturing	3-0-0	3Credits

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 importance of Additive Manufacturing
CO2	Classify the different AM processes
CO3	Design for AM processes
CO4	Understand the applications of AM
CO5	Differentiate the post processing processes

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

Course Contents:

Unit 1: Introduction to Additive Manufacturing (AM) **[07 Hours]**
Introduction to AM, AM evolution, Distinction between AM and CNC machining, Advantages of AM.
AM process chain: Conceptualization, CAD, conversion to STL, Transfer to AM, STL file manipulation, Machi setup, build , removal and clean up, post processing.
Classification of AM processes: Liquid polymer system, discrete particle system, molten material systems, and so sheet system.

Unit 2: Design for AM **[07 Hours]**
Motivation, DFMA concepts and objectives, AM unique capabilities, Exploring design freedoms, Design tools AM, Part Orientation, Removal of Supports, Hollowing out parts, Inclusion of Undercuts and Other Manufacturi Constraining Features, Interlocking Features, Reduction of Part Count in an Assembly, Identification of markin numbers etc.

Unit 3: Guidelines for Process Selection **[07 Hours]**
Introduction, selection methods for a part, challenges of selection, example system for preliminary selecti production planning and control

Unit 4: AM Applications **[07 Hours]**
Functional models, Pattern for investment and vacuum casting, Medical models, art models, Engineering analy models, Rapid tooling, new materials development, Bi-metallic parts, Re-manufacturing. Application examples Aerospace, defence, automobile, Bio-medical and general engineering industries

Unit 5: Post Processing of AM Parts and Future Directions of AM **[07 Hours]**
Support material removal, surface texture improvement, accuracy improvement, aesthetic improvement, preparati for use as a pattern, property enhancements using non-thermal and thermal techniques.
Future Directions of AM
Introduction, new types of products, employment and digiproneurship.

Texts:
1. Chua Chee Kai, Leong Kah Fai, "Rapid Prototyping: Principles and Applications", World Scientific, 2003.
2. Ian Gibson, David W. Rosen, Brent Stucker, "Additive Manufacturing Technologies: Rapid Prototyping to Dir Digital Manufacturing", Springer, 2nd edition, 2010.

References:
1. Ali K. Kamrani, EmandAbouel Nasr, "Rapid Prototyping: Theory and Practice", Springer, 2006.
2. D. T. Pham, S. S. Dimov, "Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping a Rapid Tooling", Springer, 2001.
3. Andreas Gebhardt, "Understanding Additive Manufacturing", Hanser Publishers, 2011.

Dr. Babasaheb Ambedkar Technological University, Lonere

Surface Engineering

BTMPE703F	PEC5	Surface Engineering	3-0-0	3Credits

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	Learn the importance and need of surface engineering
CO2	Describe various surface cleaning and modification techniques
CO3	Understand the concepts of surface integrity
CO4	Compare various surface coating technologies
CO5	Select appropriate method of coating for a given application
CO6	Apply measurement techniques and carry out characterization of coated surfaces.

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

Course Contents:

Unit 1: Introduction **[07 Hours]**

Definition, Significance, Role of surface Engineering in creating high performance product, Functional characterist of a surface, Nature of surfaces: Deformed layer, Beilby layer, chemically reacted layer, Physisorbed lay Chemisorbed layer; Classification of Surface Engineering Techniques.

Unit 2: Surface Preparation Techniques **[07 Hours]**

Factors affecting selection of cleaning process, Significance of surface preparation, Classification of cleani processes, Chemical cleaning processes; Mechanical Processes; Substrate considerations, Surface contaminants soils, Tests for cleanliness.

Unit 3: Surface Integrity **[07 Hours]**

Definition, Importance, Surface alterations, Factors in Surface Integrity: Visual, Dimensional, Residual stre Tribological, Metallurgical; Measuring Surface Integrity effects: Minimum and Standard data set, Macroscopic a microscopic examination.

Unit 4: Surface Modification Techniques **[07 Hours]**

Classification, Thermal treatments: Laser and electron beam hardening, Mechanical treatments: Short peening: Peeni action, surface coverage and peening intensity, Types and sizes of media, Control of process variables, equipment;

Ion Implantation: Basic Principle, Advantages and disadvantages, equipment.

Unit 5: Surface Coating Techniques and Characterization of Coatings [07 Hours]

Thermal Spraying: Types and applications; Chemical Vapour Deposition: Principles, Reactions, Types a applications; Physical Vapour Deposition: Basic principle, Evaporation, Sputtering, Ion Plating, Applicatio Electroplating: Principle of working and applications; Types of Coatings: Hard, Soft, Single layer, Multi-layer.

Characterization of Coatings

Physical characteristics and their measurements: Coating thickness, Surface Morphology and Microstructu Mechanical properties and their Measurements: Hardness, Adhesion, Friction and Wear.

References:

1. ASM Handbook, "Volume 5: Surface Engineering", ASM International.
2. K. G. Budinski, "Surface Engineering for Wear Resistance", Prentice Hall.
3. T. Burakowski, T. Wierschon, "Surface Engineering of Metals: Principles, Equipment, Technologies", CRC Pres
4. B. Bhushan, B. K. Gupta, "Handbook of Tribology: Materials, Coatings, and Surface Treatments", Tata McGr Hill Publications.

ASM Handbook, "Volume 16: Machining", ASM International.

Processing of Polymers

BTPPE703D	PEC5	Processing of Polymers	3-0-0	3Credits

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)

Unit 1: Basic Concept: **[07 Hours]**

Plastic Additives and Compounding: Various additives and their purpose (e.g.antioxidants, plasticizers, antistatic agents, blowing agents etc.), Principle of mixing and mixers,types.

Extrusion

Basic operation and analysis, solids conveying, drag induced conveying, melting mechanism,power consumption in metering zone. Overall extruder performance.Design of extrusion screws,modeling of extrusion process and compute simulation.Overall working of single screw and twinscrew extruders.

Unit 2: Polymer Devolatilization **[07 Hours]**

Basic analysis of the process, functional design considerations, screw geometry and design Devolatilization in single screw and twin screw extruders and their design.

Extruded products

Such as films, pipes, profiles, coating, foamed products, design of sizing systems, haul off Systems, cooling and / or chilling units, winders, auxiliary equipment's used, measurement and Control of parameters. Types of dies used for the production of extruded products. Analysis of theflow through the dies. Manufacture of flat films, co extruded films, oriented films, drawing andstretching units.

Unit 3: Reactive extrusion and resident time distribution (RTD) **[07 Hours]**

Process details, basic principles, equipment used, effective residence time and residence time Distribution (RTD), point measurements: characterization of melting and mixing time with the RTD, applications.

Extrusion blow molding

Types of blow molding techniques, flow analysis in the die, wall thickness control, parison swell, parison sag. Continuous and intermittent blow molding CAE of blow molding operation.

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

Types, various techniques, materials, heat transfer analysis of the process, effect of plugs on article Thickness, continuous heating of a thin moving sheet.CAE in thermoforming.

Unit 5: Injection molding **[07 Hours]**

Role of rheology in injection molding, melt flow in feed system, flow in mould cavity, mould Filling.Control of politicizing and injection process.

Reaction injection molding

Overall molding cycle, metering system for components, mixing head design, mould construction,Materials used and their applications.

Other Processing techniques: Calendering and milling, compression and transfer molding, casting,rotational molding fabrication, decoration of polymers.

References:

1. Handbook of Plastics Test Method, R.B. Brown, George Godwin Limited, 1981.
2. Handbook of Plastic Testing Technology, Brown and Vishnu Shah, A. Wiley, Inter science Publication, 2007
ME (Polymer Engineering) Syllabus Page 26
3. Handbook of Plastics Test Methods, G.V. Eves, J.A. Mead, M.M. Riky.
4. Volume 8 of ASTM Standards, BIS Standards.
5. Polymer Extrusion, Chris Rauwendal SPE, Hanser Publishers.
6. Polymer Missing and Extrusion Technology – Nich olas Cheremisinoff, Marcel Dekker 1987
7. Modeling Of Polymer Processing, Isayav, Hanser Publishers, 1991.
8. Plastics Waste Management, Mustafa.
9. Plastics Extrusion Technology – Hanser SPE, 199 6
10. Thermoforming – J.L. Throne, Hanser Publishers 1987
11. Blow Molding Handbook – Rosato, Hanser Publish ers 1987
12. Mixing and Compounding of Polymers: Theory and Practice, Ica Manas-Zloczower, Hanser Verlag, 2009.
13. Extrusion of Polymers: Theory and Practice, Chan I. Chung, Hanser Verlag, 01-Apr-2000
14. Rotational Molding of Plastics – R. J. Crawfor d, Research Studies Press Ltd.
15. Engineering with Polymers - Powell.

Stress Analysis

BTMPE703G	PEC5	Stress Analysis	3-0-0	3 Credits

Teaching Scheme:	Evaluation Scheme:
Lecture: 3 hrs/ week	Continuous Assessment: 20 Marks Mid Semester Exam: 20 Marks End Semester Exam: 60 Marks (Duration 03 hours)

Pre-Requisites: Strength of Materials, Machine Design-I

Course Outcome: At the end of course, student will be able to:

CO1	Explain the concept of stress, strain & their relationships & will also be able to choose suitable coordinate system for problems of stress analysis.
CO2	Explain the concept of Plane stress, plane strain, Stress & Strain at a point & will be able to derive the differential equation of equilibrium, Compatibility equation.
CO3	Apply the concept of stress function to solve the stress analysis problems involving simple

	components in Cartesian & Polar coordinate systems.
CO4	Explain basic principles of optics, describe polariscope & explain the effect of stressed model on behaviour of light vector in polariscope, compensation technique, separation techniques & Stress Freezing in photoelasticity
CO5	Describe various types of strain gage. Will be also able to describe & apply the theory of Wheatstone bridge for strain measurement using strain gages & to explain the technique for measurement of strain & stresses in rotary components.
CO6	Describe other techniques like Grid technique & Brittle coating method

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

Course Contents:

UNIT 1: Two dimensional problems in Cartesian coordinate System [7 Hours]

Fundamentals of stress & strain, Stress & strain components, stress-strain relationship, Elastic constant, Plane stre
Plane strain, differential equation of equilibrium, Saint Venant`s principle, Compatibility condition, Compatibil
equations for plane stress and plane strain conditions, Airys stress function.

UNIT 2: Two dimensional problems in Polar coordinate System [7 Hours]

General equations of equilibrium in polar coordinate, compatibility equation, relationship between stress compone
in polar and rectangular coordinate system, stress distribution about symmetric axis.

UNIT 3: Applications of theory of elasticity [7 Hours]

Stress analysis of cantilever subjected to end point load, Stress analysis of simply supported beam subjected to UD
Stress analysis of cylinder subjected to internal & external pressure, Pure bending of curved beams.

UNIT 4: Photoelasticity [7 Hours]

Two-Dimensional Photo elasticity – Introduction to basic optics related to photo elasticity, stress-optic law, plane
circular polariscope arrangements, effect of stressed model in plane & circular polariscope, Isoclinic & Isochromat
calibration of photo elastic material (determination of fringe constant using circular disk), photo elastic materials
their properties. Casting & preparation of photo elastic models, Tardy`s compensation technique. Separati
techniques like, shear difference, oblique incidence & electrical analogy.
Introduction to 3 – D photo elasticity - Phenomenon of Stress freezing, Stress freezing cycle, Introduction to Reflecti
polariscope, fringe sharpening & fringe multiplication.

UNIT 5: Strain Gages [7 Hours]

Strain gage technique for stress & strain analysis – Introduction to electrical resistant strain gage, gage fact

Wheatstone bridge circuit, bridge balance, output voltage of Wheatstone bridge, various bridge configuratio determination of principle strains & stresses using strain rosettes. Introduction to Strain measurement on rotati components.

Grid technique of strain analysis, Brittle coating method for stress & strain analysis.

Text Books:

1. Theory of Elasticity, S.P. Timoshenko, Mc-Graw Hill.
2. Experimental Stress Analysis, Daily & Riley, Mc-Graw Hill.

Reference Books:

1. Experimental Stress Analysis, L.S. Srinath, TMH.
2. Experimental Stress Analysis, T.K. Ray, S. Chand publications.
3. Theory of Elasticity, Sadhu Singh, Khanna publishers.
4. Experimental Stress Analysis, U.C. Jindal, Pearson publications.
5. Experimental Stress Analysis, Sadhu Singh. Khanna publishers.
6. Experimental Stress Analysis, Adel Mubeen, Dhanpat Rai & Sons.

Open Elective-III

Sustainable Development

BTMOE704A	OEC3	Sustainable Development	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	Explain the difference between development and sustainable development
CO2	Explain challenges of sustainable development and climate change
CO3	Explain sustainable development indicators
CO4	Analyze sustainable energy options
CO5	Understand social and economic aspects of sustainable development

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	2	3		2	3	3	3	2	2		2
CO2	1	1	3	1	2	3	3	3	2	2		2
CO3	2	1	1				3	2		1		2
CO4	3	3			2	3	3	2				1

CO5			3			2	3	2				1

Course Contents:

Unit 1: Introduction **[07 Hours]**
Status of environment, Environmental, Social and Economic issues, Need for sustainability, nine ways to achie sustainability, population, resources, development and environment.

Unit 2: Global Warming and Climate Change **[07 Hours]**
Global Warming and climate Change since industrial revolution, Greenhouse gas emission, greenhouse effe Renewable energy, etc.

Unit 3: Challenges of Sustainable Development and Global Environmental Issues[07 Hours]
Concept of sustainability, Factors governing sustainable development, Linkages among sustainable developme Environment and poverty, Determinants of sustainable development, Case studies on sustainable developme Population, income and urbanization Health care, Food, fisheries and agriculture , Materials and energy flows.

Unit 4: Sustainable Development Indicators and Environmental Assessment [07 Hours]

Need for indicators, Statistical procedures Aggregating indicators, Use of principal component analysis, Th environmental quality indices.
Environmental Assessment
National environmental policy act of 1969, Environmental Impact Assessment, Project categories based environmental impacts, Impact identification methods, Environmental impact assessment process.

Unit 5: Environmental Management and Social Dimensions **[07Hours]**
Revisiting complex issues, Sector policies concerning the environment, Institutional framework for environmen management, Achievements in environmental management, People's perception of the environment, Participat development, NGOs, Gender and development, Indigenous peoples, Social exclusion and analysis.

Texts:
1. J. Sayer, B. Campbell, "The Science of Sustainable Development: Local Livelihoods and the Global Environmen Biological Conservation, Restoration and Sustainability, Cambridge University Press, London, 2003.
2. J. Kirkby, P. O"Keefe, Timberlake, "Sustainable Development", Earth scan Publication, London, 1993.
3. Peter P. Rogers, Kazi F. Jalal, John A. Boyd, "An introduction to sustainable development", Glen Educatio Foundation, 2008.

References:
1. Jennifer A. Elliott, "An introduction to sustainable development". London: Routledge: Taylor and Francis grou 2001.
2. Low, N. "Global ethics and environment", London, Rout ledge, 1999.
3. Douglas Muschett, "Principles of Sustainable Development", St. Lucie Press, 1997.

Entrepreneurship Development

BTMOE704B	OEC 4	Entrepreneurship Development	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	enlarge the supply of entrepreneurs for rapid industrial development
CO2	Develop small and medium enterprises sector which is necessary for generation of employment
CO3	Industrialize rural and backward regions
CO4	Provide gainful self-employment to educated young men and women
CO5	Diversify the sources of entrepreneurship.

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									2			
CO3											2	
CO4											2	3
CO5												3

Course Contents:

Unit 1: Introduction to Entrepreneurship **[07 Hours]**

Evolution of the Concept of Entrepreneur Functions of Entrepreneur, Characteristics of an Entrepreneur, Types Entrepreneur, Concept of Entrepreneurship, Growth of Entrepreneurship, Barriers of Entrepreneurship, Role Entrepreneurship in India, Entrepreneurial Motivation, Major Entrepreneurial Competencies.

Unit 2: Small Scale Industries (SSI) **[07 Hours]**

Characteristics of Small Scale Industry, Basis for Classification of Small Scale Industry: Resource Based, Demand Bas Ancillary, Subsidiary Based or Sub-Controlled Type, Technology Based etc. Government Policy for Small Scale Indust Growth of SSI in Developing Countries, Role of National and State Agencies Providing Assistance To SSI's, Relationsl between Small and Big Industries, Ownership Structure, Registration of SSI.

Unit 3: Project Identification and Project Formulation **[07 Hours]**

Meaning of Project, Project Identification and Selection, Elements of Project Formulation, Concept and Significance Project Formulation, Meaning, Significance and Contents of Project Report.

Accounting for Small Enterprises: Objective of Accounting, Accounting Process, Journal, Ledger, Preparation Balance Sheet and Assessment of Economic Viability

Unit 4: Project Appraisal **[07 Hours]**

Concept of Project Appraisal, Project Appraisal Methods, Cash Flows as Costs and Benefits, Payback Period, Avera Rate of Return. Discounted Cash Flow Techniques, Working Capital Management, Cost of Capital, Financing Enterprises, Project Sickness & Corrective Measures.

Unit 5: Marketing Management **[07 Hours]**

Market Segmentation, Marketing Mix, and Packaging, Pricing Policy, Distribution Channels, and Govt. Purchases fr

SSIS.

Laws Concerning Entrepreneur: Income Tax Laws, Excise Duty ,The Central Sales Tax Act, Professional Tax, Va Added Tax (VAT), Service Tax, The Workmen Compensation Act, The Minimum Wages Act, The Maternity Benefit A The Payment of Bonus Act

Institutional Support

Government Policies for Small Scale Entrepreneurs, Institutional Setup, District Industries Centers, Industrial Estate SIDCO, NSIC, Directorate of Industries, Commercial Banks, New Entrepreneurial Development Agencies.

Women Entrepreneurship: Growth, Problems, Recent Trends.

References:

1. S. S. Khanka, "Entrepreneurial Development", S. Chand and Company Ltd.
2. C. B. Gupta, N. P. Srinivasan, "Entrepreneurship Development in India", S. Chand and Sons.
3. B. Badhai, "Entrepreneurship Development Programme", Mansell Publishing Ltd.
4. V. Desai, "Dynamics of Entrepreneurial Development and Management", Hindustan Publishing House.
5. David H. Holt, "Entrepreneurship", PHI Learning.
6. Roy Rajeev, "Entrepreneurship", Oxford University Press.

Plant Maintenance

BTMOE704C	OEC3	Plant Maintenance	3-0-0	3Credits

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)

Objectives: To exemplify different types of plants and its function and analyse the principles used in plan maintenance. To understand various basic aspects related to running of industry the safety methods in plants. Th course provides problems based techniques related with location, layout, maintenance, replacement of machines, etc.

Pre-Requisites: None

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

CO1	Recognize and enlist probable failures in mechanical elements.
CO2	Dismantle, assemble and align mechanisms in sequential order for given assembly.
CO3	Compare maintenance practices like on-line, shut down, corrosion, productive and preventive maintenance.
CO4	Analyze economics of plants and list factors affecting the maintenance of a plant.
CO5	Correlate the linkages between different maintenance aspects and how they impact on overall maintenance effectiveness.
CO6	Analyze different maintenance techniques and select an appropriate technique for a particular plant.

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	2	1	1	2			2
CO2	2			1	1	2	2					2

CO3	2	2	1	1	1		1	1	1			
CO4	1	1		2	1	2	1		2		1	2
CO5	2	2			1	2	2				1	2
CO6	1					1					1	1

Course Contents:

Unit 1: Introduction
Introduction to concept of maintenance, Type of maintenance; Preventive, Productive, corrective, online, shut do and their significance.
Unit 2: Preventive Maintenance
Preventive maintenance and its importance, Repair cycle, systematic recording, preventive maintenan Programming and types of schedules, Manpower and machine planning, Lubrication methods and practice, Color co schedule.
Unit 3: Online Maintenance and Shut down Maintenance
On-line maintenance, attending to joints, Valves, Pumps and other equipment's leakages,
Making shaft arrangement, stand-by unit, repairing damage to insulation, etc. without stopping the plant, attendin faulty equipment, Fault finding and troubleshoots.
Shut down Maintenance
Shut down maintenance, Economic aspects of timing, duration of Timing and duration of shut down maintenan Execution by using PERT and CPM.
Unit 5: Maintenance of Mechanical Equipment
Maintenance of major equipment like boiler, furnaces, kilns, shells and tube heat exchangers, pump and compress Towers, Cooling vessels, Valves piping.
Unit 6: Plant Condition Monitoring
Plant condition monitoring systems, instrumentation, Data collection and analysis, life expectancy and maintenar scheduling.The economics of maintenance management.

Text:
1. Lindley R. Hinggin, L.C. Morrow, "Maintenance Engineering Handbook", Tata McGraw Hill Book Company.

References:
1. Duncan C. Richardson, PE, "Plant Equipment and Maintenance Engineering Handbook", McGraw Hill Educati New York, Chicago, 2014.

Open Elective-IV
Engineering Economics

BTMOE705A	OEC4	Engineering Economics	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	Apply the appropriate engineering economics analysis method(s) for problem solving: present worth, annual cost, rate-of-return, payback, break-even, Benefit-cost ratio.
CO2	Evaluate the cost effectiveness of individual engineering projects using the methods learned and draw inferences for the investment decisions.
CO3	Compare the life cycle cost of multiple projects using the methods learned, and make a quantitative decision between alternate facilities and/or systems.
CO4	Compute the depreciation of an asset using standard Depreciation techniques to assess its impact on present or future value.
CO5	Apply all mathematical approach models covered in solving engineering economics problems: mathematical formulas, interest factors from tables, Excel functions and graphs. Estimate reasonableness of the results.
CO6	Examine and evaluate probabilistic risk assessment methods.
CO7	Compare the differences in economic analysis between the private and public sectors. Recognize the limits of mathematical models for factors hard to quantify.
CO8	Develop and demonstrate teamwork, project management, and professional communications skills

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	
CO2											3	
CO3											3	
CO4											3	
CO5					3						3	
CO6											3	
CO7											3	
CO8									2		3	

Course Contents:

Unit 1: Introduction to Economics **[07 Hours]**

Introduction to Economics: Flow in an economy, Law of supply and demand, Concept of Engineering Economi Engineering efficiency, Economic efficiency, Scope of engineering economics - Element of costs, Marginal co Marginal Revenue, Sunk cost, Opportunity cost, Break-even analysis: V ratio, Elementary economic Analys Material selection for product Design selection for a product, Process planning.

Unit 2: Value Engineering **[07 Hours]**

Make or buy decision, Value engineering: Function, aims, and Value engineering procedure. Interest formulae a their applications: Time value of money, Single payment compound amount factor, Single payment present wo factor, Equal payment series sinking fund factor, Equal payment series payment Present worth factor: equal payme series capital recovery factor:

Uniform gradient series annual equivalent factor, Effective interest rate, Examples in all the methods.

Unit 3: Cash Flow **[07 Hours]**

Methods of comparison of alternatives: present worth method (Revenue dominated cash flow diagram), Future wo method (Revenue dominated cash flow diagram, cost dominated cash flow diagram), Annual equivalent meth (Revenue dominated cash flow diagram, cost dominated cash flow diagram), rate of return method, Examples in all t methods.

Unit 4: Replacement and Maintenance Analysis **[07 Hours]**

Replacement and Maintenance analysis: Types of maintenance, types of replacement problem, determination economic life of an asset, Replacement of an asset with a new asset: capital recovery with return and concept challenger and defender, Simple probabilistic model for items which fail completely.

Unit 5: Depreciation and Evaluation of Public Alternatives [07 Hours]

Depreciation: Introduction, Straight line method of depreciation, declining balance method of depreciation, sum of years digits method of depreciation, sinking fund method of depreciation/annuity method of depreciation, serv output method of depreciation-

Evaluation of Public Alternatives

Introduction, Examples, Inflation adjusted decisions: procedure to adjust inflation, Examples on comparison alternatives and determination of economic life of asset.

Texts:

1. PanneerSelvam R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2001.

References:

1. Chan S. Park, "Contemporary Engineering Economics", Prentice Hall of India, 2011.
2. Donald G. Newman, Jerome P. Lavelle, "Engineering Economics and analysis", Engineering Press, Tex 2010.
3. E. P. Degarmo, W. G. Sullivan and J. R. Canada, "Engineering Economy", Macmillan, New York, 2011.
4. Zahid A. Khan, "Engineering Economy", Dorling Kindersley, 2012

Biology for Engineers

BTMOE705B	OEC 4	Biology for Engineers	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	Explain origin of life and Evolution, Cells, Biomolecules-Lipids
CO2	Understand Biomolecules
CO3	Understand Cell structure and function and cell cycle
CO4	Explain Mendelian genetics
CO5	Understand and Explain DNA structure, DNA replication, Transcription, Translation

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

Course Contents:

Unit 1: Introduction **[07 Hours]**
Origin of life and Evolution, Cells, Biomolecules-Lipids

Unit 2: Biomolecules **[07 Hours]**
Carbohydrates, water, Amino acids and proteins, Enzymes, Nucleotides

Unit 3: Cell structure **[07 Hours]**
Cell structure and function, Prokaryotes, Eukaryotes

Unit 4: Cell cycle **[07 Hours]**
Cell division, mitosis, meiosis, culture growth,

Unit 5: Genetics and DNA **[07 Hours]**
Mendelian genetics, genetic disorders, Mendelian inheritance principle, pedigree analysis, Non- Mendelian inheritan
DNA
Chromatin, DNA structure, DNA replication, Transcription, Translation.

Texts:

1. Arthur T. Johnson, "Biology for Engineers", CRC Press.

References:

1. N. A. Campbell, J. B. Reece, "Biology", International edition, Benjamin Cummings, New York, 7th edition or lat 2007 or later.
2. G. Karp, "Cell and Molecular Biology: Concepts and Experiments", Wiley, New York, 7th edition, 2013.

Intellectual Property Rights

BTMOE705C	OEC4	Intellectual Property 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	State the basic fundamental terms such as copyrights, Patents, Trademarks etc.,
CO2	Interpret Laws of copy-rights, Patents, Trademarks and various IP registration Processes.
CO3	Exhibit the enhance capability to do economic analysis of IP rights, technology and innovation related policy issues and firms commercial strategies.
CO4	Create awareness at all levels (research and innovation) to develop patentable technologies.
CO5	Apply trade mark law, copy right law, patent law and also carry out intellectual property audits.
CO6	Manage and safeguard the intellectual property and protect it against unauthorized use.

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

Course Contents:

Unit 1: Introduction to Intellectual Property **[07 Hours]**
Introduction, types of intellectual property, international organizations, agencies and treaties, importance of intellect property rights.

Unit 2: Trade Marks **[07 Hours]**
Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating tra mark, trade mark registration processes.

Unit 3: Law of Copy Rights **[07 Hours]**
Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work public copy right ownership issues, copy right registration, notice of copy right, international copy right law.

Unit 4: Law of Patents and Trade Secrets **[07 Hours]**
Foundation of patent law, patent searching process, ownership rights and transfer.

Trade Secrets
Trade secretes law, determination of trade secretes status, liability for misappropriations of trade secrets, protection submission, trade secrete litigation.

Unfair competition: Misappropriation right of publicity, false advertising.

Unit 5: New Development of Intellectual Property **[07 Hours]**
New developments in trade mark law; copy right law, patent law, intellectual property audits.
International overview on intellectual property, international trade mark law, copy right law, international patent la and international development in trade secrets law.

Texts:

1. Deborah, E. Bouchoux, "Intellectual Property Right", Cengage learning.
2. Prabuddha Ganguli, "Intellectual property right: Unleashing the knowledge economy", Tata McGraw H Publishing Company Ltd.

References:

1. Ajit Parulekar, Sarita D'Souza, "Indian Patents Law-Legal and Business implications", Macmillan India Ltd., 20
2. B. L. Wadhera, "Law related to patents, Trademarks, Copyrights, Designs and Geographical indications", Univer law Publishing Pvt. Ltd., India, 2000.
3. P. Narayanan, "Law of copyright and Industrial Designs", Eastern Law house, Delhi, 2010.

Mechanical Engineering Lab –V

BTMCL706	PCC16		0-0-4	2 Credit

Practical Scheme:	Examination Scheme:
Practical: 4 hrs/batch	Continuous Assessment: 60 Marks End Semester Exam: 40 Marks

Group A (Mechatronics Lab)

List of Practical's/Experiments/Assignments (Any SIX)

1. Study and demonstration of various types of sensors
2. Speed control of various types of Electrical Motors
3. MinimumtwocircuitsonPneumaticstobedevelopedonPneumatictrainerkit
4. Minimum two circuits on Electro-Pneumatics to be developed on Electro- Pneumatic trainer kit
5. Minimum two circuits on Hydraulics and Electro-hydraulics to be developed on Hydraulic trainer kit
6. Programming of Microprocessor and Microcontroller
7. Programming on PLC
8. Demonstration of Process control such as temperature, level, flow, etc. control using PID controller

Group B

Perform any THREE Practical's/ Assignments on Elective – V

SEMESTER VII
Mini Project

BTMP707	Mini Project	PROJ-6	0L-0T-6P	3 Credits

Teaching Scheme:	Examination Scheme:
Practical: 6 hrs/week	Continuous Assessment: 30 Marks Mid Semester Exam: -- End Semester Exam: 20 Marks

IT – 3

BTMI608 (IT – 3)	IT – 3 Evaluation	PROJ-7	0L-0T-0P	1 Credits

Teaching Scheme:	Examination Scheme:
Practical: -- hrs/week	Continuous Assessment: -- Mid Semester Exam: -- End Semester Exam: 100 Marks

SEMESTER VIII
Project /Internship

BTMP801/ BTMI801	Project / Internship	PROJ-8	0L-0T-16P	8 Credits

Teaching Scheme:	**Examination Scheme:**
Practical: 16 hrs/week	Continuous Assessment: 60 Marks Mid Semester Exam: -- End Semester Exam: 40 Marks

- BTMP707 Mini Project and BTMP801/ BTMI801 Project /Internship are independent and allotment will also b done independently in respective semester.
- BTMP707 Mini Project will be done in-house only.
- Evaluation of both will be done independently as per the time schedule in AC.
- In case student(s) choose in-house project, it may be an extension of the Mini Project, however, Mini Project should be completed in all respect in semester VII itself.