G.H. Raisoni College of Engineering and Management, Wagholi, Pune – 412 207

(An Autonomous Institute Affiliated to SPPU, Pune)

Third Year B. Tech Mechanical Engineering

(Course 2016)

Course Book

(With effect from June 2018)

Prepared by,

Dr. R. R. Arakerimath

(HOD Mech. And BOS) **Director, GHRCEM**

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DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To produce excellent Mechanical Engineering graduates to cater the needs of industries to face Research challenges.

MISSION

Our efforts are dedicated towards

1. To impart quality education through strengthening teaching learning process.
2. Creating competency in core Mechanical Engineering and Computer Aided Engineering.
3. To prepare students for accepting industrial and research challenges through project based learning.
4. To prepare professional engineers having lifelong learning ability and ethical values towards society and environment.

INTRODUCTION

GHRCEM, Pune is nationally acclaimed Institute that aims at creating professionals who will be driven by a firm commitment to excellence, yet rooted in the rich cultural heritage of our nation. GHRCEM, Pune is accredited by National Assessment and Accreditation Council (NAAC), Government of India. This Institute has also been granted autonomy by UGC. GHRCEM, Pune is fast emerging as a pioneering Research cum Teaching Institution molding a new generation of engineers, managers, scientists and entrepreneurs of caliber and character.

The Department of Mechanical Engineering was established in year 2006. Presently the department has well equipped laboratories, including state of art equipment's like CNC Trainer machine, CAD/CAM/CAE software etc. The department organizes Guest Lectures to students, Training services. Faculty of mechanical department organizes and participates in national/international conferences, workshops and seminars. The department has SAE, MESA, ISTE Chapters for professional growth and activities. The students of Mechanical Engineering have been recruited by renowned companies like Engineers India Limited, Infosys, NTPC, Tata Motors etc. They have also brought laurels to the department by winning various competitions of national level (BAJA SAE, SUPRA) co-curricular and extracurricular activities like paper presentations, projects, quizzes, sports etc. The department has organized National and International conference during NCRDME 2012-13, ICRAME 2014-15, NCRDME 2016-17. Department has approved Ph.D. research Centre w.e.f. 2014 under UOP Pune. The Institute offers a fulltime programme of 4-years in Mechanical Engineering and the Programme offered list is given below:

Program Offered

Sr. No.	Programme Level	Name of Course	Course Type	Medium of Instruction	Course Establishment	Sanctioned Intake
1	UG B. Tech	1st year	Regular Shift	English	2006-2007	120
		Direct 2nd year	Regular Shift	English	2007-2008	60
2	PG M. Tech	HPE	Regular Shift	English	2011-2012	18
		CADME	Regular Shift	English	2014-2015	24
3	Ph. D	Mechanical Engineering	Regular Shift	English	2014-2015	-

PROGRAM EDUCATIONAL OBJECTIVES

The graduate shall

1. Demonstrate core mechanical engineering skills to solve industrial problems.
2. Be able to apply analytical and soft skills while serving the industry and society at large.
3. Be able to deliver professional duties and responsibility in team effectively.
4. Be able to demonstrate lifelong abilities and ethical values looking at environmental issues.

LIST OF PROGRAM SPECIFIC OUTCOMES (PSOs)

At the end of graduation:

1. Able to grasp comprehensive and apply the knowledge of mechanical engineering acquired through core courses of engineering.
2. Will be able to apply design, develop and manufactures skills to solve the real life problems associated with industries.
3. Able to use knowledge of soft skills like software tools and multidisciplinary skills to modify and develop new products.

PROGRAM OUTCOMES

Engineering Graduates will be able to:

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, review 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.

Course Code

B. TECH. MECHANICAL ENGINEERING T.Y-SEMESTER-V

S.NO	COURSE CODE	COURSE NAME	SEM	SCHEME	SUBJECT	ELECTIVE	OFFER
1	BMEL301	Machine Design-I	V	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
2	BMEP301	Machine Design-I	V	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
3	BMEL302	Dynamics Of Machines	V	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
4	BMEP302	Dynamics Of Machines	V	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
5	BMEL303	Metrology And Quality Control	V	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
6	BMEP303	Metrology And Quality Control	V	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
7	BMEL304	Manufacturing Process-II	V	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
8	BMEP304	Manufacturing Process-II	V	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
9	BMEL305	Energy Conversion-I	V	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
10	BMEL306	Industrial Electrical And Electronics Engineering	V	UG Mechanical Engineering 2017-18 [Autonomous]	Theory	No	Yes
11	BMEP306	Industrial Electrical And Electronics Engineering	V	UG Mechanical Engineering 2017-18 [Autonomous]	Practical	No	Yes

S.NO	COURSE CODE	COURSE NAME	SEM	SCHEME	SUBJECT	ELECTIVE	OFFER
12	BMEGP304	GENERAL PROFICIENCY-IV	V	UG MECHANICAL ENGINEERING 2017-18 [AUTONOMOUS]	AUDIT COURSE	No	Yes

B. TECH. MECHANICAL ENGINEERING T.Y-SEMESTER-VI

S.NO	COURSE CODE	COURSE NAME	SEM	SCHEME	SUBJECT	ELECTIVE	OFFER
1	BMEL307A	Nano Technology	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
2	BMEL307B	Tribology	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
3	BMEL307C	Reliability Engineering	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
4	BMEL307D	Mechanical Vibration	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
5	BMEL307E	Machine Tool Design	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
6	BMEL307F	Optimization Techniques	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
7	BMEL307G	Unconventional Energy Sources	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
8	BHUL302	Constitution Of India	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
9	BHUL303	IPR And Patents	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
10	BCOL307D	Software Testing And Quality	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
11	BITL307	Multimedia System	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
12	BECL300	Fuzzy Logic	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
13	BECL406A	Devices And Control	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
14	BCEL301	Environmental Engineering	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes

S.NO	COURSE CODE	COURSE NAME	SEM	SCHEME	SUBJECT	ELECTIVE	OFFER
15	BCEL311	Integrated Water Resources Planning And	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	Yes	Yes
16	BMEL308	Energy Conversion-II	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
17	BMEP308	Energy Conversion-II	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
18	BMEL309	Machine Design-II	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
19	BMEP309	Machine Design-II	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
20	BMEL310	Heat Transfer	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
21	BMEP310	Heat Transfer	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Practical	No	Yes
22	BMEL311	Industrial Fluid Power	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
23	BMEL312	Industrial Engineering And Management	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Theory	No	Yes
24	BMEGP305	General Profieciency-V	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Audit Course	No	Yes
25	BMEGP306	General Profieciency-VI	VI	UG Mechanical Engineering 2018-19 [Autonomous]	Audit Course	No	Yes

Course Structure
T.Y (B.Tech.)-MECH

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of B.Tech (MECHANICAL ENGINEERING)

*TAE will be based on Home Assignment, Seminar, Quiz, Surprise Test, Group Discussion, Poster Presentation, Mini modeling, Attentiveness and Attendance

SEMESTER-V

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						
							Theory			Practical		Total	Duration of paper (hrs)
		Th.	Tu.	Pr.	Total		TAE (20)	CAE (20)	ESE (60)	Cont. Ass	Ext.		
SEM-V													
BMEL301	Machine Design-I	3	-	-	3	3	20	20	60	-	-	100	3
BMEP301	Machine Design-I	-	-	2	2	1	-	-	-	25	-	25	-
BMEL302/ BMEL310	Dynamics of Machines/ Heat Transfer	4	-	-	4	4	20	20	60	-	-	100	3
BMEP302/ BMEP310	Dynamics of Machines/ Heat transfer	-	-	2	2	1	-	-	-	25	25	50	-
BMEL303	Metrology and Quality control	3	-	-	3	3	20	20	60	-	-	100	3
BMEP303	Metrology and Quality control	-	-	2	2	1	-	-	-	25	25	50	-
BMEL304	Manufacturing Process II	3	-	-	3	3	20	20	60	-	-	100	3
BMEP304	Manufacturing Process II	-	-	2	2	1	-	-	-	25	25	50	-
BMEL305	Energy Conversion-I	3	1	-	4	4	20	20	60	-	-	100	3
BMEL306	Industrial Electrical and Electronics Engineering	1	-	-	1	1	10	10	30	-	-	50	2
BMEP306	Industrial Electrical and Electronics Engineering	-	-	2	2	1	-	-	-	25	-	25	-
BMEGP304/ BMEGP305	General Proficiency-IV/ General Proficiency-V	2	-	-	2	Audit Course	-	-	-	G	-	-	-
	Total	**19**	**1**	**10**	**30**	**23**	**110**	**110**	**330**	**125**	**75**	**750**	**-**

TAE – Teachers Assessment Evaluation
CAE – Class Assessment Examination
ESE – End Semester Examination
Cont. Ass. – Continuous Assessment

Th. – Theory
Tu. – Tutorial
Pr. – Practical
Ext. – External

DEPARTMENT OF MECHANICAL ENGINEERING

Scheme of B.Tech (MECHANICAL ENGINEERING)

*TAE will be based on Home Assignment, Seminar, Quiz, Surprise Test, Group Discussion, Poster Presentation, Mini modeling, Attentiveness and Attendance

SEMESTER-VI

Sub. Code	Name of the Course	Teaching Scheme				Credits	Evaluation Scheme						
							Theory			Practical		Total	Duration Of paper (hrs)
		Th.	Tu.	Pr.	Total		TAE (20)	CAE (20)	ESE (60)	Cont. Ass.	Ext.		
SEM-VI													
BMEL307XX	Elective-I/ Open Electives	3	-	-	3	3	20	20	60	-	-	100	3
BMEL308	Energy Conversion II	4	-	-	4	4	20	20	60	-	-	100	3
BMEP308	Energy Conversion II	-	-	2	2	1	-	-	-	25	25	50	-
BMEL309	Machine Design II	4	-	-	4	4	20	20	60	-	-	100	3
BMEP309	Machine Design II	-	-	2	2	1	-	-	-	25	25	50	-
BMEL310/ BMEL302	Heat Transfer/ Dynamics of Machines	4	-	-	4	4	20	20	60	-	-	100	3
BMEP310/ BMEL302	Heat Transfer/ Dynamics of Machines	-	-	2	2	1	-	-	-	25	25	50	-
BMEL311	Industrial Fluid Power	3	-	-	3	3	20	20	60	-	-	100	3
BMEL312	Industrial Engineering & Management	3	-	-	3	3	20	20	60	-	-	100	3
BMEGP305/ BMEGP304	General Proficiency-V/ General Proficiency-IV/	2	-	-	2	Audit Course	-	-	-	G	-	-	-
BMEGP306	General Proficiency-VI	2	-	-	2	Audit Course	-	-	-	G	-	-	-
	Total	**25**	-	**6**	**31**	**24**	**120**	**120**	**360**	**75**	**75**	**750**	**-**

ELECTIVE–I

BMEL307A- Nano Technology
BMEL307B- Tribology
BMEL307C- Reliability Engineering
BMEL307D- Mechanical Vibration
BMEL307E- Machine Tool Design

OPEN ELECTIVES

BMEL307F-Optimization Techniques
BMEL307G-Unconventional Energy Sources
BHUL302-Constitution of India
BHUL303-IPR and Patents
BHUL304-Bio-System in Engineering
BCOL307D-Software Testing and Quality Assurance
BITL307-Multimedia System
BECL300-Fuzzy Logic
BECL406A-Devices and Control
BCEL301-Environmental Engineering
BCEL311-Integrated Water Resource Planning and Management

TAE – Teachers Assessment Evaluation	Th. – Theory
CAE – Class Assessment Examination	Tu. – Tutorial
ESE – End Semester Examination	Pr. – Practical
Cont. Ass. – Continuous Assessment	Ext. – External

Department of Mechanical Engineering

Session : 2018-2019 Offer List

TY SEM-V (Group-I)

Sr No.	Sub Code	Course	Hrs (L+P)	Total Credits	Marks (L+P)
1	BMEL301 & BMEP301	Machine Design-I	3+2	4	100+25
2	BMEL302 & BMEP302	Dynamics of Machines	4+2	5	100+50
3	BMEL303 & BMEP303	Metrology and Quality control	3+2	4	100+50
4	BMEL304 & BMEP304	Manufacturing Process II	3+2	4	100+50
5	BMEL305	Energy Conversion-I	4	4	100+50
6	BMEL306 & BMEP306	Industrial Electrical and Electronics Engineering	1+2	2	50+25
7	BMEGP304	General Proficiency-IV	2	Audit course	-
		Total:	30	23	750

TY SEM-V (Group-II)

Sr. No.	Sub Code	Course	Hrs (L+P)	Total Credits	Marks (L+P)
1	BMEL301 & BMEP301	Machine Design-I	3+2	4	100+25
2	BMEL310 & BMEP310	Heat Transfer	4+2	5	100+50
3	BMEL303 & BMEP303	Metrology and Quality control	3+2	4	100+50
4	BMEL304 & BMEP304	Manufacturing Process II	3+2	4	100+50
5	BMEL305	Energy Conversion-I	4	4	100+50
6	BMEL306 & BMEP306	Industrial Electrical and Electronics Engineering	1+2	2	50+25
7	BMEGP305	General Proficiency-V	2	Audit course	-
		Total:	30	23	750

TY SEM-VI (Group-I)

Sr. No.	Sub Code	Course	Hrs (L+P)	Total Credits	Marks (L+P)
1	BMEL307XX	Elective-I/ Open Electives	3+0	3	100
2	BMEL308 & BMEP308	Energy Conversion II	4+2	5	100+50
3	BMEL310& BMEP309	Machine Design II	4+2	5	100+50
4	BMEL310 & BMEP310	Heat Transfer	4+2	5	100+50
5	BMEL314	Industrial Fluid Power	3+0	3	100
6	BMEL315	Industrial Engineering & Management	3+0	3	100
7	BMEGP305	General Proficiency- V	2	Audit course	----
8	BMEGP306	General Proficiency- VI	2	Audit course	----
		Total:	31/32	24	750

TY SEM-VI (Group-II)

Sr No.	Sub Code	Course	Hrs (L+P)	Total Credits	Marks (L+P)
1	BMEL307X	Elective-I/ Open Electives	3+0	3	100
2	BMEL308 & BMEP308	Energy Conversion II	4+2	5	100+50
3	BMEL310& BMEP309	Machine Design II	4+2	5	100+50
4	BMEL302 & BMEP302	Dynamics of Machines	4+2	5	100+50
5	BMEL314	Industrial Fluid Power	3+0	3	100
6	BMEL315	Industrial Engineering & Management	3+0	3	100
7	BMEGP304	General Proficiency- IV	2	Audit course	----
8	BMEGP306	General Proficiency- VI	2	Audit course	----
		Total:	31/32	24	750

Course Syllabus
TY-B.Tech (Sem-V)

BMEL301: MACHINE DESIGN I	
Teaching Scheme: **Lectures:** 3Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credit: 3	
PREREQUISITE:	
1. Mechanics of Material	
COURSE OBJECTIVE:	
1. To prepare students with fundamental aspect of design.	
2. Student should select proper materials for different machine elements depending on their physical and mechanical properties.	
3. To develop competency in designing various components of various joints.	
4. To develop competency in designing a system involving the various component, as a design project in Practical.	
5. To develop an ability to identify, formulate, and solve engineering problems	
COURSE OUTCOME: Upon successful completion of the course, students will be able to	
1. Demonstrate the fundamentals of stress analysis, theories of failures and selection of material in the design of machine components	
2. Design mechanical elements for fluctuating loads	
3. Summarize and apply design knowledge for various springs	
4. Explain and design various clutches, brakes and flywheels	
5. Design and apply principles of pressure vessels used for various applications	
6. Understand and Design various mechanical element's such as shafts, keys and couplings	
COURSE CONTENTS	**Hrs**
Unit–I: Design of basic mechanical components	7
Definition of design, types of design, design process, need, defining the problem, feasibility preliminary, design alternatives, final design selection, preliminary and final plans & drawings Failure criterion and manufacturing considerations in design. Design of Cotter and Knuckle Joint, shrink and press fit joints. Riveted Joint: Riveted joint for boilers, structural works (Uniform Strength Joint), and eccentric loaded riveted Joint. Welded Joint: Design of single transverse, double transverse, parallel fillet, combination fillet butt joint eccentrically loaded welded joints. Bolted Joint; Design of bolted fasteners, bolts of uniform strength, bolted joints under eccentric loading. Power screw. Torque analysis and design of power screws, stresses in power screws.	
Unit–II: Design of Springs	7

Types, applications and materials for springs, Derivation of expression for deflection and shear stress in helical spring, Style of ends, design of helical and tension springs, Surges in spring springs in series and parallel, Concentric Helical Springs, Helical torsion springs, Shot peening, Introduction to leaf spring.	
Unit–III: Design of Clutches, brakes and flywheel	7
Kinematics of Friction Drives such as brakes, clutches, design of friction clutch, single plate, Multiple plate, cone, centrifugal clutch, design of brake, shoe brake, band brake, and internal expanding brake. Flywheel : coefficient of fluctuation of energy and coefficient of fluctuation of speed, energy store in flywheel, stresses in flywheel, design of flywheel	
Unit–IV: Design of Shafts and keys	7
Design of transmission shafts on the basis of strength, rigidity and critical speed, ASME code for Shaft design, Types of Keys, Design of keys and splines. Coupling : types of shaft coupling, design of flange coupling, flexible bush coupling.	
Unit–V: Design for Fluctuating Load	7
Stress concentration - causes & remedies, fluctuating stresses, fatigue failures, S-N curve, endurance limit, notch sensitivity, endurance strength modifying factors, design for finite and infinite life, cumulative damage in fatigue failure, Soderberg, Gerber, Goodman, Modified Goodman diagrams.	
Unit–VI: Design of Pressure Vessel	7
Classification of thin and thick cylindrical pressure vessel, stresses in thin and thick Cylindrical pressure vessels. ASME code of pressure vessel and piping, When It Is subjected to internal pressure, Expression for circumferential and longitudinal stresses, design of pressure vessel, heads and cover Plate.	

Text Books:

1. Martin J. Siegel, VladimirL. Maleev, James Busse Hartman, 'Mechanical Design of Machine', International Text book Co,1965.
2. J. E. Shigley, Charles R. Mischke, Richard G. Budynas, 'Mechanical Engg. Design', McGraw-Hill.
3. V. B. Bhandari, 'Design of Machine Elements', Tata McGraw-Hill Education.
4. Robert L. Norton, "Machine Design, An Integrated Approach", Prentice Hill.

Reference Books:
1. Black P. H. and O. Eugene Adams, 'Machine Design', McGraw- Hill.
2. Gitin M . Maitra and L. V. Prasad, 'Handbook of Mechanical Design', 2nd Edition, TMH Publications.
3. B. D. Shiwalkar, 'Design Data book', Benett & Co Publishing Division, 2nd edition.
4. Spotts M. F. and Shoup T.E., "Design of Machine Elemnets", Prentice Hall International.

BMEP301: MACHINE DESIGN I	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25Marks **External**: 25Marks
Course Outcomes:	
1. Describe the design process, material selection, calculation of stresses under loading conditions.	
2. Demonstrate knowledge of manufacturing tolerances, geometric tolerances and surface finish symbols in designing a machine component.	
3. Understand the different geometric modelling techniques	
4. Construct assemblies of mechanical elements from the concepts learnt using drafting softwares.	
The design project shall consist of half imperial sheets (A2 size) involving assembly-drawing with a bill of material and overall dimensions and drawings of individual components. The Project should be assigned to a group of three to five students. Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. Design data book shall be used wherever necessary for selection of standard components.	Hrs
1. Project 1 shall be based on any one of the following topics- by using CAD software. i) Cotter joint/ knucle joint for a specified application. ii) Transmission Shaft/Machine tool spindles for specified application/Flange coupling.	8
2. Project 2 shall be based on: **i)** Design of Pressure Vessels and using CAD sheet drawing.	8
3. Assignments The assignment shall be internally presented in the form of power point presentation, by a group of three to five students**.** A report of assignment (Max 8 to 10 pages) along with print out of ppt is to be submitted. Each student shall complete any two of the	

following assignments.	
a. Use of dimensional tolerances, Geometrical tolerances and surface finish symbols in machine component drawings.	4
b. Selection of materials using weighted point method.	4
c. Selection of manufacturing methods for machine elements designed in any one of the above design projects.	4
d. Theories of failures and their applications.	4

BMEL302: DYNAMICS OF MACHINES

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 4Hrs/Week	**Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks
Tutorials: Nil	**End Sem Examination:** 60 Marks

Credit : 4

Prerequisite (If any):

1. Kinematics of Machine

Course Objective:

1. To make the students conversant with force analysis.
2. To understand gyroscopic principle and its effects in various applications.
3. To develop competency in graphical and analytical methods in solving problems in rotating and reciprocating machineries.
4. To make the students conversant with basic concepts of vibrations, it"s effects and measurement.

Course Outcome: Students will be able to

1. Understand the basics concepts of static and dynamics force analysis.
2. To develop knowledge about proper selection of governors.
3. Determine unbalanced forces and bearing reactions for a system of rotating masses and
4. Understand the gyroscopic effect.
5. Determine unbalanced forces and couples for reciprocating masses.
6. Understand free and forced vibrations of single degree of freedom systems and measure vibrations.

Course Contents	**Hrs**
Unit – I : Static and Dynamic Force Analysis	10
Theory and analysis of Compound Pendulum, Concept of equivalent length of simple pendulum, Bifilar suspension, Trifilar suspension. Dynamics of reciprocating engines: Two mass statically and dynamically equivalent system, correction couple, static and dynamic force analysis of reciprocating engine mechanism (analytical method only), Crank shaft torque, Introduction to T-θ diagram.	
Unit-II: Governors	8
Governor types, centrifugal governors, gravity controlled and spring controlled centrifugal governors, characteristics, effect of friction, controlling force curves.	
Unit – III: Balancing of Rotary Masses and Gyroscope	8
Balancing of Rotary Masses: Static and Dynamic balancing of Rotary masses, Balancing of several masses rotating in different planes. **Gyroscope:** gyroscopic forces and torques, gyroscopic stabilization, Gyroscopic effects in airplane, ship and automobiles.	
Unit – IV : Balancing of Reciprocating masses	8
Balancing of Reciprocating masses, Partial balancing of locomotive, balancing of primary and secondary forces of Multi cylinder. In-Line Engine, V-Engines, Radial Engines. Crankshaft and associated components, gas forces and inertia forces on crankshaft.	
Unit-V: Single Degree of Freedom Systems – Free Vibration	10

Elements of a vibratory system, degrees of freedom, types of vibration, natural frequency, modeling of a system, formulation of equation of motion by equilibrium and energy methods. Undamped free vibrations: Natural frequency for longitudinal, transverse and torsional vibratory systems. Damped free vibrations: Different types of damping, free vibrations with viscous damping - over damped, critically damped and under damped systems, initial conditions, logarithmic decrement, rate of decay of oscillations.	
Unit –VI : Single Degree of Freedom Systems – Forced Vibration	10
Forced vibrations of longitudinal and torsional systems, Frequency Response to harmonic excitation, excitation due to reciprocating and rotating unbalance, magnification factor, resonance phenomenon and phase difference, Quality Factor. Critical speed of shafts. Force and Motion transmissibility, Vibration Measuring devices, Accelerometers, Impact hammer, Vibration Analyzer	

Text Books:
1. Uicker, J. J., Shigley, J. E., and Pennock, G. R., Theory of Machines and Mechanisms, Oxford University Press.
2. R L Norton, Kinematics and Dynamics of Machinery, First Edition, McGraw Hill Education (India) P Ltd. New Delhi
3. S.S.Ratan, Theory of Machines, Third Edition, McGraw Hill Education (India) Pvt. Ltd. New Delhi.
Reference Books:
1. A. Ghosh, A. K. Mallik, Theory of Mechanisms and Machines, East West Press Pvt. Ltd.
2. Thomas Bevan, Theory of Machines, Pearson.
3. Grover G. K. —Mechanical Vibrations‖, New Chand and Bros., Roorkee

BMEP302: DYNAMICS OF MACHINES LAB	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25Marks **External**: 25Marks
Credits: 1	
Course Outcomes: On successful completion of the course, the student will be able to,	
1. Understand the gyroscopic effects and to determine gyroscopic couple	
2. Measure the radius of gyration	
3. Measure Sound.	
4. Measure vibration parameters in single degree freedom systems	
5. Study balancing parameters of rotors	
List of Practical (perform any 7 Experiments and all the assignments)	**Hrs**
1. Determination of gyroscopic couple and sense of direction	2
2. To determine whirling speed of shaft	2
3. To determine the radius of gyration "k" of a given shaft using Bi-filler suspension.	2

4. To determine the radius of gyration "k" of a given shaft using Tri-filler suspension.	2
5. Sound Measurement Using Sound Level Meter	2
6. To determine the time period and natural frequency of undamped free vibrations using vibration Analyzer.	2
7. To determine the natural frequency of vibration of two rotor system and verify the node position.	2
8. To determine the damping coefficient of damped single rotor system.	2
Assignments:	
1. Assignment on Static Balancing (Graphical Method)	4
2. Assignment on Dynamic Balancing (Graphical Method)	4
3. Assignment on Longitudinal Vibrations and also write a MATLAB program	4
4. Assignment on Transverse Vibrations and also write a MATLAB program	4

BMEL303 : METROLOGY AND QUALITY CONTROL	
Teaching Scheme: **Lectures:** 3Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credit: 3	
Prerequisite (If any):	
1. Engineering Mathematics	
Course Objective:	
1. Select suitable instrument / gauge / method of inspection for determining geometrical and dimensional measurements.	
2. Calibrate measuring instruments and also design inspection gauges.	
3. Understand the advances in Metrology such as use of CMM, Laser, Machine Vision System for Metrology etc.	
4. Select and apply appropriate Statistical Quality Control Technique for givan application	
5. Select and Apply appropriate Quality Management Tool and suggest appropriate Quality Management System (QMS).	
COURSE OUTCOME: Students will be able to	
1. Explain tolerance, limits of size, fits, geometric and position tolerances and gauge design .	
2. Apply knowledge of thread from errors and surface roughness parameters.	
3. Demonstrate knowledge of CMM, Interferometer and laser metrology.	
4. Develop an ability of problem solving and decision making by identifying and analyzing the cause for variation and recommend suitable corrective actions for quality improvement.	
5. Use/apply Quality Control Techniques/ Statistical Tools appropriately.	
6. Illustrate quality management techniques such as JIT, KANBAN and QMS.	
COURSE CONTENTS	Hrs.
Unit – I Measurement standards and Design of gauges	7
Introduction: Principles of Engineering metrology, Measurement standards, Types and sources of errors, Accuracy and Precision, Calibration: Concept and procedure, traceability, **Geometric Form Measurement:** Straightness, Flatness, Roundness - Straight edge, use of level beam comparator, autocollimator testing of flatness of surface plate. **Design of Gauges:** Tolerances, Limits and Fits [IS 919-1993], Taylor's principle, Types of gauges, Wear allowance on gauges, Types of gauges-plain plug gauge, ring gauge, snap gauge, limit gauge and gauge materials, Considerations of gauge design (numerical).	
Unit –II Comparators, Thread Metrology, Surface Roughness Measurement	7

Comparators: Mechanical, Pneumatic, Optical, Electrical (LVDT). **Measurement of Thread form:** Thread form errors, Measurement of Minor, Major and Effective diameter (Three Wire Method), Flank angle and Pitch, Floating Carriage Micrometer (Numerical). **Surface Roughness Measurement:** Introduction to Surface texture, Parameters for measuring surface roughness, Surface roughness measuring instrument: TalySurf.	
Unit – III Advances in Metrology	7
Coordinate Measuring Machine (CMM): Fundamental features of CMM – development of CMMs – role of CMMs – types of CMM and Applications, – types of probes. **Machine Vision Systems:** vision system measurement – Multisensory systems. **Interferometer:** Principle, NPL Interferometer **Laser Metrology:** Basic concepts of lasers, advantages of lasers, laser interferometers, types, applications	
Unit – IV Introduction to Quality and Quality Tools	7
Concept of Quality: Various Definitions and Quality Statements, Cost of quality & value of quality, Deming's cycles & 14 Points, Juran Trilogy approach, Old New Seven Tools, Quality Circles. **Importance of Quality deployment at Design and Manufacturing Engineering:** Opportunities for improvement product design, Importance of– initial planning for quality, concept of controllability: self-controls – defining quality responsibilities on the factory flow – self inspection	
Unit –V Statistical quality control	7
Statistical quality control: Statistical concept, Frequency diagram, Concept of variance analysis, Control Chart for Variable (X & R Chart) & Attribute (P & C Chart), Process capability(Indices: cp, cpk, ppk), Statistical Process Control (Numerical). Production PartApproval Method (PPAP). **Acceptance Sampling**: Sampling Inspection, OC Curve and its characteristics, sampling methods, Sampling Plan: Single, Double (Numerical), Multiple, Comparison of Plan, calculation of sample size, AOQ, Probability of Acceptance (Numerical)	
Unit –VI Total Quality Management	7
TQM: Introduction, Quality Function Deployment, 5S, Kaizen, Poka yoke, Kanban, JIT, FMECA, Zero defects, TPM. Six Sigma: DMAIC - Concept and Applications. **Quality Management System**:Need for quality management system – design of quality management system - quality management system requirements – ISO 9001, TS-16949, ISO-14000, Quality Audit.	

Text Books:
1. Jain R.K., Engineering Metrology, Khanna Publication
2. Gupta I.C., Engineering Metrology, Dhanpatrai Publiartions
3. Bewoor A. K. and Kulkarni V. A., Metrology and Measurements, Tata McGraw hill Publication.
4. Grant S. P., Statistical Quality Control, Tata McGraw hill Publication.

Reference Books:
1. Narayana K.L., Engineering Metrology, 3rd Edition, SCI Tech Publications
2. Galyer J.F & Shotbolt C.R., Metrology for engineers, 5th Edition, ELBS
3. Judge A.W., Engineering Precision Measurements, Chapman and Hall
4. Juran J. M., Quality Handbook, McGraw Hill Publications.

BMEP303: METROLOGY AND QUALITY CONTROL	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25Marks **External**: 25Marks
Credit: 1	
COURSE OUTCOME: At the end of this Course Students will be able to	
1. Select and use appropriate measurement instrument for a given application.	
2. use measuring tools such as Sine Bar, Sine Center, Bevel Protractor, Tool Maker Microscope, Gear Tooth Micrometer, Optical Flats etc.	
3. Express error and correction factors of various measuring devices.	
4. Understand the basic measurement units and able to calibrate various measuring devices.	
5. Understand the basic of alignment and Acceptance testing of Lathe, Milling, and Drilling Machine.	
6. Determine given geometry using coordinate measuring machine CMM.	
LIST OF PRACTICAL(ANY EIGHT out of 1, 2, 4, 6 are compulsory)	**Hrs**
1. Demonstration of linear and angular measuring instruments, slip gauges and their applications.	4
2. Error determination of linear / angular measuring instruments and determination of linear and angular dimensions of given part	4
3. Calibration of measuring instrument. Example – Dial gauge, Micrometer, Vernier (any one) (Refer ISO 17025).	2
4. Verification of dimensions and geometry of given components using Mechanical /Pneumatic comparator.	2
5. Machine tool alignment testing on machine tool – Lathe / Drilling / Milling.	2
6. Demonstration of surfaces inspection using optical flat/interferometers. / Demonstration of surface roughness measurement using surface roughness tester	2

7. Determination of geometry and dimensions of given composite object / single point tool, using profile projector and tool maker's microscope.	2
8. Measurement of thread parameters using floating carriage diameter measuring machine.	2
9. Measurement of spur gear parameters using Gear Tooth Vernier / Span Micrometer / Gear Rolling Tester.	2
10. Determination of given geometry using coordinate measuring machine (CMM).	2
Assignments:	
11. Case study on Total Quality Management- KANBAN, JIT/ TQM	4
12. Determination of process capability from given components and plot variable control chart/ attribute chart.	4

BMEL304 MANUFACTURING PROCESS II	
Teaching Scheme: **Lectures:**3Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:**20 Marks **End Sem Examination:** 60 Marks
Credit: 3	
PREREQUISITE:	
1. Manufacturing Process I	
COURSE OBJECTIVE:	
1. To select process parameter and tools for obtaining desired machining characteristic	
2. To understand design of manufacturing processes.	
3. To analyze and understand the metal cutting phenomenon	
4. To design and develop tooling for metal cutting operations	
5. To figure out application of modern machining .	
6. To understand principles of manufacturing processes.	
COURSE OUTCOME: Upon successful completion of the course, students will be able to	
1. Understand theory of metal cutting process for economic machining.	
2. Demonstrate knowledge of the fundamental metal cutting process such as milling and their process parameters.	
3. Explain various metallurgical processes and plastic shaping process.	
4. Apply knowledge of Jigs and Fixtures used in various machining operations.	
5. Understand the application of CNC/DNC machines with programming ability	
6. Classify and study various advanced machining process	
COURSE CONTENTS	**Hrs**
Unit–I Theory Of Metal Cutting	8
Single point cutting tool: single point Tool geometry, Mechanics of shearing Shear plane angle, Shear stress, strain and Shear strain rate. Process parameters and their effect on cutting forces. Merchant's circle of forces Estimation of shear force, Normal shear force, Friction force, Normal friction force, Calculation of Total power and Specific energy. Measurement of cutting forces by tool dynamometer for turning, drilling, milling and grinding operations. Machinability Tool life, Tool wear, Cutting fluid and their types, Taylor's tool life relation along with numerical ,Economics of machining	
Unit–II Milling Process	7
Introduction, specifications, types, column and knee type milling machine, fixed bed type milling machines, production milling machines, special purpose milling machines such as thread milling machines, profile milling machine, Gear Milling / Hobbling machines. Mechanisms and	

Attachments for Milling. Cutting parameters, Types of milling operations, Types of milling cutters, Tool geometry and their specifications. Calculation of machining time for Milling processes (Numericals).	
Unit–III Powder Metallurgy process & Plastics	7
Powder Metallurgy: Power manufacture and conditioning, production of sintered structure components. Self lubricating bearing. Cemented carbides, ceramic, sintered carbide cutting tools. **Composite materials:** classification, different types of composite materials and its applications. **Plastics:** processing of plastics, thermoplastics, thermosetting plastics, general properties and application of thermosetting and thermo plastics **General plastic processes:** Extrusion, injection moulding, compression moulding, transfer moulding, blow moulding, calendaring.	
Unit–IV Jig & Fixture	7
Concept of degree of freedom, 3-2-1 principle of location, General guidelines to design Jigs and fixtures, advantages of jig and fixtures **Jigs:** Definition. Elements of jig with the types, Location guidelines, Principles of clamping, Principles of guiding element, Channel jig, Template jig, Plate jig, Angle plate jig, Turn over jig, Box jig, and Latch type jig. **Fixtures:** Definition. Elements of fixtures, Location guidelines, Principles of clamping, Principles of setting element, Turning fixture, Welding fixture, Milling fixture, Introduction to Assembly and Inspection fixtures. Indexing fixtures. Concept, elements and advantages of modular fixture, Pokayoke concept in jigs and fixtures.	
Unit–V CNC/ DNC Technology	7
CNC Technology: Introduction, Construction and working of CNC, DNC and machining center. CNC axes and drives. Automatic Tool Changer (ATC) and Automatic pallet changer (APC) **CNC Tooling:** New trends in Tool Materials, Turning tool geometry (ISO 1832 Coding system), Tool inserts (coated and uncoated), Modular tooling system for Turning. Milling tooling systems, Tools presetting, Work holding. **CNC Programming:** Word address format (WAF) -ISO Standard, G & M codes, Type of CNC Control systems, Manual part programming, Subroutine, Canned cycles.	
Unit–VI Advanced Machining Processes	8
Introduction, classification of advanced machining processes. Principles, Working, Process Parameters, Estimation of MRR (simple numerical), Advantages, Limitations and Application for following processes: Electric Discharge Machining (EDM), LASER Beam Machining (LBM), Abrasive Jet Machining (AJM), Ultra Sonic Machining (USM) and Electro Chemical Machining (ECM)	

Text Books:
1. Mikell. P. Grover, Fundamentals of Modern Manufacturing, Pearson Publications
2. Amitabh Ghosh and Asok kumar Mallik, Manufacturing science, Ellis Horwood Ltd
3. S. K Hajra Choudhury, Elements of workshop technology – Vol. II,, Media Promoters And Publishers, Mumbai.

Reference Books:
1. W.A.J Chapman,"Workshop Technology Vol I-III", Oxford and IBH Publishing Company Private Limited, 1988.
2. Production technology –HMT, Tata McGraw Hill publication
3. RLindberg," Processes and Materials of Manufacture", CBS Publication and Distributors, 2002.
4. Serope Kalpakjian and Steven R. Schmid, Manufacturing Processes for Engineering Materials, Pearson
5. B.S. Raghuvanshi," Workshop Technology Vol. I &II ",Dhanpat Rai Publications,2009.

BMEP304 Manufacturing Processes-II	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25 Marks **External**: 25 Marks
Credits: 1	
COURSE OUTCOME:	
1. Understanding measurement of metal cutting process forces.	
2. To know the gear cutting operation with indexing mechanism.	
3. To get acquainted with metallurgical manufacturing process	
4. Get the knowledge of Jigs and Fixtures so as to utilize machine capability for variety of operations.	
5. Figure out application of modernization in machining by using CNC.	
LIST OF PRACTICALS (Perform any 7 Experiment. Experiment No. 3, 5 & 7 are compulsory)	Hrs
1. Measurement of cutting forces by tool dynamometer.	2
2. Study of indexing mechanisms in milling.	2
3. Practical on Gear cutting operation. (perform practical with group of 4 students)	8

4. Study of Sintering or powder metallurgical operation.	2
5. Demonstration of one job CNC mill/lathe (perform practical with group of 4-6 students)	4
6. Study of Jigs & Fixtures	2
7. Practical on assembly of two parts containing Lathe/ Milling/ Grinding and shearing Process	6
8. Practical on a)Shearing Process b) Lapping c) Superfinishing	2
9. Open ended practical : a) Industrial visit (b) Study of industrial audit	4

BMEL305 Energy Conversion– I	
Teaching Scheme **Lectures:** 3 Hrs/Week **Tutorials:** 1Hrs/Week	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credits: 4	
Prerequisite (If any):	
1. Engineering Thermodynamics	
2. Fluid Machinery	
Course Objective:	
1. To enable understanding of the types of steam boilers and its performance parameters.	
2. To understand the different steam turbines, steam nozzles, steam condensers.	
3. To Provide students with exposure to the systematic methods for solving engineering problems on boiler performance,	
4. To build the necessary theoretical background that suits the power sector needs.	
5. To understand effect of draught ,chimney height on performance of steam Generators.	
6. To understand analysis of fuel and flue gas.	
Course Outcome: On completion of the course, learner will be able to	
1. Explain and evaluate efficiency of steam Generators	
2. Classify different types of boilers and its applications and its various mountings and accessories	
3. Determine condition for maximum discharge of mass through the chimney and its effect on performance of steam generators.	
4. Demonstrate the working of different types of steam nozzles and its applications, conditions for maximum discharge of steam through it.	
5. Understand the working of different types of condensers, performance parameters and its applications in steam power plants.	
6. Determine type of Solar collector for a given application	
Course Contents	**Hrs**
UNIT-I: Introduction to Steam Generators	8
A) Principles of Steam Generation, Classification of Steam Generators, Fire Tube And Water Tube Steam Generators, High Pressure Steam Generators. Boiler Mountings And Accessories. Bubbling Fluidized Bed Boilers (Elementary Treatment Expected). B) Fuels for Steam Generators, Gradation & Analysis of Coal, Coal Handling Systems, Ash Collection and Handling Systems, Flue Gas Analysis, Feed Water Supply Systems. Fluidized Bed	

UNIT-II: Draught And Chimney	8
Draught And Its Classification, Chimney Height, Chimney Diameter, Efficiency, condition For Maximum Discharge. Performance of Steam Generators. Evaporation Capacity, Equivalent Evaporation, Boiler Efficiency.	
UNIT-III: Steam Nozzles	6
Steam Nozzles: Adiabatic Expansion In Nozzles, Maximum Discharge, Critical Pressure Ratio And Effects Of Friction, Calculation Of Throat And Exit Areas, Super saturated Flow, Wilson Line	
UNIT - IV : Steam Turbines	10
Steam Turbines: Principles of Working of Steam Turbines, Classification Of Steam Turbines, Comparison of Impulse and Reaction Turbines, Compounding of Steam Turbines. Energy Losses in Steam Turbines, Flow of Steam Through Turbine Blades, Ideal and Actual Reheat Factors, Velocity Diagrams, Graphical and Analytical Methods, Work Done, Thrust And Power, Dimensions And Proportioning Of the Blades ,Steam Turbine Efficiencies, Condition For Maximum Efficiencies, Reheat and Regenerative Cycles, Governing of Steam Turbines.	
UNIT - V : Steam Engine and Steam Condensers	8
Introduction to Steam Engine, Steam Condensers: Types Of Condensers, Classification of Condensers, And Quantity Of Cooling Water Required, Design Calculations For Surface Condensers, Daltons Law of Pressures, Sources of Air Leakages and Air Removal, Air Ejectors. Cooling Towers: Wet Cooling, Dry Cooling Towers Cooling Ponds.	
UNIT - VI : Non Conventional Energy Sources	8
Solar Energy: Introduction, components, Types of collectors & solar ponds, Photovoltaic Power System, Heliostat. Wind, Tidal, OTEC, geothermal, magneto hydrodynamics, fuel cell, Challenges utilization of non conventional energy sources	

List of Tutorials	
Perform any 8 Tutorials: (6 & 7 are compulsory)	Hrs
1. Demonstration of different types of steam Generators	2
2. Demonstration of different Boiler Mountings And Accessories.	2
3. Study of Draught, Chimney height and condition For Maximum Discharge.	2
4. Case study on fuels for steam Generators	2
5. Study of Fluidized Bed Boilers	2
6. Design and Analysis of steam nozzles	2
7. Study of Steam turbines and its efficiencies	2
8. Assignment on types of Condensers and condenser efficiency	2
9. Study of types of Cooling towers	2
10. Case study on solar energy types of solar collectors	2
11. Study of wind energy and wind mills	2

Text Books:
1. Sarkar B. K, "Thermal Engineering", 1st Edition, Tata McGraw Hill, 2005.
2. P K Nag, Power Plant Engineering", 3rd Edition, Tata McGraw Hill, 2008.
3. Yunus Cengel, "Engineering Thermodynamics", Tata McGraw Hill Publication".
Reference Books:
1. R. K. Rajput, " Thermal Engineering", 8th Edition, Laxmi Publications, New Delhi, 2010.
2. S P Sukhatme , J K Nayak "Solar Energy" McGraw Hill Education (India) Pvt Ltd
3. M.M. El-Wakil, Power Plant Engineering McGraw-Hill Education
4. R.Yadav, "Steam & Gas turbines and Power plant engineering" , central publishing House, Allahabad

BMEL306: Industrial Electrical and Electronics Engineering	
Teaching Scheme **Lectures:** 1 Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 10 Marks **Continuous Assessment:** 10 Marks **End Sem Examination:** 30 Marks
Credit : 1	
Prerequisite (If any):	
1. Basic Electrical Engineering 2. Basic Electronics Engineering	
Course Objective: To understand	
1. Principle of operation and speed control of DC machines	
2. Induction motor principle and its applications	
3. Microcontrollers	
4. Embedded systems terminologies and sensors	
5. Data acquisition system for mechanical applications	
Course Outcome: Student should be able to	
1. Develop the capability to identify and select suitable DC motor and its speed control method for given industrial application.	
2. Develop the capability to identify and select suitable induction motor and its speed control method for given industrial application.	
3. Formulate Program for Arduino IDE using conditional statements	
4. Adapt Interfacing sensors with Arduino IDE	
Course Contents	**Hrs**
Electrical Engineering	
Unit – I : D. C. Machines	4
Construction, working principle of D.C. generator, emf equation of D. C. generator (derivation not expected), working principle of D.C. motor, types of D.C. motor, back emf, torque equation for D.C. motor, characteristics of D.C. motor (series and shunt only), three-point starter for D.C shunt motor, methods for speed control of D.C. shunt and series motors, industrial applications.	
Unit – II: Three Phase Induction Motors	4
Constructional feature, working principle of three phase induction motors, types; torque equation, torque slip characteristics; power stages; efficiency, starters (auto transformer starter, star delta starter); methods of speed control and industrial applications	
Electronics Engineering	
Unit – III : Introduction to Microcontrollers	4
Introduction to microcontroller and microprocessors, role of embedded systems, open source embedded platforms, Atmega 328P- features, architecture, portstructure, sensors and actuators, data acquisition systems. Introduction to Arduino IDE-Features, IDE	

Overview, Programming concepts-Variables, Functions, Conditional Statements.	
Unit – IV: Peripheral Interface	4
Concept of GPIO in Atmega 328P based Arduino board, digital input and output, UART concept, timers, interfacing with LED, LCD and keypad, serial communication using Arduino IDE. Concept of ADC in Atmega 328P based Arduino board, interfacing with temperature sensor (LM35), LVDT, strain gauge, accelerometer, Industrial Applications.	

Text Books:
1. Edward Hughes "Electrical Technology", ELBS, Pearson Education.
2. Nagrath & Kothari, "Electrical Machines", Tata Mc Graw
3. Ajay Deshmukh, 'Microcontrollers Theory and Applications', TATA McGraw Hill
Reference Books:
1. S. K. Bhattacharya, "Electrical Machine", Tata Mc Graw Hill publishing Co. Ltd, 2nd Edition.
2. Kenneth J. Ayala, 'The 8051 Microcontroller', Cengage Learning.
3. A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, "Electrical Machines", Tata McGraw Hill Publication Ltd. Fifth Edition.
4. S. K. Bhattacharya, "Electrical Machine", Tata Mc Graw Hill publishing Co. Ltd, 2nd Edition.

BMEP306: Industrial Electrical and Electronics Engineering	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25 Marks **External**: Nil
Credits: 1	
Course Outcomes:	
1. Compare different types of loads, characteristics of motors and choose the motor for specific applications	
2. Perform load test on different types of motors	
3. Perform experiments on LED and LCD Interfacing to display the result	
4. Perform experiments on Temperature sensor and accelerometer Interfacing to display the result	
List of Practical (Any 4 out of 1 to 6 and any 4 out of 7 to 12)	**Hrs**
Electrical Engineering	
1. Speed control of DC shunt motor.	2
2. Brake test on DC shunt motor.	2

3. No load and blocked rotor test on 3 phase Induction Motor.	2
4. Load test on 3 phase Induction Motor.	2
5. Load test on single phase Induction Motor	2
6. Study of starters for AC and DC motors.	2
Electronics Engineering (Experiment 9 & 11 are compulsory)	
7. Interfacing of LED to blink after every 1 sec.	2
8. Display data using serial communication.	2
9. Interfacing of LCD to display the message and interface with keypad to display the key pressed.	4
10. Interfacing of temperature sensor (LM35) and show output on LCD/serial terminal.	2
11. Study of interfacing accelerometer to change the speed of DC Motor.	4
Assignments (Perform any one)	
12. IEEE Papers reviewed report	2
13. Presentation on any motor/generator/startor	2

Guidelines for Instructor's Manual
Practical Sessions -
The Instructor's Manual should contain following related to every experiment –

- Brief theory related to the experiment.
- Connection diagram /circuit diagram
- Observation table
- Sample calculations for one reading
- Result table
- Graph and Conclusions.
- Data sheets of the ICs used(if any)

BMEGP 304: GENERAL PROFICIENCY –IV (Advanced Communication Skills)	
Teaching Scheme: **Practical:** 2Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** Nil **External**: Nil
Audit Course: G	
Course Objective:	
1. To make them aware of advanced techniques of public speaking, one to one interaction and social ethics.	
2. To communicate and express efficiently and assertively	
COURSE OUTCOME: Upon successful completion of the course, students will be able to	
1. Build vocabulary to increase the learning capability and also in improve in voice and pronunciation which help them in recruitment activities.	
2. Build confidence to express their own views and ideas freely from their own experience and to the news for whole week.	
3. Apply the knowledge of phonetics and phonology to articulate speech	
4. Demonstrate ability to analyze, evaluate and summarize charts, graphs and presentations	
5. Build confidence to speak fluently and effectively their ideas and views assertively for effective public speaking.	
6. Apply the soft skill in report writing.	
COURSE CONTENTS	**Hrs.**
Module– I: Vocabulary Building	2
Objective : To enable the student to learn new words that he/she can use while communicating. **Outcomes** : By the end of the teaching sessions, student will be able to learn and express and it will help especially towards recruitment activities **Methodology :** Group of words to be taught from Greek and Latin root words. (Norman Lewis)	
Module– II: Reading Ability Enhancement	2
Objective : To enable the students to read and comprehend information, pronounce words correctly and to follow directions given. **Outcomes :** By the end of the session the student will be able to learn how to read information and improve his/her diction, voice & pronunciation. **Methodology :** Read editorials from newspaper aloud so that the student will hear in his/her own voice and modulate accordingly.	
Module– III: Expression Ability Enhancement	2

Objective: To enable the student to express himself or herself without inhibitions, in simple and correct English towards placement. **Outcome :** By the end of the sessions the student will be able to talk freely and assertively giving examples from his/her own life experiences. **Methodology :** Allows the students to talk freely, how their strengths, weakness, opportunities and threats to groups or individually in the session.	
Module– IV: Current News Awareness	2
Objective : To make the student aware of the national and international affairs going on in the world around him/her **Outcome :** By the end of the session the students will be aware of the goings on in terms of current affairs for the whole week. **Methodology :** Group work with assigned sectors and presentations.	
Module– V: Sentence formation	2
Objective: To enable students to speak and write grammatically correct sentences for proper knowledge transfer. **Outcome**: By the end of the session the students will learn to write and speak sentences without commonly made grammatical mistakes. **Methodology:** Give students sentences with errors and ask them to correct it. Tell them to construct a paragraph on any given topic	
Module– VI: Extempore	2
Objective : To enable the students to speak without preparation as in a recruitment GD or PI. **Outcome :** By the end of the session the students will understand how to organize their thoughts very quickly and talk about the given topic. **Methodology :** Each student to be given a simple topic in the session and asked to speak for 2-3 minutes in the session	
Module– VII: 3 C report writing	2
objective:- To know about the company, its competitors and customers. **Outcome :** By the end of the session the students will learn how to prepare a 3 C report. **Methodology** : Each student to choose a company to prepare the 3 C report by researching on all the departments of the company.	
Module– VIII: Debate	2
objective : To prepare the students on how to take a stand and present something assertively. **Outcome :** By the end of the session the student will be able to understand how to disagree with each other without getting into a conflict. **Methodology :** Topics to be given to teams in the previous session for preparation for and against the motion.	

Module– IX: Debate	2
Objective : To prepare the students on how to talk in front of an audience. **Outcome :** By the end of the session the students will understand all about content, target audience, body language **Methodology :** Topics to be given to students in the previous session and individually presented in the class for 2-3 minutes	
Module– X: Competition Sessions	2
Objective : To enable the students to compete with each other and prove their quality **Outcome :** By the end of the sessions the students will understand healthy competition, ambition to succeed and benchmark themselves. **Methodology :** Topics, evaluation sheets and short listing to be carried out before declaring the winner.	

Course Syllabus
TY-B.Tech(Sem-VI)

BMEL307A NANO TECHNOLOGY	
Teaching Scheme: **Lectures:** 3Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credit : 3	
Prerequisite (If any):	
1. Material Engineering.	
2.Applied Physics	
Course Objective:	
1. To create awareness about interdisciplinary issues.	
2. To create awareness regarding emerging trend for cutting edge technology.	
3. Introduce students to Fuzzy Logic concepts and techniques and foster their abilities in designing and implementing for real-world problems	
4. To analyze & undestand the various types & properties of Nano materials	
5. To analyze the Deposition techniques, Self-assembly such as Supramolecular approach	
Course Outcome:	
1. Understand the fundamentals and basics of nanotechnology.	
2. Explain significance and potential opportunities to create better materials and products	
3. Clasify and compare the different classes of Nano materials & composites.	
4. Compare and study the different the characteristics of nano technology using various technique.	
5. Explain the Properties and technological advantages of nano materials in different industrial sectors	
6. Demonstrate knowlodge Deposition techniques, Self-assembly such as Supramolecular approach	
Course Contents	**Hrs**
Unit – I : Fundamentals And Overview Of Nanoscience	7
Nano revolution of the XX century, Basic concepts of Nano science and technology, Properties at nanoscale (optical, electronic and magnetic). Theory, definitions and scaling, Challenges and future prospect of Nanotechnology	
Unit – II: Different Classes Of Nanomaterials	7
Carbon based nano materials and other nanomaterials, Metal and Semiconductor Nanomaterials, Quantum Dots, Wells and Wires, Molecule to bulk transitions, Bucky balls and Carbon Nanotubes. Introduction to Nano composites	
Unit – III : Synthesis Of Nanomaterials	8
Top-down approaches: Mechanical Alloying, Nanolithography, CVD. Bottom-up approaches: Physical vapor deposition, Laser Ablation, Sol-get processing, chemical synthesis. Wet Deposition techniques, Self-assembly (Supramolecular approach), Molecular design. Microwave Synthesis of materials from steam power plant.	
Unit – IV : Tools to characterize Nanomaterials	7
X-Ray Diffraction (XRD), small angle X-ray scattering (SAXS), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), Scanning Tunneling Microscope (STM), Field Ion Microscope (FEM), Three Dimensional Atom Probe(3DAP), Nanoindentation.	

Unit – V: Properties Of Nanomaterials	7
Properties and technological advantages of nano materials in different industrial sectors such as semi conductors, sensors, nanostructured bioceramics and nanomaterials for drug delivery applications etc measurement, nuclear measurement	
Unit – VI : Diversified Applications	8
Nano-Electronics, Micro- and Nano-electromecanical systems (MEMS/NEMS), Applications of Nanotechnology in chemical industries, Agriculture industries, Automotive industries, Nano-Medical applications, textiles, Paints, Energy, Defence and Space Applications, Concerns and challenges of Nanotechnology .	

Text Books:
1. .Hari Singh Nalwa,'Nanostructured Materials and Nanotechnology', Academic Press, 2002
2. Pradeep T 'Nano: The Essentials', McGraw Hill Publishing Co. Ltd., 2007
3.Mick Wilson et al, 'Nanotechnology', Overseas Press (India) Pvt. Ltd., 2005.
4.Charles P. Poole, Jr., Frank J. Owens, 'Introduction to nano technology', Wiley, 2003
Reference Books:
1. A.Nabok, 'Organic and Inorganic Nanostructures', Artech House, 2005
2 C.Dupas, P.Houdy, M.Lahmani, ' Nanoscience: Nanotechnologies and Nanophysics', Springer-Verlag Berlin Heidelberg, 2007
3.K.W. Kolasinski, 'Surface Science: Foundations of Catalysis and Nanoscience', Wiley, 2002
4.S.Yang and P.Shen: 'Physics and Chemistry of Nanostructured Materials', Taylor & Francis, 2000
5.Charles P. Poole, Jr., Frank J. Owens, 'Introduction to nano technology', Wiley, 2003

BEML307B: TRIBOLOGY

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 3Hrs/Week	**Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks
Tutorials: Nil	**End Sem Examination:** 60 Marks

Credit : 3

Prerequisite:

1. Kinematics of Machines
2. Machine Design-I & II

Course Objective:

1. To know about properties of lubricants, modes of lubrication, additives etc.
2. To Select suitable/proper grade lubricant for specific application.
3. To select suitable material combination for tribological contact.
4. To Apply the basic theories of friction, wear and lubrications about frictional behavior commonly encountered sliding surfaces.
5. To suggest an explanation to the cause of tribological failures.
6. To design bearing, friction, wear test rig for laboratory purposes.

Course Outcome: After successful completion of this course, students will be able to

1. Demonstrate properties of basic theories of wear and friction.
2. Select suitable grade of lubricants and its specification.
3. Distinguish between hydrodynamic and hydrostatic lubrication
4. Develop and model the lubrication system at optimum conditions with minimum energy loss.
5. Compare and classify various types of wear and fiction in the bearing surfaces and application.
6. Compare and apply tribological aspects in various mechanical processes.

Course Contents	**Hrs**
Unit – I : Introduction to Tribology	7
Tribology definition, Tribology in design- bearing material its properties and construction Tribological design of oil seals and gasket. Tribology in industry (Maintenance). Lubrication-Definition, basic modes of lubrication, properties of lubricants, additives, EP lubricants, Recycling of used oil, oil conservation, oil emulsion. Bearing Terminology-Types of Sliding contact, rolling contact bearings. Comparison between sliding and rolling contact bearing. (Theoretical treatment only)	
Unit – II: Friction and wear	7
Friction- Introduction, laws of friction, Friction classification, causes of friction. Theories of dry friction, Friction measurement, Stick-slip motion and friction instabilities, Wear-classification, wear between solids, wear between solid and liquids, factors affecting wear. Theories of wear. Wear measurement. Approaches to friction control and wear prevention. (Numerical)	
Unit – III : Hydrodynamic lubrication	8
Theory of hydrodynamic lubrication, mechanism of pressure development in oil film. Two dimensional Reynold`s equation and its limitations, Petroff`s equation. Infinitely long journal bearing, infinitely short journal bearing and finite bearing, designing journal bearing using Raimondi and Boyd approach. Hydrodynamic thrust bearing-Introduction, types. Flat plate thrust bearing-Pressure equation, load, centre of pressure, frictional force equation. Tilting pad thrust bearing- bearing-Pressure equation, load, centre of pressure, frictional force equation. (Numericals on Raimondi and Boyd approach and thrust bearing only)	

Unit – IV : Hydrostatic lubrication	7
Hydrostatic lubrication-Basic concept, advantages, limitations, viscous flow through rectangular slot, load carrying capacity, flow requirement of hydrostatic step bearing, energy losses, optimum design of stepped bearing, compensators and their actions. Squeeze film lubrication- Basic concept, circular and rectangular plate approaching a plane (Numericals on hydrostatic bearing, Squeeze film lubrication).	
Unit – V: Elasto-hydrodynamic lubrication and Gas (air) lubrication	7
Elasto-hydrodynamic lubrication-Principle and applications, pressure viscosity term in Reynold's equation, Hertz theory, Ertel-Grubin equation, lubrication of spheres. Gas(air) lubricated bearings-Introduction, advantages, disadvantages, applications of tilting pad bearing, hydrostatic and hydrodynamic bearing with air lubrication, Active and passive magnetic bearings(working principle, types and advantages over conventional bearing). (Theoretical treatment only)	
Unit – VI : Tribological Aspects	6
Lubrication in rolling, forging, drawing and extrusion. Mechanics of tyre road interaction, road grip, wheel on rail road. Surface engineering for wear and corrosion resistance-diffusion, plating and coating methods, selection of coatings, properties and parameters of coatings. Other bearings-porous bearing, foil bearing, Lobe, hybrid bearing. (Theoretical treatment only)	

Text Books:
1. Mujumdar B. C., Introduction to Tribology and Bearings, S. Chand and Company Ltd. New Delhi.
2. Fuller D. D., Theory and Practice of Lubrication for Engineers, John Wiley and Sons.
3. Bharat Bhushan, Principles and Applications of Tribology, 2nd Edition, Wiley India
4. Davis J., Surface Engineering for Corrosion and Wear Resistance, Woodhead Publishing, 2001.
Reference Books:
1. Halling J., Principles of Tribology, McMillan Press Ltd.
2. Bhushan B. and Gupta B. K., Handbook of Tribology: Material, Coatings and Surface Treatments, McGraw Hill Ltd.
3. Cameron A., Basic Lubrication Theory, Wiley Eastern Ltd.
4. Tadausz Burakowski, Surface Engineering of Metals: Principles, Equipments and Technologies‖, Taylor and Francis.

BEML307C: Reliability Engineering

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 3Hrs/Week	**Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks
Tutorials: Nil	**End Sem Examination:** 60 Marks

Credit : 3

Prerequisite:

NIL

Course Objective:

1. To provide students with a comprehensive understanding on various aspects of reliability engineering
2. To enable students to understand reliability considerations in designing machine components, elements and systems
3. To ensure sound maintenance of machines and systems and bring about reliability improvement
4. To perform reliability engineering analysis and its management throughout the product life cycle

Course Outcome: After successful completion of this course, students will be able to

1. Demonstrate understanding of basic reliability measures such as failure rate, availability, MTTF, MTBF, MTTR, etc.
2. Evaluate reliability for redundant, series, and parallel systems
3. Develop fault trees and apply various reliability models to identify and analysis possible faults in machine systems and assess their impact on overall system reliability & maintainability.
4. Make use of reliability improvement techniques and undertake product testing.
5. Understand Maintenance, Quality and Productiveness,
6. Test FEMA, FMECA, DOE, Taguchi method.

Course Contents	**Hrs**
Unit – I : Introduction to Reliability	7
Fundamental concepts of reliability, Reliability definitions, fundamental concepts of product reliability, relationship to quality control and safety, achieving reliability; Equipment survival: time dependency, probability functions, probability of survival concept, failure rate, de-rating procedure, Mean Time To Failure (MTTF), Mean Time Between Failure (MTBF), failure rate, bath tub curve, the tree periods of equipment life	
Unit – II: Probability Concepts and System Reliability	7
Reliability prediction methods, applying the Poisson distribution, series, parallel and mixed configurations, logic diagrams, probability of survival of series systems and parallel redundant systems, application of binomial distribution, series-parallel redundancy, limitations of redundant systems in standby, system reliability, reliability apportionment techniques	
Unit – III : System reliability Analysis	7
Reliability improvement, improvement of components, redundancy, element, unit and standby redundancy, optimization, reliability-cost tradeoff, fault tree analysis, fault tree evaluation techniques, minimal cut set method, minimal tie set method, Delphi methods, Monte Carlo evaluation.	
Unit – IV : Reliability Testing	7
Reliability testing, methods and types of life testing, sequential reliability testing, reliability test standard MIL-STD-781B	

Unit – V: Reliability Management	7
Maintainability engineering, objectives of maintenance, types of maintenance, maintainability, factors affecting maintainability, designing for maintainability, assuring maintainability, qualitative and quantitative maintainability requirements,	
Unit – VI : Reliability in Design & Development	7
Equipment availability, system down time, system down time, availability - inherent, achieved and operational availability, MTBF and MTTR tradeoff, MTTR prediction, reliability centered maintenance, concept of integrated logistic support, life cycle costs, maintenance engineering analysis, failure modes and effects analysis (FMEA), applications in power plants, computer systems etc. Introduction to Design of Experiments (DOE) and Taguchi Method. Human factors in design and design principles.	

Text Books:
1. L. S. Srinath, Reliability Engineering, Affiliated East-West Press Pvt Ltd, 3rd Edition, 1998
2. Roy Billinton and Ronald N Allan , Reliability Evaluation of Engineering Systems, Springer, 2007
3. Roger D. Leitch, Reliability Analysis for Engineers, An Introduction, Oxford University Press, 1995
4. Bryan Dodson, Dennis Nolan, Reliability Engineering Handbook, Marcel DekkerInc, 2002
Reference Books:
1. S. S. Rao, Reliability Based Design, Mc Graw Hill Inc. 1992
2. E. E. Lewis, Introduction to Reliability Engineering, John Wiley & Sons.
3. B. S. Dhillon, Maintainability, Maintenance and Reliability for Engineers, CRC press.

BMEL307D: MECHANICAL VIBRATION	
Teaching Scheme: **Lectures:**3Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credit :-3	
PREREQUISITE(IF ANY):	
1.Machine Design – I, II	
2.Applied Mathematics-II,III	
3. Kinematics of Machines.	
COURSE OBJECTIVE:	
1 To understand basic concepts of mechanical vibrations.	
2 To develop competency in analytical methods in solving problems of vibrations.	
3 To make students conversant with Concepts of Degrees of freedom.	
4 To make the students conversant with basic concepts of Rotor dynamics.	
5 To make the students conversant with various techniques of vibration measurement.	
COURSE OUTCOME: Students will be able to	
1. Understand the basics of mechanical vibrations and their applications	
2. Apply Free and forced vibrations problems.	
3. Understand the principles of Single DOF and Two DOF for mechanical Vibrations.	
4. Solve the numerical methods of multi DOF.	
5. Analyze the principles of torsional Vibrations problems.	
6. Apply knowledge of Conditioning Monitoring to Vibration instrumentation.	
COURSE CONTENTS	**Hrs.**
UNIT I Introduction	7
Need & scope, concepts & terms used, SHM, method of representing vibration, Fourier series & harmonic analysis. Classification of Vibration. natural frequency, equivalent springs, modeling of a system, formulation of equation of motion by equilibrium and energy methods.	
UNIT II: Damped free and forced vibrations:	8

(a) Damped free vibrations, types of damping, logarithmic decrement, coulomb damping, and damping materials. (b) Forced Vibrations: types of excitation, forced excitation, support excitation, excitation due to unbalance in machines, response due to above types of excitations, transmissibility, force transmissibility & motion transmissibility, vibration isolators, commercial isolation materials & shock mounts.	
UNIT III: Two DOF system- Free un-damped vibrations	7
(a) Free un-damped vibrations – principal modes and natural frequencies, co-ordinate coupling and principal co-ordinates. (b) Forced vibrations (undamped) – harmonic excitation, vibration, dampers & absorbers, dynamic vibration absorber – tuned & untuned type. Geared systems(Torsional vibrations)	
UNIT IV Multi DOF systems	7
Close couple systems, coupled systems, orthogonality of mode shapes, modal analysis, Maxwell's reciprocal theorem, Rayleigh's method, Dunkerley's method, Stodola method, Holzer's method.	
Unit V: Rotor Dynamics	7
Single mass system- torsional vibration in rotary machinery, two mass system, multi mass system, balancing of rotor, dynamic behavior of rotor, gyroscopic effects	
Unit VI: Conditioning Monitoring and Vibration instrumentation	8
Displacement, velocity, acceleration, shock measurement, transducer, terminal devices, spectrum analyzer, exciter, special mounting techniques signature analyzer, concept of signature and prediction of trouble by signature monitoring Vibration Measurements- vibration pickups, accelerometers; inductance and capacitance type pickups, piezoelectric pickups	

Text Books:

1. Singiresu S Rao, 'Mechanical Vibration', 4th Edition, 2013
2. Singh Vp, Vp Singh, 'Mechanical Vibration', Dhanpat Rai & Co (p) Ltd, 3rd Edition,2012.
3. J.S. Rao and K. Gupta, 'Introductory Course On Theory & Practice Of Mechanical Vibrations', New Age International (p) Ltd , 2nd edition, 2012
4. Mechanical Vibrations: S. Graham Kelly, Schaum's Outline Series, Tata McGraw Hill, Special Indian edition, 2007

Reference Books:
1. Leonard Meirovitch, 'Elements of vibration analysis', Tata Mcgraw Hill Publishing Co Ltd, 2nd Edition, 2007
2. G. K. Grover, 'Mechanical Vibration', Nemchand & Brothers, 8th Edition, 2009.
3. AD Dimarogonas, SA Paipetis, 'Analytical Methods In Rotor Dynamics', Applied Science Publishers London,1983.

BMEL307E: Machine Tool Design

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures:3Hrs/Week	**Teachers Assessment:** 20 Marks
Tutorials: Nil	**Continuous Assessment:** 20 Marks
	End Sem Examination: 60 Marks

Credit : 3

Prerequisite (If any):

1. Manufacturing Processes-I & II
2. Machine Design-I.

Course Objectives:

1. To Explore various design aspects of various machine tool elements like tool drives, guide-ways, spindles, Power screws, etc.
2. Design machine tools structures, guide-ways, spindles and power screws.
3. Design of Spindle, power screws.
4. Develop understanding of dynamics of machine tools.
5. Get proper knowledge in the latest area of tooling like CNC and recent trends in machine tools.

Course Outcomes: After completion of the course student will be able to,

1. Design gear box for spindle drive and feed gear box.
2. Analyze various components of machine tool structure, different machine tools considering static and dynamic loads.
3. Design Guide ways and understand its functions.
4. Design Spindles, Spindle Supports and Power Screws
5. Understand different machine tools considering dynamic loads. Understand effect of vibrations on life of machine tools.
6. Analyze design considerations for Special features in Machine tools.

Course Contents	**Hrs**
Unit – I : Machine Tool Drives	7
Design considerations for drives based on continuous and intermittent requirement of power, Types and selection of motor for the drive, Regulation and range of speed based on preferred number series, geometric progression. Design of speed gear box for spindle drive and feed gear box. (Simple Numericals)	
Unit – II: Design of Machine Tool Structure	8
Analysis of forces on machine tool structure, static and dynamic stiffness. Design of beds, columns, housings, bases and tables. Toolpost and Turret (Numericals)	
Unit – III : Design of Guide-ways	7

Functions and types of guide-ways, design criteria and calculation for slide-ways, design of hydrodynamic, hydrostatic and aerostatic slide-ways, Stick-Slip motion in slide-ways. (Numericals)	
Unit – IV : Design of Spindles, Spindle Supports and Power Screws	8
Design of spindle and spindle support using deflection and rigidity analysis, analysis of antifriction bearings, preloading of antifriction bearing. Design of power screws: Distribution of load and rigidity analysis. (Numericals)	
Unit – V: Dynamics of Machine Tools	8
Dynamic characteristic of the cutting process, Stability analysis, vibrations of machine tools. Control Systems, Mechanical and Electrical, Adaptive Control System, relays, push button control, electrical brakes, drum control. Machine Control systems and its types.	
Unit – VI : Special features in Machine Tool Design	7
Design considerations for SPM, NC/CNC, and micro machining, Retrofitting, Recent trends in machine tools, Design Layout of machine tool using matrices. Step-less drives Design considerations of Step-less drives, electromechanical system of regulation, friction, and ball aviators, PIV drive, Epicyclic drive, principle of self locking,	

Text Books:

1. N.K. Mehta, Machine Tool Design, Tata McGraw Hill, ISBN 0-07-451775-9.
2. Bhattacharya and S. G. Sen., Principles of Machine Tool, New central book agency Calcutta, ISBN 81-7381-1555.
3. D. K Pal, S. K. Basu, Design of Machine Tool, 4th Edition. Oxford IBH 2005, ISBN 81- 204-0968

Reference Books:

1. N. S. Acherkan, Machine Tool, Vol. I, II, III and IV, MIR publications.
2. F. Koenigsberger, Design Principles of Metal Cutting Machine Tools, The Macmillan Company New York 1964.
3. N. Ignatyev, N. Acherkan, V. Push," Machine Tool Design", University press of pecific
4. Sharma, P. C., A Text Book Of Machine Tools & Tool Design, S. Chand Limited,(2005)

BMEL307F: OPTIMIZATION TECHNIQUES

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 3Hrs/Week	**Teachers Assessment:** 20 Marks
Tutorials: Nil	**Continuous Assessment:** 20 Marks
	End Sem Examination: 60 Marks

Credit : 3

Prerequisite (If any):

1. Applied Numerical Methods and Optimization.

Course Objective:

1. To develop the skills of mathematical modeling.
2. To develop analytical skills to provide solution to simple Optimization problems in the field of engineering
3. To make the learners aware of the importance of optimizations in real scenarios
4. To develop the skills of using Optimization techniques for various engineering problems

Course Outcome: Students will be able to

1. Develop the mathematical problem and apply various optimization techniques.
2. Apply transportation problem & assignment problem as a decision making tool
3. Use dynamic and nonlinear programming for optimization of various engineering problems
4. Provide the concepts of various classical and modern methods of for constrained and unconstrained problems in both single and multivariable
5. Understand and apply the concept of optimality criteria for various type of optimization problems
6. Apply the methods of optimization in real life situation

Course Contents	**Hrs**
Unit – I : Linear Programming & Non Linear Programming	7
Simplex algorithm, two phases of the simplex method, applications, One-dimensional minimization - exhaustive search, golden section method, quasi-Newton method, random search methods, Powell's method	
Unit – II: Transportation Problems	7
Modeling and solution of the Transportation Problem – Existence of solution – degeneracy – MODI Method, Optimization Methods like UV and Stepping Stone Method	
Unit – III : Assignment Problems	7
Introduction, Structure, Assignment Problems, Formulation Travelling Salesman Problems, Travelling Salesman as an Extension of Assignment Problem, Hungarian Method to solve	

Assignment Problem	
Unit – IV : Dynamic Programming	7
Multistage decision process- concept of sub optimization- principle of optimality- computational procedure in dynamic Programming	
Unit – V: Discrete Variables	7
Application to problems involving discrete variables, continuous variables and constraints involving equations and inequalities	
Unit – VI : Evolutionary Structural Optimization (ESO) Methods	7
ESO Based on Stress Level, evolutionary methods, two-bar frame, Michell type structure, ESO for stiffness or displacement optimization, Bi-directional Evolutionary Structural, Optimization (BESO) method, BESO Based on von Mises Stress, topology optimization for natural frequency. Genetic Algorithm with examples.	

Text Books:
1. S. D Sharma: Operations Research, KedarNath Ram , Nath & Co Publishers Meerut
2. Sharma J k : Operation Research, Theory and Apllications, Macmillan India Limited
3. J C Pant: Introduction to Optimization : Operation Research , Jain Brothers New Delhi
4. S.S. Rao : Engineering Optimization : Theory & Practice, New Age International (p) Limited
Reference Books:
1. H.M. Wager: Principles of Operations Research, Prentice Hall of India, New Delhi
2. Kanti Swarup et al: Operations Research, Sultan Chand and co.
3. E. J. Haug and J.S. Arora, Applied Optimal Design, Wiley, New York.
4. Handy A Taha, Operations Research – An Introduction, Prentice Hall of India, New Delhi.

BMEL307G: UNCONVENTIONAL ENERGY SOURCES

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 3Hrs/Week	**Teachers Assessment:** 20 Marks
	Continuous Assessment: 20 Marks
Tutorials: Nil	**End Sem Examination:** 60 Marks

Credit : 3

Prerequisite (If any):

Nil

Course Objective:

1. On the background of depleting sources of conventional energy, demonstrate significance of renewable Sources of energy and technologies of their Utilization
2. Enable the students to estimate the potential of different resources at different numerical exercises
3. Understand economics of renewable energy system
4. Expose them to conceptualize and design renewable energy appliances and equipment
5. Enable them to independently analyze, implement and asses the existing real life systems
6. Develop a professional insight about renewable energy technologies so as to motivate all concerned for enhanced employment of renewable energy option

Course Outcomes: Students will be able to

1. List and generally explain the main sources of energy and their primary applications in the United States, and the world.
2. Discuss remedies/potential solutions to the supply and environmental issues associated with fossil fuels and other energy resources.
3. List and describe the primary renewable energy resources and technologies.
4. Convert units of energy—to quantify energy demands and make comparisons among energy uses, resources, and technologies.
5. Collect and organize information on renewable energy technologies as a basis for further analysis and evaluation.
6. Describe the challenges and problems associated with the use of various energy sources

Course Contents	**Hrs**
Unit:1 Introduction	08

Introduction: Indian Scenario, Need, Characteristics and challenges in the successful utilization of renewable energy sources, Jawaharlal Nehru National Solar Mission (JNNSM) Solar Energy Resource: Estimation of Potential of the Sun. Solar Extraterrestrial Radiation, Spectral Distribution, Earth sun angles, observer sun angles, Tilt factor, solar radiation intensity incident on tilted surface. Measurement of Solar Radiation	
Unit:2 Low temperature applications of Solar Thermal Energy	06
Low temperature applications of Solar Thermal Energy –Water and air Heating, Flat Plate collectors, losses, Performance evaluation, storage, Testing and standards, Economics, Subsidies and incentives available	
Unit:3 Medium and high temperature applications of Solar Thermal Energy	07
Medium and high temperature applications of Solar Thermal Energy – Concentrating collectors, classification, types and suitability, tracking, Performance evaluation, Industrial Process heating systems, Solar thermal power generation, technologies, Storage issues and challenges in the commercialization.	
Unit:4 Solar Photovoltaic Conversion	06
Solar Photovoltaic Conversion- Basic Semiconductor Physics, A generic photovoltaic cell, Modules and Arrays, Impact of Temperature and Shading on the performance of a PV module, Stand alone and grid connected Solar Photovoltaic Systems, components, system design and economics	
Unit:5 Wind power systems	06
Wind power systems – Types of Wind turbines, Terminology, Impact of tower height, Maximum Rotor efficiency (Betz Limit), Wind turbine generators, Average power in wind, Estimation of wind availability, performance evaluation	
Unit:6 Bio-Energy	07
Bio-Energy: Biomass as a source of energy, Classification of biomass, Biomass conversion processes, Types of gasifiers, Briquetting, Gasification and combustion of biomass, Biomethanation, Biogas as a rural energy source, Environmental significance, Biogas production mechanism, Biogas plant and its components, Types of biogas plants, Design and construction features.	

Text Books:

1. S. P. Sukhtme, J. K. Nayak, Solar Energy Principles of Thermal Collection and Storage, Tata McGraw Hill
2. Duffie John A.and Beckman William A., Solar Engineering of Thermal Processes, John Wiley and Sons,Inc. Second Edition, 1991
3. Gilber Masters, Renewable and Efficient Power Systems, Wiley Inter-science, John Wiley and Sons. Inc. ,2004
4. Tiwari G. N. & Ghosal M. K. Fundamentals of Renewable Energy Sources by, Narosa Publishing House

Reference Books:
1. Garg H.P., Prakash J., Solar energy Fundamentals and Applications, Tata Mc Graw Hill Publishing Company, New-Delhi, Latest Edition
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publications, 2nd Edition, 1992.
3. V.V. N. Kishore, Editor, Renewable Energy Engineering and Technology, A knowledge Compendium, The Energy and Resources Institute, New Delhi, 2008

BMEL308: ENERGY CONVERSION – II

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 4Hrs/Week	**Teachers Assessment:** 20 Marks
Tutorials: Nil	**Continuous Assessment:** 20 Marks
	End Sem Examination: 60 Marks

Credits: 4

Prerequisite :

1. Energy Conversion-I
2. Engineering thermodynamics

Course Objective:

1. To understand theory and performance evaluation of Positive displacement compressor
2. To understand theory and performance evaluation of Rotary, Centrifugal, Axial flow compressor
3. To get familiar with fundamentals of I. C. Engines, Construction and working Principle of an Engine, to study Combustion in SI and CI engines and its controlling factor in order to extract maximum power.
4. Perform Testing of I. C. Engines and methods to estimate Indicated, Brake and Frictional Power and efficiencies
5. To understand the thermodynamics and Brayton cycles.
6. To understand the working of hydroelectric and nuclear power plants

Course Outcome: On completion of the course, learner will be able to

1. Explain construction, working of various types of reciprocating with performance calculations.
2. Understand construction, working of Rotary, Centrifugal, and Axial flow Compressors.
3. Classify various types of Engines, Understand Theory of Carburetion, Modern Carburetor, Stages of Combustion in S. I and C. I Engines
4. Understand Testing of I. C. Engines and analyze its performance.
5. Explain methods improving efficiency of gas turbine
6. Demonstrate different types of Nuclear power plants and nuclear wastage

Course Contents	**Hrs**
UNIT-I: Reciprocating compressors	9
Positive displacement Compressors. Reciprocating compressors : Parts, Operations, Work done during isothermal, polytrophic and adiabatic compression process, PV diagram, isothermal efficiency, Effect of clearance, volumetric efficiency, Mechanical efficiency, Multistage compressor, condition for minimum work input, Actual indicator diagram	
UNIT-II: Rotary, Centrifugal, Axial flow Compressors	9
Rotary Compressors: Rotary and vanes blower and screw compressor: Principle, operation, parts, indicator diagram, work done, Roots efficiency, vanes efficiency. (No analytical treatment expected) **Centrifugal Compressor:** Principle, operation, parts, velocity diagram, static & total head quantities, work done by impeller, isentropic efficiency of compressor, slip factor, pressure	

coefficient, power input factor. **Axial flow compressor**: Principle, operation, parts, velocity diagram, work done, Degree of reaction stage efficiency compressor characteristics, surging & chocking. Poly tropic efficiency.	
UNIT-III: I.C. Engines	9
I.C. Engines: Air standard & fuel air cycles, parts of I.C. Engines, working of I.C. Engines, Two stroke and four stroke I.C. Engines SI & CI Engines, Introduction to combustion in SI & CI Engine, carburetion and fuel injection. (Analytical treatment not expected)	
UNIT - IV : I.C. Engine Testing	9
I.C. Engine Testing: Measurement of power: Indicated, friction and brake power, measurement of speed, fuel land air consumption, calculation of indicated and brake thermal efficiency, volumetric efficiency, mechanical efficiency, percentage of excess air, Heat balance sheet, performance, characteristics and factors influencing the performance of I.C. Engines.	
UNIT - V : Diesel & Gas Turbine Power plant	9
A) Diesel Engine Power Plant: Plant Layout, Diesel Engine Power Plant Performance Analysis, Application, selection of engine size, advantages & disadvantages of diesel power plant. B) Gas Turbine Power Plants : Introduction, fuels, materials selection for GTPP, Brayton Cycle analysis, Thermal Efficiency, Work ratio, maximum & optimum pressure ratio, Actual cycle effect of operating variables on thermal efficiency, inter-cooling, reheating, & regeneration cycle, Open, Closed & Semi Closed cycles Gas Turbine Plant , combined cycle plant (Numerical Treatment).	
UNIT - VI : Hydroelectric and Nuclear power plant	9
Hydroelectric Power Plant: Introduction, Site Selection, Advantages and Disadvantages of HEPP, Hydrograph , Flow duration curve ,Mass Curve, Classification of HEPP with layout. Nuclear Power Plants: Elements of NPP, Nuclear reactor & its types, fuels moderators, coolants, control rod, classification of NPP, N-waste disposal	

Text Books:

1. John B. Heywood, Internal Combustion Engine Fundamentals 1st Edition, Tata McGraw-Hill Education, 2004
2. V. Ganeshan, 'Internal Combustion Engine' Tata McGraw publication
3. P K Nag, "Power Plant Engineering", 3rd Edition, Tata McGraw Hill, 2008.
4. Paul W. Gill, James H. Smith," Fundamentals of Internal Combustion Engines", 4th Edition, Oxford & IBH Publishing Company Pvt. Ltd.

Reference Books:
5. Internal Combustion Engine by M.L.Mathur and R.P.Sharma, Dhanpat Rai Publications (P) Ltd.
6. R.Yadav, "Steam & Gas turbines and Power plant engineering" , central publishing House, Allahabad
7. Domkundwar & Arora, —Power Plant Engineering, Dhanpat Rai & Sons, New Delhi
8. Domkundwar & Domkundwar: Internal Combustion Engine, Dhanpat Rai

BMEP308: ENERGY CONVERSION – II	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25 Marks **External**: 25 Marks
Credits: 1	
Course Outcomes: Students will be able to	
1. Explain the working principle of various types of compressors and know their application range	
2. Explain the limits of safe operation of compressors	
3. Understand performance test on diesel engine.	
4. Demonstrate knowledge of the operating characteristics of common IC engines.	
5. Demonstrate an understanding of Challenges related to industrial application.	
List of Practicals	
Perform any three of experiments 1 to 6	Hrs
1. Demonstration of Carburetors such as zenith, carter, soles, S.U. etc.	2
2. Demonstration of Engine Cooling and lubrication systems	2
3. Study and Demonstration of Cogeneration GT Plant and Jet propulsion systems	2
4. Study and assignment on Nuclear Power plants	2
5. Study and assignment of Environmental Impact of Power Plants	2
6. Trial on Multi-cylinder Diesel Engine with energy balance sheet	2
Perform any three of experiments 7 to 11	

7. Study & Performance analysis of reciprocating compressor	4
8. Study and demonstration of Power Transmission system of four wheelers	4
9. Trail on centrifugal compressor for its performance.	4
10. Performance trial on variable compression ratio I.C. Engine	4
11. A visit to Hydroelectric power plant/Gas turbine plant and write technical report on it	4
Industrial Fluid Power- perform any two	
12. Trial on Gear/Vane/Piston pump and plotting of performance characteristics.	2
13. Study of simple hydraulic systems used in practice such as copy turning attachment, hydraulic clamps, jack, dumper, forklift etc.	2
14. Testing of pressure relief valve.	2

BMEL309: MACHINE DESIGN – II

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 4Hrs/Week	**Teachers Assessment:** 20 Marks
Tutorials: Nil	**Continuous Assessment:** 20 Marks
	End Sem Examination: 60 Marks

Credit : 4

Prerequisite (If any):

1. Machine Design – I

Course Objective:

1. To understand the principles of design and selection
2. To develop competency in designing various components of mechanical power transmission system like belt drives, rope drives, chain drives and gear drives.
3. To understand applications of design theories and principles for mechanical design.

Course Outcome: Students will be able to

1. Select and design the bearings for various applications of loads
2. Apply principles of Belt Conveyors in practice. Understand the principles and design aspects of flywheel and coupling design for manufacturing
3. Select suitable drive combination based on requirement.
4. Explain failure modes in gears and design spur and helical gear drives.
5. Design bevel gear and worm gear drives.
6. Understand principles of wire rope drives and chain drives.

Course Contents	**Hrs**
Unit – I : Rolling Contact Bearings:	10
Types of rolling contact Bearings, Static and dynamic load carrying capacities, Stribeck's Equation, Equivalent bearing load, Load- life relationship, Selection of bearing life Selection of rolling contact bearings from manufacturer's catalog, Design for cyclic loads and speed, bearing with probability of survival other than 90% Taper roller bearing: Force analysis and selection criteria. (Theoretical Treatment only)	
Unit – II: Sliding Contact Bearings	8
Classification of sliding contact bearing. **Lubricating oils:** Properties, additives, selection of lubricating oils, Properties & selection of bearing materials. **Hydrodynamic Lubrication:** Theory of Hydrodynamic Lubrication, Pressure Development in oil film, 2DBasic Reynolds Equation, Somerfield number, Raimondi and Boyd method, Thermal considerations, Parameters of bearing design, Length to Diameter ratio, Unit bearing Pressure, Radial Clearance, minimum oil film thickness.	
Unit – III : Design of Spur Gears	10
Review of kinematics of gears and terminology, types of gears, force analysis of spur gear, interference, tooth profiles. Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by	

velocity factor and Buckingham's equation, design of spur gear drive.	
Unit – IV : Design of Helical Gears	8
Types of Helical gears, Force analysis of helical gear, formative number of teeth. Beam strength (Lewis) equation, Velocity factor, Service factor, Load concentration factor, Effective load on gear, Wear strength (Buckingham's) equation, Estimation of module based on beam and wear strength, Estimation of dynamic tooth load by velocity factor and Buckingham's equation, design of helical gear drive.	
Unit – V: Design of Worm gears and Bevel gears	9
Worm gear drive : types and proportion of worm and worm gear, force analysis, beam strength of worm gear teeth, dynamic tooth load, wear load , thermal rating of worm gear, design of worm and worm gear. **Bevel gear drive:** types of bevel gear, proportions of bevel gear, force analysis of bevel gear drive design of bevel gear drive	
Unit – VI : Design of Belt Drives, Wire Rope drives and Chain Drives	8
Belt drive: Materials and construction of flat and V belts, geometric relationships for length of belt, power rating of belts, concept of slip & creep, initial tension, effect of centrifugal force, maximum power condition, Selection of Flat and V-belts from manufacturer's catalog, belt tensioning methods, relative advantages and limitations of Flat and V- belts, construction and applications of timing belts. **Wire Rope drives:** Introduction to haulage system, design of wire rope, sheave and drums, Construction of wire ropes, lay of wire rope, stresses in wire rope, selection of wire ropes, rope drums construction (Theoretical treatment only) **Chain Drives**: Types of chains and its Geometry, selection criteria for chain drive, Polygon effect of chain, Modes of failure for chain, Lubrication of chains	

Text Books:

5. Martin J. Siegel, VladimirL. Maleev, James Busse Hartman, 'Mechanical Design of Machine', International Text book Co,1965.
6. J. E. Shigley, Charles R. Mischke, Richard G. Budynas, 'Mechanical Engg. Design', McGraw-Hill.
7. V. B. Bhandari, 'Design of Machine Elements', Tata McGraw-Hill Education.
8. Robert L. Norton, "Machine Design, An Integrated Approach", Prentice Hill.

Reference Books:

1. Black P. H. and O. Eugene Adams, 'Machine Design', McGraw- Hill.
2. Gitin M . Maitra and L. V. Prasad, 'Handbook of Mechanical Design', 2nd Edition, TMH Publications.
3. B. D. Shiwalkar, 'Design Data book', Benett & Co Publishing Division, 2nd edition.
4. Spotts M. F. and Shoup T.E., "Design of Machine Elemnets", Prentice Hall International.

BMEP309: MACHINE DESIGN – II	
Teaching Scheme: **Practical:** 1Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25 Marks **External**: 25 Marks
Credits: 1	
Course Outcomes:	
1. Students will be able to make proper assumptions with respect to material, factor of safety, static and dynamic loads for various machine components	
2. Enable the students to have high ethical standards in terms of team work to be a good design engineer.	
3. Enable the students to identify the applications of all the mechanical components in industry	
4. Ability to perform both part and assembly drawings of mechanical components using softwares such as CATIA	
Design Project	**Hrs**
a) One design project based on either Design of a Two Stage Gear Box (the two stages having different types of gear pair) or single stage worm gear box. The design project shall consist of two full imperial (A1) size sheets involving assembly drawing with a part list and overall dimensions and drawings of individual components. b) Manufacturing tolerances, surface finish symbols and geometric tolerances should be specified for important surfaces. c) A design report giving all necessary calculations of the design of components and assembly should be submitted in a separate file. d) Design data book shall be used wherever necessary to achieve selection of standard components	14
Assignments (Any two of the following)	
a) Application of belt drive and its selection method for Industrial application. (By using Manufacturer's Catalog).	4
b) Application of chain drive and its selection method for Automobile application. (By using Manufacturer's Catalog).	4
c) Mounting of machine elements on transmission shaft (like Bearings, gears, Pulley, Sprocket, etc).	4
d) Selection of Bearing from Manufacturer's Catalog.	4
e) Construction and details of Gears.	4

BMEL310: HEAT TRANSFER	
Teaching Scheme: **Lectures:**4 Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credit: 4	
PREREQUISITE (IF ANY):	
1.Engineering Thermodynamic	
2.Fluid Mechanics	
COURSE OBJECTIVE:	
1. To provide a general knowledge on the basic mechanisms of heat transfer.	
2. Make the right assumptions and approximations for modeling practical situations	
3. To develop intellectual skills of providing analytical solutions to variety of real life situation	
4. Exploring the advanced career opportunities in the area of heat transfer like Design of heat	
COURSE OUTCOME:	
1. Identify the exact mode of heat transfer involved in the process.	
2. Evaluate the impact of boundary conditions on the solutions of heat transfer problems.	
3. Apply heat transfer concept to increases heat transfer rate through extended surfaces	
4. Formulate basic equations and correlation for heat transfer problems.	
5. Evaluate heat transfer by radiation between objects with simple geometries.	
6. Evaluate the effectiveness and rating of heat exchangers.	
Unit – I : Introduction to Heat Transfer	10
Introduction: Basic modes of heat transfer, conduction, convection and radiation, laws of heat transfer, three dimensional heat conduction equation in Cartesian, cylindrical (no derivation) and spherical coordinates (no derivation), thermal conductivity and thermal diffusivity. **One dimensional steady state conduction equation without heat generation:** heat conduction in plane wall, composite wall, composite cylinder and composite sphere, electrical analogy, concept of thermal resistance and conductance, contact resistance, overall heat transfer coefficient, critical radius of insulation for cylinders and spheres.	
Unit – II : One Dimensional Heat Conduction	08
One dimensional steady state heat conduction with internal heat generation: Heat conduction with uniform heat generation in plane wall, cylinder and sphere with different boundary conditions.	

Boundary and initial conditions: Temperature boundary condition, heat flux boundary condition, convection boundary condition, radiation boundary condition. **Unsteady state heat conduction**: Lumped heat capacity analysis, Biot number, fourier number and their significance, heister charts.	
Unit – III: Extended surfaces	08
Extended surfaces: Types of fins, Governing equation for fins of uniform cross section area, solution (with derivation) for infinitely long and adequately long (with insulated end) fin and short fin(without derivation), fin efficiency and effectiveness of fin.	
Unit – IV : Convection	10
Fundamentals of Convection: Mechanism of convection, local and average heat transfer coefficients, concept of velocity and thermal boundary layer thickness. **Forced convection**: Physical signification of dimensionless numbers, flow of high moderate and low prandtl number, fluid flow over a flat surface, empirical correlations for external and internal flow for both laminar and turbulent flow. **Free or Natural convection**: Introduction, dimensionless numbers, empirical co relations for natural convection.	
Unit – V : Thermal Radiation	08
Thermal Radiation: Fundamental concept of radiation, black body radiation, laws of radiation, surface emission properties, Radiation shape factor, Heat exchange by radiation between two black and diffuse gray surfaces, electrical network analogy for thermal radiation (Irradiation, Radiosity), radiation shields	
Unit – VI : Heat exchanger, Condensation and Boiling	10
Heat exchanger: Classification, overall heat transfer coefficient, fouling factor, LMTD method of heat exchanger analysis for parallel, counter flow and cross flow arrangement, effectiveness- NTU method, heat exchanger analysis by NTU method, design aspects of heat exchangers, introduction to compact heat exchanger introduction to heat pipe.. **Condensation and Boiling:** Boiling heat transfer, types of boiling, pool boiling curve and force boiling phenomenon, film wise and drop wise condensation, (no numerical).	

Text Books:
1. J.P. Holman, 'Heat Transfer', McGraw Hill Book Company, New York
2. Incropera and Dewitt, 'Fundamentals of Heat and Mass Transfer', John Wiley and Sons.

3. P.K. Nag, Heat & Mass Transfer, McGraw Hill Education Private Limited.
References:
1. YVC Rao 'Heat Transfer', Universities press
2. Yunus .A.,Cengel, 'Heat and Mass Tranfer', Tata McGraw Hill Publication
3. M. Thirumaleshwar, Fundamentals of Heat and Mass Transfer, Pearson Education India.
4. Fundamental of Heat and Mass Transfer by Incropera and Dewitt, Wiley Publication
5. M.F Spott

BMEP310: HEAT TRANSFER	
Teaching Scheme: **Practical:** 2 Hrs/Week	**Examination Scheme (Laboratory)** **Continuous Assessment:** 25Marks **External**: 25 Marks
Credits: 1	
Course Outcomes:	
1. Ability to measure the thermal conductivity of different common metallic materials.	
2. Ability to measure the quantity of heat transfer between fluids and solid boundaries.	
3. Ability to carry out simple experimental work in radiative heat transfer .	
4. Ability to measure the amount of heat exchanged between fluids flowing within heat exchangers.	
5. Ability to measure heat flux for boiling and condenstion.	
6. Ability to carry out simple experimental work in advance heat transfer system .	
Perform Any eight experiments (1-11) and all the assignments (12-14) from the following list	
LIST OF PRACTICALS	Hrs.
1) Determination of Thermal Conductivity of metal rod	2
2) Determination of thermal conductivity of insulating power	2
3) Determination of thermal conductivity of composite wall	2
4) Determination of heat transfer coefficient in Natural Convection	2

5) Determination of heat transfer coefficient in Force Convection	2
6) Determination of temperature distribution, fin efficiency in Natural/Force Convection	2
7) Determination of Emissivity of a teat surface	2
8) Determination of Stefan Boltzmann Constant	2
9) Determination of effectiveness of heat exchanger	2
10) Study of pool boiling phenomenon and determination of critical heat flux	2
11) Determination of equivalent thermal conductivity of heat pipe	2
12) Assignment on 1-D transient heat transfer program using finite difference methods.	4
13) Assignment to solve transient heat transfer problem using Heisler and Grober charts.	4
14) Assignment on multi-pass /cross flow heat exchanger using effectiveness charts.	4

BMEL311: INDUSTRIAL FLUID POWER

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures: 3Hrs/Week	**Teachers Assessment:** 20 Marks
Tutorials: 1hr/week	**Continuous Assessment:** 20 Marks
	End Sem Examination: 60 Marks

Credit : 3

Prerequisite (If any):

1. Fluid Mechanics

Course Objective:

1. To instill within each student a positive safety attitude with regard to the design, construction, operation, and maintenance of fluid power systems.
2. To provide students with knowledge of the applications of fluid power in process, construction and manufacturing industries.
3. To provide students with an understanding of the physical laws and principles that governs the behavior of fluid power systems.
4. To provide students with an understanding of the fluids and components utilized in modern industrial fluid power systems.
5. To develop within each student a measurable degree of competence in the design, construction and operation of fluid power circuits.

Course Outcome: Students will be able to

1. Understand the concepts of fluid statics and dynamics as applied to commercial and industrial control.
2. Explain hazards of hydraulic and pneumatic circuits and be able to work safely.
3. Apply and recognize standard schematic symbols for common fluid power components.
4. Demonstrate and troubleshoot basic fluid power, electro-hydraulic, and electro-pneumatic circuits using schematic diagrams.
5. Explain the operation, application, and maintenance of common fluid power components such as pumps, compressors, valves, cylinders, motors, rotary actuators, accumulators, pipe, hose, and fittings.
6. Analyze and develop hydraulic and pneumatic circuits.

Course Contents	**Hrs**
Unit – I : Introduction to Fluid Power	8
Fluid power system: Components, advantages and applications. Transmission of power at static and dynamic states. Pascal's law and its applications such as hydraulic press/Jack (Numerical treatment). Fluids for hydraulic system: Types, properties, selection. Additives, effect of temperature	

and Pressure on hydraulic fluid. Seals, sealing materials, compatibility of seal with fluids. Types of pipes, hoses, material, quick acting couplings. Pressure drop in hoses/pipes. Fluid conditioning through filters, strainers, sources of contamination and contamination control, heat exchangers.	
Unit – II: Pumps	7
Types, classification, principle of working and constructional details of Vane pumps, gear pumps, radial and axial plunger pumps, screw pumps, power and efficiency calculations, characteristics curves, selection of pumps for hydraulic Power transmission. **Power units and accessories:** Types of power units, reservoir assembly, constructional details, pressure switches, temperature switches, Temperature switches. **Accumulators:** Types, selection/ design procedure, applications of accumulators. Types of Intensifiers, Pressure switches /sensor, Temperature switches/sensor, Level sensor	
Unit – III : Fluid Power Control	7
Symbols for hydraulic and pneumatic circuits. Control of fluid power through different valves such as pressure control valves, directional control valves, and flow control valves (Principle, classification, constructional details, symbols, advantages, disadvantages and applications). Flow rate, working pressure, differential pressure Check valve, Servo valves, Proportional valves and Cartridge valves, cut off Valves.	
Unit – IV : Hydraulics	8
Actuators: (i) Linear and Rotary. (ii) Hydraulic motors- Types- Vane, gear, Piston types, radial piston. (iii) Methods of control of acceleration, deceleration. (iv) Types of cylinders and mountings. (v) Calculation of piston velocity, thrust under static and dynamic applications, considering friction, inertia loads. (vi) Design considerations for cylinders. Cushioning of cylinders. (Numerical treatment) **Industrial circuits –** Simple reciprocating, Regenerative, Speed control (Meter in, Meter out and bleed off), Sequencing, Synchronization, transverse and feed, circuit for riveting machine, automatic reciprocating, fail safe circuit, counter balance circuit, actuator locking, circuit for hydraulic press, unloading circuit (Numerical treatment), motor breaking circuit.	
Unit – V: Pneumatics	8
Principle of Pneumatics: (i) Laws of compression, types of compressors, selection of compressors. (ii) Comparison of Pneumatics with Hydraulic power transmissions. (iii) Types of filters, regulators, lubricators, mufflers, dryers. (iv) Pressure regulating valves, (v) Direction control valves, two way, three way, four way valves. Solenoid operated valves, push button, lever control valves. (vi) Speed regulating - Methods used in Pneumatics. (vii) Pneumatic actuators-rotary, reciprocating.(viii) Air motors- radial piston, vane, axial piston (ix) Basic pneumatic circuit, selection of components(x) Application of pneumatics in low cost Automation and in industrial automation Introduction to vacuum and vacuum	

measurement, Vacuum pumps, types, introduction to vacuum sensors and valves. Industrial application of vacuum	
Unit – VI : System Design	7
Design of hydraulic/pneumatic circuit for practical application, Selection of different components such as reservoir, various valves, actuators, filters, pumps based on design. (Students are advised to refer manufacturers" catalogues.).Case studies on various circuit designs.	

Text Books:
1. Pinches, Industrial Fluid Power, Prentice hall Publications
2. D. A. Pease, Basic Fluid Power, 2nd edition, Prentice hall Publications
3. J. J. Pipenger, Tyler G. Hicks, Industrial Hydraulics, McGraw Hill Publications
4. S. Ilango and V Soundararajan "Introduction to Hydraulic and Pneumatics", , Prentice Hall of India, 2nd Edition
Reference Books:
1. Esposito "Fluid Power with Application", Pearson Education Publications , 7th Edition.
2. D. S. Pawaskar "Industrial Fluid Power", Nishant Prakashan Publications.
3. Majumdar, Pneumatic Systems, Tata McGraw Hill Publications

BMEL312: INDUSTRIAL ENGINEERING AND MANAGEMENT	
Teaching Scheme: **Lectures:**3Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** 20 Marks **Continuous Assessment:** 20 Marks **End Sem Examination:** 60 Marks
Credit :- 3	
PREREQUISITE(IF ANY):	
1. Manufacturing Process	
2. Engineering Mathematics	
COURSE OBJECTIVE:	
1. To introduce the concepts, principles and framework of contents of Industrial Engineering	
2. To acquaint the students with various productivity enhancement techniques.	
3. To acquaint the students with different aspects of Production Planning and Control and Facility Design.	
4. To introduce the concepts of various cost accounting and financial management practices as applied in industries.	
5. To acquaint the students with different aspects of Human Resource activities and Industrial Safety rules.	
COURSE OUTCOME: Students will be able to	
1. Apply the Industrial Engineering concept in the industrial environment.	
2. Apply different concepts involved in methods study and understanding of work content in different situations.	
3. Understand project work based on the course content	
4. Explain different aspects of work system design and facilities design pertinent to manufacturing industries.	
5. Identify various cost accounting and financial management practices widely applied in industries	
6. Develop capability in integrating knowledge of design along with other aspects of value addition in the conceptualization and manufacturing stage of various products.	
COURSE CONTENTS	**Hrs.**
Unit I: Introduction to Industrial Engineering and Productivity	7
Introduction: Definition and Role of Industrial Engineering, Contribution of Taylor and Gilbreth, Organization : Concept of organization, characteristics of organization, elements of organization, organizational structure, organization charts; Types of organization- formal line, military organization, functional organization, line & staff organization; Introduction to	

management principles, authority and responsibility, span of control, delegation of authority. **Productivity:** Definition of productivity, Productivity of materials, land, building, machine and power. Measurement of productivity: factors affecting the productivity, Productivity Models and Index (Numerical), productivity improvement programmers.	
Unit II: Method Study	7
Work Study: Definition, objective and scope of work-study. Human factors in work-study. Method Study : Definition, objective and scope of method study, activity recording and exam aids, Charts to record moments in shop - operation process charts, flow process charts, travel chart, two handed chart and multiple activity charts. Charts to record movement at work place - principles of motion economy, classification of moments, SIMO chart, and micro motion study. Definition and installation of the improved method, brief concept about synthetic motion studies.(Numerical); Introduction to Value Engineering and Value Analysis;	
Unit III: Work Measurements	7
Work Measurements: Definition, objectives and uses; Work measurement techniques. **Work sampling -** need, confidence levels, sample size determinations, random observation, conducting study with the simple problems. **Time study:** Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating and standard rating, standard performance, scales of rating, factors affecting rate of working, allowances and standard time determination; Introduction to PMTS and MTM. (Numerical), Introduction to MOST.	
Unit IV: Production Planning and Control	7
Introduction: Types of production systems, Need and functions of PPC, Aggregate production planning, Capacity Planning, ERP: Modules, Master Production Schedule; MRP and MRP-II; Forecasting techniques: Causal and time series models, moving average, exponential smoothing, trend and seasonality; (Numerical) **Supply Chain Management:** Concept, Strategies, Supply Chain Network, Push and Pull Systems, Logistics, Distribution; Order Control strategies: MTO, MTA, MTS.	
Unit V: Facility Design	8
Facility Location Factors and Evaluation of Alternate Locations; Types of Plant Layout; Computer Aided Layout Design Techniques; Assembly Line Balancing (Numerical); Material Handling: Principles, Types of Material Handling Devices; Stores Management Inventory Control: Functions, costs, classifications- deterministic and probabilistic inventory models, Concept of EOQ, purchase model without shortages (Numerical); ABC and VED Analysis.	

Unit VI: Engineering Economy, Human Resource and Industrial Safety	8
Engineering Economy and Costing: Elementary Cost Accounting and Methods of Depreciation; Break Even Analysis (Numerical); Introduction to Debit and Credit Note, Financial Statements (Profit and Loss Account and Balance Sheet), Techniques for Evaluation of Capital Investments. Human Resource Development: Functions: Manpower Planning, Recruitment, Selection, Training; Concept of KRA (Key Result Areas); Performance Appraisal (Self, Superior, Peer, 3600). Industrial Safety: Safety Organization, Safety Programme, General Safety Rules.	

Text Books:
1. Martend Telsang, Industrial Engineering , S. Chand Publication.
2. O. P. Khanna, Industrial engineering and management, DhanpatRai publication
3. M Mahajan, Industrial Engineering and Production Management, Dhanpat Rai and Co.
4. Barnes, Motion and time Study design and Measurement of Work, Wiley India

Reference Books:
1. H.B. Maynard, K Jell, Maynard's Industrial Engineering Hand Book, McGraw Hill Education.
2. Zandin K.B., Most Work Measurement Systems, ISBN 0824709535, CRC Press,2002
3. Eilon, Samul, Elements of production planning and control, NewYork Macmillan, 1962
4. Banga and Sharma, Industrial Organisation & Engineering Economics, Khanna publication.

BMEGP305: GENERAL PROFICIENCY-V(Employability Skills and Report Writing)

Teaching Scheme:	**Examination Scheme (Theory)**
Lectures:2Hrs/Week	**Teachers Assessment:** Nil
Tutorials: Nil	**Continuous Assessment:** Nil
	End Sem Examination: Nil

Credit :

Audit Course :G

Prerequisite (If any):

Nil

Course Objective:

1. To make students communicate their knowledge and feelings with a purpose.
2. To perform effectively in one to one and group discussion meetings and in public.
3. To make students more focused for enhancing employability prospects.

Course Outcome: Students will be able to

1. Build up the learners confidence in oral and interpersonal communication by reinforcing the basics of pronunciation
2. Write more accurate and effective technical reports.
3. Create favorable environment for better recruitment.
4. Perform better in group discussion and interview.
5. Learn about Leadership, team building, decision making
6. Employ with competence and understanding an appropriate range of verbal and non-verbal skills in a wide variety of specified situations.

Course Contents	**Hrs**
Module 1: Communication & Interpersonal Skills	02
Contents: Creative and innovative techniques of self-introduction and practice to introduce within 30 secs and to include only relevant points. feedback will be given immediate after performance **Methodology :** Script on Self- Introduction , Practicing of the script	
Module 2: Tips on Aptitude Test Preparations & Cracking	02
Contents : Various areas/sections related to Aptitude Test **Methodology :** Practicing & Discussion	

Module 3: Aptitude Test Practice	040
Contents : Various areas/sections related to Aptitude Test **Methodology :** Practicing & Discussion	
Module 4: CV Making Workshop	02
Contents : Guiding the students to prepare the CV addressing to specific needs of the different fields and use of technical terminologies accordingly **Methodology:** Workshop mode - Students to prepare the resume and immediate correction and suggestions will provide.	
Module 5: Final CV Soft And Hard Copy	02
Contents: Guiding the students to prepare the CV addressing to specific needs of the different fields and use of technical terminologies accordingly. **Methodology :** Workshop mode-Students to prepare the resume and immediate correction and suggestions will provided	
Module 6 : Group Discussion	02
Contents : Students will be given practice of putting their points , initiating, summarizing, concluding and leading the discussion. Do's & Don'ts of GD, Tips & Techniques **Methodology :** Interactive & Discussion Mode	
Module 7: Problem Solving Skills	02
Contents : Example & Exercise Based **Methodology** : Interactive & Discussion Mode	
Module 8 : Presentation Skills	02
Contents : Creating effective power point presentation; using verbal communication to make your point; being prepared for likely queries **Methodology** : Verbal Presentation on a topic to specified audience, with the help of audio-visual aids	
Module 9 : Personal Interview	02
Contents: Guided exercises in proper English writing, with proper use of basic grammar and punctuations etc. Stress on ability to express thoughts in a simple way. **Methodology**: Simulation method with mock practice. Knowledge of Types of Interview questions- Behavioral, Competence , EQ , General and Technical	
Module 10: Personal Interview	02
Contents: One To One Interview with Faculty **Methodology:** Simulation method with mock practice. Knowledge of Types of Interview questions- Behavioral: Competence, EQ, General and Technical.	
Module 11 : Body Language	02

Contents: Creative and innovative techniques of self-introduction and practice to introduce within 30 secs and to include only relevant points. Guidance- Dressing, Stress control and how to enter the interview room. One to one feedback will be given immediate after performance. **Methodology:** Script on Self- Introduction, Practicing of the script, Competition on Self-Introduction.	
Module 12 : Report Writing	4
Contents: Report writing format, Process for report writing, decide the objective, report format and types, collect the facts and data, structure the report, readability,	
Methodology: Review of sample of report, Practicing the report writing	

BMEGP306: General Proficiency –VI (Research Methodology Workshop)	
Teaching Scheme: **Lectures:** 2Hrs/Week **Tutorials:** Nil	**Examination Scheme (Theory)** **Teachers Assessment:** Nil **Continuous Assessment:** Nil **End Sem Examination:** Nil
Credit : Audit Course	
Prerequisite (If any): Nil	
Course Objective:	
1. To orient the students for research in the area of interest.	
2. To provide step wise procedure for carrying out research.	
3. To introduce various mathematical, analytical and simulation tools useful for research.	
4. To learn methods for safeguarding the intellectual property rights.	
Course Outcome: Students are able to	
5. Understand the need and importance of research tools.	
6. Decide type of research	
7. Prepare research report and publish research findings.	
8. Write research proposals, research papers etc.	
9. Analyze, decide the research method.	
Course Contents	**Hrs**
10. Steps in Research methodology. Types of Research methodology and applications	4
11. Use of literature survey, steps and presentations	4
12. Mathematical modeling and its type with example	6
13. Research analysis tools, research setup, experimental tools, and methods of listing observations.	4
14. Research analysis software.	4
15. Research funding, writing of proposals, Research reports and journals, Patent writing/IPR etc.	6

Note: Students are requested to submit following in the form of report

1. 4 Assignments based on syllabus
2. Solve two case studies of Research analysis
3. Should attend Research methodology workshop for 2-5 days and submit report of all in the form of Journal/Report