RAMAIAH
Institute of Technology

CURRICULUM

Outcome Based Education

(Effective from the Academic Year 2023 – 2024)

MECHANICAL ENGINEERING

III & IV SEMESTER B.E.

RAMAIAH INSTITUTE OF TECHNOLOGY
(Autonomous Institute, Affiliated to VTU)
Bangalore – 560054.

About the Institute:

Dr. M. S. Ramaiah a philanthropist, founded 'Gokula Education Foundation' in 1962 with an objective of serving the society. M S Ramaiah Institute of Technology (MSRIT) was established under the aegis of this foundation in the same year, creating a landmark in technical education in India. MSRIT offers 17 UG programs and 11 PG programs. All these programs are approved by AICTE. All eligible UG and PG programs are accredited by National Board of Accreditation (NBA). The institute is accredited with **'A^{+}' grade by NAAC in March 2021** for 5 years. University Grants Commission (UGC) & Visvesvaraya Technological University (VTU) have conferred Autonomous Status to MSRIT for both UG and PG Programs since 2007. The institute has also been conferred autonomous status for Ph.D. program since 2021. The institute is a participant to the Technical Education Quality Improvement Program (TEQIP), an initiative of the Government of India. The institute has 380 competent faculty out of which 67% are doctorates. Some of the distinguished features of MSRIT are: State of the art laboratories, individual computing facility for all faculty members, all research departments active with sponsored funded projects and more than 300 scholars pursuing Ph.D. To promote research culture, the institute has established Centre of Excellence for Imaging Technologies, Centre for Advanced Materials Technology, Centre for Antennas and Radio Frequency systems (CARFS), Center for Cyber Physical Systems, Schneider Centre of Excellence & Centre for Bio and Energy Materials Innovation. **Ramaiah Institute of Technology has obtained "Scimago Institutions Rankings" All India Rank 107 & world ranking 600 for the year 2022.**

The Entrepreneurship Development Cell (EDC) and Section 8 company "Ramaiah Evolute" have been set up on campus to incubate startups. **M S Ramaiah Institute of Technology is recognized by Atal Ranking of Institutions on Innovation Achievements (ARIIA), MoE, Govt. of India.** MSRIT has a strong Placement and Training department with a committed team, a good Mentoring/Proctorial system, a fully equipped Sports department, large air-conditioned library with good collection of book volumes and subscription to International and National Journals. The Digital Library subscribes to online e-journals from Elsevier Science Direct, IEEE, Taylor & Francis, Springer Link, etc. The Institute is a member of DELNET, CMTI and VTU E-Library Consortium. The Institute has a modern auditorium, recording studio, and several hi-tech conference halls with video conferencing facilities. The institute has excellent hostel facilities for boys and girls. MSRIT Alumni have distinguished themselves by occupying high positions in India and abroad and are in touch with the institute through an active Alumni Association.

As per the National Institutional Ranking Framework (NIRF), MoE, Government of India, Ramaiah Institute of Technology has achieved 78th rank among 1314 top Engineering Institutions & 23rd Rank among 105 School of Architecture in India for the year 2023.

About the Department:

The Department of Mechanical Engineering started in the year 1962 with an intake of 40 students. The department has grown strong over the last 52 years and today has an intake of 180 students and 43 teaching staff. All the faculty members are well qualified and possess post graduate degree with 29 doctorates. The department offers four-year degree course and also offers two Master's Degree in Manufacturing Science & Engineering and Computer Integrated Manufacturing, with an intake of 18 each. The Department also offers research program which includes MSc Engineering by research and PhD degree from Visvesvaraya Technological University and at present 11 researchers are pursuing PhD. The department received software grants from Autodesk a leading Computer Aided Design multinational company and has been using them in the curriculum. The faculty members have taken up number of research projects funded by external agencies like DRDO, DST, AICTE and Visvesvaraya Technological University and received funding to the tune of 1 Crore. In view of the golden jubilee celebrations, the department has conducted a national level project exhibition and an International Conference on "Challenges and Opportunities in Mechanical Engineering, Industrial Engineering and Management Studies" – ICCOMIM. Faculty members from the department have published books on different domains of Mechanical Engineering and are recommended by Visvesvaraya Technological University Board of Studies as reference text books.

The students from the department participate both at the national and international competition throughout the year, in the year 2013 – AeRobusta – 4-member student team from the department participated in SAE Aero Design competition and stood 18th position out of 64 teams from all over the world. The team AeRobusta stood FIRST AMONG THE ASIAN COUNTRIES.

Another team from the department also participated in the "Unmanned Air Vehicle System "conducted by U.S. Navy at Maryland, USA. The team secured 5th Place in the technical session out of 36 participating teams from all over the world.

A team of two students also participated in the CAD Design Competition conducted by Autodesk, a CAD multinational company, in association with IIT Madras and secured FIRST PLACE among the teams from all over India with a cash prize of Rs1,20,000 and also received a free Trip to Autodesk University, held at Las Vegas, USA.

VISION OF THE INSTITUTE

To be an Institution of International Eminence, renowned for imparting quality technical education, cutting edge research and innovation to meet global socio-economic needs

MISSION OF THE INSTITUTE

MSRIT shall meet the global socio-economic needs through

1. Imparting quality technical education by nurturing a conducive learning environment through continuous improvement and customization
2. Establishing research clusters in emerging areas in collaboration with globally reputed organizations
3. Establishing innovative skills development, techno-entrepreneurial activities and consultancy for socio-economic needs

QUALITY POLICY

We at M S Ramaiah Institute of Technology strive to deliver comprehensive, continually enhanced, global quality technical and management education through an established Quality Management System complemented by the synergistic interaction of the stake holders concerned

VISION OF THE DEPARTMENT

To be a centre of International repute in Mechanical Engineering and to create qualified human resources needed to meet the demanding challenges in different areas and emerging fields of Mechanical Engineering and allied sciences.

MISSION OF THE DEPARTMENT

To impart quality technical education to meet the growing needs of the profession through conducive and creative learning environment, to produce qualified and skilled human resources, create R&D environment, to be a centre of excellence and to offer post graduate programs in the emerging fields of Mechanical Engineering.

Program Educational Objectives (PEOs):

To produce engineers with sound basic theoretical knowledge along with required practical skills in various specialized fields of Mechanical Engineering.

To inculcate team work capabilities and communication skills among students through co-curricular activities.

To motivate students for higher studies in specialised areas of Mechanical Engineering and explore possible profession in R & D, academic and self-employment opportunities.

To bring in awareness on environmental issues and commitments towards Professional ethics, social responsibilities and need for lifelong learning

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: 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.
PO3: 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.
PO4: 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.
PO5: 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.
PO6: 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.
PO7: 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.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10: 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.

PO11: 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.
PO12: 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.

PSOs of the program offered:

Mechanical Engineering Graduates will be able to:
PSO1: Ability to apply their knowledge in engineering mechanics, materials science, design, thermal engineering, production, management, CAD/CAM, robotics - on an applied basis.
PSO2: Ability to apply the learned principles to the analysis, design, development and implementation to advanced mechanical systems and processes, be prepared to work professionally in Mechanical Engineering domain.

Semester wise Credit Breakdown for B.E Degree Curriculum
Batch 2022-26

Semester / Course Category	First	Second	Third	Fourth	Fifth	Sixth	Seventh	Eighth	Total Credits
Basic Sciences (BSC)	08	08	03	03	--	--	--	--	22
Engineering Sciences (ESC)	08	09	--	--	--	--	--	--	17
Humanities, Social Sciences and Management (HSMC)	02	02	--	--	03	03	--	--	10
Ability Enhancement Course (AEC)	02	01	01	01	01	--	03	--	09
Universal Human Values (UHV)	--	--	02	--	--	--	--	--	02
Professional Core Courses (PCC)	--	--	11	12	12	06	04	--	45
Integrated Professional Core Course (IPCC)	--	--	04	04	03		04	--	15
Professional Elective Courses (PEC)	--	--	--	--	03	06	03	--	12
Institutional Open Elective Courses (IOE)	--	--	--	--	--	03	03	--	06
Internship (INT)	--	--	--	Yes	--	--	--	05	05
Mini Project / Project Work (PW)	--	--	--	--	--	04	03	10	17
Non Credit Mandatory Courses (NCMC)	--	--	Yes	--	Yes	--	--	Yes	--
Total Credits	20	20	21	20	22	22	20	15	160

SCHEME OF TEACHING FOR THE ACADEMIC YEAR 2023-2024

III SEMESTER B.E. MECHANICAL ENGINEERING

B.E. in Mechanical Engineering

Scheme of Teaching and Examination 2023-24

(Effective from the academic year 2022-23)

III SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	ME31	Integral Transforms and Applications	Mathematics	BSC	2	1	0	3	4
2	ME32	Manufacturing Process I	Mechanical	IPCC	3	0	1	4	5
3	ME33	Basic Thermodynamics	Mechanical	PCC	2	1	0	3	4
4	ME34	Mechanics of Materials	Mechanical	PCC	2	1	0	3	4
5	ME35	Material Science & Metallurgy	Mechanical	PCC	3	0	0	3	3
6	MEL36	Materials Testing Laboratory	Mechanical	PCC	0	0	1	1	2
7	MEL37	Computer Aided Machine Drawing	Mechanical	PCC	0	0	1	1	2
8	UHV38	Universal Human Value Course	Mechanical	UHV	2	0	0	2	2
9	MEAEC39	Ability Enhancement Course- III	Humanities	AEC	1	0	0	1	1
				Total	15	3	3	**21**	**27**
11	PE83	Physical Education		NCMC	All students have to register compulsorily for any one of the courses with the concerned coordinator (Yoga Teacher/ Physical Education Director/ NSS Coordinator) in the beginning of the III semester. Attending the registered course from III to VIII semesters. Qualifying is mandatory for the award of the degree.				
	YO83	Yoga							
	NS83	NSS							
12	AM31	Additional Mathematics - I *****		NCMC	0	0	0	0	3

Ability Enhancement Course- III **

Nomenclature: BSC: Basic Science Course**, IPCC:** Integrated Professional Core Course**, PCC:** Professional Core Course**, HSMC:** Humanity and Social Science & Management Courses**, AEC–**Ability Enhancement Courses**, UHV:** Universal Human Value Course, **NCMC**: Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

The Non Credit Mandatory Course, Physical Education (Sport and Athletics)/Yoga/National Service Scheme (NSS):

1. Student shall select any one of the NCMC's namely, Physical Education (Sport and Athletics)/Yoga/ NSS prescribed for VIII semesters and shall attend the course from the III semesters and upto end of VIII semesters to complete all the formalities of the course and appear for the SEE. Marks scored in SEE shall be included in the VIII semester grade card.
2. The above mentioned NCMC's shall not be considered for vertical progression as well as for the calculation of SGPA/CGPA but completion of the courses shall be mandatory for the award of degree.
3. SEE marks will be allotted by the concerned course teacher based on attendance and performance in the practice sessions/field in the ratio of 50:50. Maximum CIE marks are 50. SEE should be awarded by the course teacher every semester (III to VIII) for 50 marks and marks scored by the student are scaled down to 50 in the VIII semester.
4. The students who take a course on Physical Education and Yoga, he/she has to take up the semester end practical examination prescribed for 100 marks. The students who opt for NSS course have to submit report and attend viva-voce examination. The marks of the report shall be 50 marks and for the presentation/viva-voce 50 marks. SEE scale down to 50 marks.
5. In case, any student fails to secure the minimum 40% of the prescribed marks, he/she shall be deemed to have secured **'F'** grade.

***Lateral Entry Students:**

The Non-Credit Mandatory Course, Inter/Intra Institutional Internship: All the students admitted under the lateral entry category shall have to undergo a mandatory summer Internship of 02 weeks which is an NCMC course, during the intervening vacation of the III and IV semesters. Summer Internship shall include Inter / Intra Institutional activities. A Viva-voce examination shall be conducted during the IV semester. The internship shall

be considered as a head of passing and shall be considered for vertical progression and for the award of the degree. Those, who do not take up / complete the internship shall be declared fail and shall have to complete during subsequent examination after satisfying the internship requirements during subsequent semesters.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics I is prescribed for III Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other III semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured **'F'** grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics I shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

SCHEME OF TEACHING FOR THE ACADEMIC YEAR 2023-2024

IV SEMESTER B.E. MECHANICAL ENGINEERING

B.E. in Mechanical Engineering

Scheme of Teaching and Examination 2023-24

(Effective from the academic year 2022-23)

IV SEMESTER

Sl. No.	Subject Code	Subject	Teaching Department	Category	Credits				Total contact hours /week
					L	T	P	Total	
1	ME41	Numerical methods, complex analysis and probability models	Mathematics	BSC	2	1	0	3	4
2	ME42	Machine Design-I	Mechanical	IPCC	3	0	1	4	4
3	ME43	Applied Thermodynamics	Mechanical	PCC	2	1	0	3	4
4	ME44	Mechanical Measurements & Metrology	Mechanical	PCC	3	0	0	3	3
5	ME45	Manufacturing Process II	Mechanical	PCC	3	0	0	3	3
6	MEL46	Applied Thermodynamics Laboratory	Mechanical	PCC	0	0	1	1	2
7	MEL47	Mechanical Measurements & Metrology Laboratory	Mechanical	PCC	0	0	1	1	2
8	MEL48	Manufacturing Process Laboratory	Mechanical	PCC	0	0	1	1	2
09	MEAEC49	Ability Enhancement Course- IV	Mechanical	AEC	1	0	0	1	1
10	INT410	Intra/Institute Internship	Mechanical	NCMC	0	0	0	0	0
				Total				**20**	**25**
11	AM41	Additional Mathematics II *****	Mathematics	NCMC	0	0	0	0	-

Ability Enhancement Course – IV ******

Nomenclature: BSC: Basic Science Course**, IPCC:** Integrated Professional Core Course**, PCC:** Professional Core Course**, INT –**Internship**, HSMC:** Humanity and Social Science & Management Courses**, AEC–**Ability Enhancement Courses, **NCMC**: Non-credit Mandatory Course

L –Lecture, T – Tutorial, P- Practical/ Drawing

Integrated Professional Core Course (IPCC): Refers to Professional Theory Core Course Integrated with practical of the same course. Credit for IPCC is 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 1). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated only by CIE (no SEE). However, questions from the practical part of IPCC can be included in the SEE question paper.

*** Lateral Entry Students:**

The Non-Credit Mandatory Course, Additional Mathematics II is prescribed for IV Semester Lateral Entry Diploma students admitted to III Semester of BE Program. The student shall register for this course along with other IV semester courses. The students shall attend classes for the course during the semester and complete all formalities of attendance and CIE. In case, any student fails to secure the minimum 40% of the prescribed CIE marks, he/she shall be deemed to have secured an F grade. In such a case, the student has to fulfill the requirements during subsequent semester/s to appear for CIE. Incase student fails to register for the said course/ falls short of attendance, he/she will repeat the course whenever it is offered next. Additional Mathematics II shall have CIE component only and no SEE component. This Course shall not be considered for vertical progression, but completion of the course shall be mandatory for the award of the degree.

AICTE Activity Points to be earned by students admitted to BE program (For more details refer to Chapter 6, AICTE, Activity Point Program, Model Internship Guidelines):

Every regular student, who is admitted to the 4-year degree program, is required to earn 100 activity points in addition to the total credits earned for the program. Students entering 4 years' degree program through lateral entry are required to earn 75 activity points in addition to the total credits earned for the program. The activity points earned by the student shall be reflected on the students VIII semester grade card. The activities to earn the points can be spread over the duration of the course. However, minimum prescribed duration should be fulfilled. Activity points (non-credit) have no effect on SGPA/CGPA and shall not be considered for vertical progression. Incase student fail to earn the prescribed activity points; VIII semester grade card shall be issued only after earning the required activity Points. Students shall be eligible for the award of degree only after the release of the VIII semester grade card.

III SEMESTER

INTEGRAL TRANSFORMS AND COMPLEX ANALYSIS	
Course Code: ME31	**Credits: 2:1:0**
Pre – requisites: Calculus	**Contact Hours: 28L+14T**
Course Coordinator: Dr G Neeraja, Dr Vijay Kumar & Dr A Sreevallabha Reddy	

Course Content

Unit I

Laplace Transforms: Definition, transforms of elementary functions, properties of Laplace transforms, existence conditions, transform of derivatives, integrals, multiplication by t^n, division by t, evaluation of integrals by Laplace transforms. Transform of and Periodic function.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation,Videos
- Links: https://nptel.ac.in/courses/111/105/111105134/
- Impart us recording: https://a.impartus.com/ilc/#/course/119640/593

Unit II

Application of Laplace Transforms: Unit–step function, Unit–impulse function. Inverse transforms, Convolution Theorem, Solution of linear differential equations and Simultaneous linear differential equations using Laplace transforms. Engineering applications.

- Pedagogy/Coursedeliverytools: Chalkand talk, PowerPoint Presentation,Videos
- Links: https://nptel.ac.in/courses/111/105/111105134/
- impart us recording: https://a.impartus.com/ilc/#/course/119640/593

Unit III

Fourier Series: Trigonometric Fourier series and its convergence, Periodic functions, Dirichlet conditions, Fourier series of periodic functions, Fourier series of even and odd functions, half range Fourier series, Practical harmonic analysis.

- Pedagogy/Course delivery tools: Chalkand talk, PowerPoint Presentation,Videos
- Links:https://nptel.ac.in/courses/111/105/111105134/
- impart us recording: https://a.impartus.com/ilc/#/course/619570/1030

Unit IV

Fourier Transforms: Infinite Fourier transform, Infinite Fourier sine and cosine transforms, properties, Inverse transforms, Convolution theorem, Parseval's identities (statements only).

- Pedagogy/Course delivery tools: Chalkand talk, PowerPoint Presentation,Videos
- Links:https://nptel.ac.in/courses/111/108/111108066/
- impart us recording: https://a.impartus.com/ilc/#/course/119635/593

Unit V

Applications of Fourier series and Fourier transform: Solution of one dimensional wave equation, one dimensional heat equation and two dimensional Laplace equation using Fourier series, Solution of one dimensional wave equation and one dimensional heat equation using Fourier Transforms.

- Pedagogy/Course delivery tools: Chalkand talk, PowerPoint Presentation,Videos
- Links:https://nptel.ac.in/courses/111/101/111101153/
- impart us recording: https://a.impartus.com/ilc/#/course/290290/703
  https://a.impartus.com/ilc/#/course/171951/703

Text Books:

1. **Erwin Kreyszig** –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015
2. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.

Reference Books:

1. **George B. Thomas, Maurice D. Weir, Joel R. Hass** - Thomas' Calculus, Pearson, 13th edition, 2014.
2. **Peter V. O' Neil** – Advanced Engineering Mathematics, Thomson Brooks/Cole,
3. 7th edition, 2011.
4. **Glyn James & Phil Dyke** – Advanced Modern Engineering Mathematics, Pearson Education,5th edition, 2018.
5. **Srimanta Pal & Subobh C Bhunia -** Engineering Mathematics, Oxford University Press, 3rd Reprint, 2016.

Course Outcomes (COs):

At the end of the course the student will be able to

1. Evaluate Laplace Transforms of given function and understand their Properties **(PO–1,2 & PSO–1, 2).**
2. Obtain inverse Laplace transforms and use the same to solve system of ODE's **(PO–1,2 & PSO–1, 2).**
3. Construct the Fourier series expansion of a function/tabulated data **(PO–1,2 & PSO–1, 2).**
4. Evaluate Fourier transforms and use Z-transforms to solve difference equations **(PO–1,2 & PSO–1, 2).**
5. Find the solution of PDE's analytically using Fourier techniques. **(PO–1,2 & PSO–1, 2).**

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2,CO3
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Quiz	10	CO1,CO2,CO3
Assignment	10	CO1,CO2,CO3,CO4,CO5
Semester End Examination (SEE)		
Course end examination(Answer any one question from each unit – Internal choice)	100	CO1,CO2,CO3,CO4,CO5

MANUFACTURING PROCESS -I	
Course Code: ME32	**Credits: 3:0:1**
Pre – requisites: Nil	**Contact Hours: 42L+14P**
Course Coordinator: BHARATH M R	

Course Content

Unit I

Introduction to Casting - Casting, Steps involved in casting, Advantages and limitations of casting.
Pattern Making - Types of pattern, allowance.
Moulding Sand - Ingredients of molding sands and its properties. Core sand ingredients. Core Making.
Gating System – Definition, elements of gating system, functions and gating ratio
Molding Methods - Green molding, hand and machine molding. Jolt-Squeeze Machine and Sand slingers. Shell Molding and investment casting.
Melting Furnaces - Classification of Furnaces, Oil fired furnaces, Electric furnaces Arc, resistance and Induction furnaces.
Cleaning and Inspection of Castings - fettling operations, Defects in Casting.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Lab component/ Practical topics: Preparation of Mould cavity using single piece and split piece pattern, Clay Content Test and moisture content test,
- Links: Casting Process-https://www.youtube.com/watch?v=2CIcvB72dmk
- Links: Furnaces for casting-https://www.youtube.com/watch?v=GUctNyh1FR0

Unit II

Introduction to forming - Forming, classification, Advantages, limitations and applications.
Forging - Classification of forging processes, forging machines & equipment, Die-design parameters, Material flow lines in forging, forging defects.
Drawing - Steps involved in wire drawing, drawing die details, Types of tube drawing processes.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation
- Lab component/ Practical topics: Forging of a mild steel component into different shapes
- Links: Forging https://www.youtube.com/watch?v=r5FXtKoThj4
- Links: Drawing https://www.youtube.com/watch?v=rL9iEgeNCro

Unit III

Extrusion - Types of extrusion processes, Special type of extrusion processes, Metal flow pattern in extrusion, Defects in extruded products.
Rolling - Classification. Types of rolling mills, Metal flow pattern in rolling, Defects in rolled products.
Sheet metal forming - Introduction, Material used, Operations, Punches and Dies used.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation
- Lab component/Practical topics: Permeability Test, Sand Hardness test, Sheet metal forming demo
- Links: Extrusion https://www.youtube.com/watch?v=wuVnnfEocks
- Links: Rolling https://www.youtube.com/watch?v=MLRpwAEuVjI
- Links: Sheet Metal Work https://www.youtube.com/watch?v=LTZ4K3NoIr0

Unit IV

Welding - Introduction, classification. Principles, TIG, MIG, SAW, FCAW, Electro slag welding. **Other Welding Processes** - Principle and applications of resistance welding (Spot), Thermit Welding, Friction welding, Explosive Welding, Ultrasonic welding, Laser Welding Processes.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation
- Lab component/ Practical topics: Electric Arc Welding Demo, Sieve analysis
- Links: Welding https://www.youtube.com/watch?v=jQddm3YONNc
- Links: Special Welding Processes https://www.youtube.com/watch?v=TlhGTSDfQxc

Unit V

Destructive Testing – Tensile test, compressive test, fatigue test, bending test, shear strength test, corrosion test.

Introduction to NDT - Nondestructive Testing, X –Ray radiography, dye penetrant test, Ultrasonic test, Magnetic particle Inspection, Eddy Current testing, Holography methods of Inspection.

NDT Techniques- Penetrant test, Magnetic particle Inspection, Ultrasonic test, Eddy Current testing, Holography methods of Inspection, X –Ray radiography.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation
- Lab component/Practical topics:-Sand Test Using UTM
- Links: Destructive Testing- https://www.youtube.com/playlist?list=PL7Le4pic01uIA-3SFGhMsrB3_wBG-8eru
- Links: NDT-https://www.youtube.com/watch?v=0VwKaHNvxLk

Text Books:

1. Manufacturing Technology : Foundry Forming and Welding, P.N.Rao 2 Edition TMH,2003
2. Manufacturing Technology", Serope Kalpakjain, Steuen.R.Sechmid, Pearson Education Asia, 5th Ed. 2006..
3. Mechanical metallurgy by George E. Dieter Tata McGraw - Hill publication. 3rd edition 2013.
4. Manufacturing Processes for Engineering materials by Serope kalpakajiam and
5. Steven R Schimid, Pearson education, 4th edition 2007.
6. Manufacturing Process-III, By Dr.Radha Krishna, Sudha Publications.2010. 2nd.

Reference Books:

1. Materials and Process of Manufacture, Roy A Lindberg, PHI Publications, 2 edition 2006.
2. Principal of Metal Casting, Heine, Loper, Philip Rosenthal, TMH. 1 21st edition2005.
3. Materials & Processes in Manufacturing by Paul Degarmo E, Jt Black, Ronald A Kohser. Prentice -hall of India, 8th edition 2006

4. Manufacturing Science, by Asok Kumar Mallik & Amitabha Ghosh – Affiliated East-west Press Pvt Ltd, 2nd edition 2012.
5. Fundamentals of Metal forming processes, B.L. Juneja, First edition New age International, 2007.
6. Theory of Plasticity and Metal forming Processes, Dr. Ssadhu singh, Khanna Publishers, 3rd edition 2003
7. Metal Forming processes, by G.R Nagpal, Khanna Publishers, Second edition, 2005.

Web links and video lectures (e-Resources):

1) https://nptel.ac.in/courses/112107083
2) https://nptel.ac.in/courses/112107250
3) https://nptel.ac.in/courses/112107089
4) https://www.youtube.com/watch?v=DK1dItnI8mM

Course Outcomes (COs):

At the end of the course, students will be able to

1. 1.List and define the manufacturing processes such as casting, forming, joining processes. (PO1, PO4, PO5, PO6, PO7, PO10, PO11, PO12, PSO1 & PSO2)
2. Classify and compare different manufacturing processes. (PO1, PO2, PO3, PO4, PO5, PO7, PO10, PO11, PO12, PSO1 & PSO2)
3. 3.Select suitable manufacturing processes for said applications (PO1, PO2, PO3, PO4, PO5, PO7, PO10, PO11, PO12, PSO1 & PSO2)
4. 4.Illustrate with sketches and arrive at the working principle of said manufacturing processes and inspection methods employed. (PO1, PO2, PO3, PO4, PO5, PO7, PO10, PO11, PO12, PSO1 & PSO2)
5. 5.Justify the importance of examining a manufactured product before being put into service. (PO1, PO2, PO3, PO4, PO5, PO7, PO10, PO11, PO12, PSO1 & PSO2)

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1, CO-2, CO-3, CO-4 & CO-5
Internal test-II	30	CO-1, CO-2, CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Experiment Conduction and Record Writing	10	CO-1, CO-2, CO-3, CO-4 & CO-5
Viva-Voce and Assignment writing	10	CO-1, CO-2, CO-3, CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

BASIC THERMODYNAMICS	
Course Code: ME33	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 28L +14T**
Course Coordinator: Mr. ASHOK KUMAR K	

Course Content

Unit I

Fundamental concepts and definitions: Thermodynamics; definition and scope, microscopic and macroscopic approaches, types of system, thermodynamic properties, thermodynamic state, path and process, path and point function, quasistatic process, cyclic and non cyclic processes, thermodynamic equilibrium, Zeroth law of thermodynamics,

Work and heat, Thermodynamic definition of work, expressions for displacement work in various processes through p v diagrams, heat definition, unit and sign convention, equivalence of heat and work

- Pedagogy/Course delivery tools:-Chalk and talk, animated videos
- Lab component/ Practical topics:-ATD lab
- Links: Thermodynamic properties-https://www.youtube.com/watch?v=iUEjQQtrT50

Unit II

First Law of Thermodynamics: Statement of first law of thermodynamics, extension of first law to non cyclic processes, energy, energy as a property of the system, enthalpy, specific heat at constant volume and constant pressure, Steady state, steady flow energy equation, some important applications

Second Law of thermodynamics: Thermal reservoir, Heat engine, schematic representation and efficiency, reversed heat engine, schematic representation and coefficient of performance, Kelvin-Planck statement and Clasius' statement of second law of thermodynamics, PMMI and PMMII, equivalence of the two statements

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Lab component/ Practical topics:-ATD lab
- Links: First law of TD -https://www.youtube.com/watch?v=ZvuhbYlMU_U
- Links: Kelvin plank and Clasius statements-https://www.youtube.com/watch?v=L30WZ4PXp_c

Unit III

Carnot cycle : Reversible and irreversible processes, factors that make a process irreversible, reversible heat engine, carnot cycle, carnot principle

Entropy: Clasius inequality; statement, proof, application to a reversible cycle, entropy a property, entropy definition, principle of increase of entropy, calculation of entropy using T- dS relations, entropy as a coordinate.

- Pedagogy/ Course delivery tools:-Chalk and talk, animated videos
- Lab component/ Practical topics:-ATD lab
- Links: Carnot cycles-https://www.youtube.com/watch?v=7W-eX3yx1gM
- Links: Entropy -https://www.youtube.com/watch?v=umV67dqWVKw

Unit IV

Pure substance: P-T and P-V diagrams, triple point and critical points, subcooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of a pure substance with water as example. Enthalpy of change of phase (Latent heat), dryness fraction, T-S and h-s diagrams, representation of various processes on these diagrams, Steam tables and its use
Combustion thermodynamics: Theoretical (Stoichiometric) air for combustion of fuels, excess air, mass balance, actual combustion. Exhaust gas analysis. A/F ratio, energy balance for a chemical reaction, enthalpy of formation, enthalpy and internal energy of combustion, combustion efficiency. Numerical problems

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Lab component/ Practical topics:-ATD lab
- Links: Pure substance-https://www.youtube.com/watch?v=OHhnm2p5G3o
- Links: Combustion thermodynamics-https://www.youtube.com/watch?v=uvR7zNJ1KoI

Unit V

Ideal and Real gases: Introduction, Vander wall's equation, Vander wall's constants in terms of critical properties, law of corresponding states, compressibility factor, compressibility chart, ideal gas, equation of state, internal energy and enthalpy as functions of temperature only, universal and particular gas constants, ideal gas mixture; Dalton's law of additive pressure, Amagat's law of additive volumes, evaluation of properties, analysis of various processes.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics:-Heat transfer lab- Air conditioning test rig
- Links: Ideal gases-https://www.youtube.com/watch?v=1yymkQQOPAo
- Links: Real gases-https://www.youtube.com/watch?v=sTufBlv9e20

Text Books:

1. Fundamental of Classical Thermodynamics- G J Van Wylen and R E Sonntag, Wiley Eastern. 1st dition, 2002
2. Basic and Applied Thermodynamics- P K Nag, Tata McGrawHill, 3rd edition., 2002

Reference Books:

1. Thermodynamics an engineering approach-Yunus A Cenegal and Michael A Boles. Tata McGraw hill Pub. 1st edition 2002
2. Engineering Thermodynamics- R K Rajput, Laxmi publications Pvt Ltd, 3rd Edition., 2007

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=9GMBpZZtjXM&list=PLD8E646BAB3366BC8
2. https://www.youtube.com/watch?v=fdW7HmgEPgA
3. https://www.youtube.com/watch?v=3btbPs5wvNw
4. https://www.youtube.com/watch?v=G-L81TfsqKI
5. https://www.youtube.com/watch?v=WomsUEVVtCk

Course Outcomes (COs):

Students will be able to

1. **Analyze** problems on temperature scale, work and heat, understand principles of thermodynamics in engineering applications. [PO1,PO2,PO3,PO4,PO5, PO12, PSO1 & PSO2]
2. **Solve** problems associated with various thermodynamic processes and calculate properties of the thermodynamic system during execution of process or cycle. [PO1,PO2,PO3,PO4,PO5, PSO1 & PSO2]
3. **Apply** the concept of entropy principle to calculate entropy during the execution of a process or cycle and demonstrate the concept of availability and irreversibility[PO1,PO2,PO3,PO4, PSO1 & PSO2]
4. **Analyze** the behavior of working fluid in thermodynamic system during a process or cycle and solve the problems related to combustion thermodynamics, Ideal and Real gases[PO1,PO2,PO3,PO4,PO7, PO12, PSO1 & PSO2]
5. **Develop** a capability to apply principles of thermodynamics to solve numerical and design problems of engineering devices and provide useful solutions. [PO1,PO2,PO3,PO4,PO5,PO7, PO12, PSO1 & PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

MECHANICS OF MATERIALS	
Course Code: ME34	**Credits: 2:1:0**
Pre – requisites: Nil	**Contact Hours: 28L +14T**
Course Coordinator: Dr. ARUNA KUMAR P C	

Course Content

Unit I

Simple stress and strain: Introduction, stress, strain, mechanical properties of materials, linear elasticity, Hook's law and poisons ratio, stress – strain relation – behavior in tension for mild steel and non ferrous metals. Extension / shortening of a bar, bars with cross sections varying in steps, bars with continuously varying cross sections (circular and rectangular) Elongation due to self weight, principle of super position,

Volumetric strain: expression for volumetric strain, Stress in composite section, Elastic constants, simple shear stress, shear strain.

Temperature stresses (including compound bars)

- Pedagogy/Course delivery tools:-Chalk and talk, animated videos
- Lab component/Practical topics:-Tensile and compression tests
- Links: Simple stress and strain-https://www.youtube.com/watch?v=B9lyGZzb_6M
- Links: volumetric strain-https://www.youtube.com/watch?v=w8IZOi0n3Mk
- Links: temperature stresses-https://www.youtube.com/watch?v=dzeCpS7xTno

Unit II

Compound stresses: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress.

Thick and thin cylinders: stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume) , Thick cylinders subjected to internal and external pressures (Lame's equation) (Compound cylinders not included)

- Pedagogy/Course delivery tools:-Chalk and talk, animated videos
- Lab component/Practical topics:-Tensile, compression tests
- Links: compound stresses-https://www.youtube.com/watch?v=bY9PW66AUQQ
- Links: Thick and thin cylinders-https://www.youtube.com/watch?v=y2dbpuBYPjU

Unit III

Bending moment and shear force in beams: Introduction, rate of loading, sign conventions, relationship between shear force and bending moments, shear force and bending moment diagrams for different beams subjected to concentrated loads, uniform distributed load (UDL)and couple for different types of beams.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Lab component/ Practical topics:-Bending test
- Links: SFD & BMD-https://www.youtube.com/watch?v=pMUG_2CoP4I
- Links: SFD & BMD-https://www.youtube.com/watch?v=arr_xwk-JsM

Unit IV

Bending stresses in beams: Introduction, theory of simple bending. Assumptions in simple bending, relationship between bending stresses and radius of curvature, relationship between bending moment and radius of curvature, moment carrying capacity of a section.

Shear stresses in beams: Shear stress across rectangular, I Section & circular sections.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Lab component/ Practical topics:-Bending and shear tests
- Links: Bending stresses-https://www.youtube.com/watch?v=EDN9yFr4ehY
- Links: shear stresses-https://www.youtube.com/watch?v=PZJxokhWL3E

Unit V

Deflection of beams: Introduction, differential equation for deflection, equations for deflections, slope and moments, double integration method for cantilever and simply supported beams for point load, UDL. Macaulay's Method.

Torsion of circular shafts: Introduction, pure torsion, assumptions, derivation of torsional equations, polar modulus, torsional rigidity / stiffness of shafts, power transmitted by solid and hollow circular shafts.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics:-Torsion test
- Links: Deflection of beams-https://www.youtube.com/watch?v=Qt-lls7jV5I
- Links: torsion of circular shafts-https://www.youtube.com/watch?v=OBTZAYqHSY8

Text Books:

1. Mechanics of materials, **S.I** units, Ferdinand Beer & Russell Johnston, TATA McGrawHill – 1st edition 2003
2. Strength of materials, W.A Nash , Schaums outline series , 4th edition – 2007

Reference Books:

1. Mechanics of materials, K.V. Rao, G.C. Raju, 1st edition, 2007
2. Strength of materials, Ramamrutham, 5th edition 2006.
3. Mechanics of materials, James. M Gere. Thomson, 5th edition, 2004

Web links and video lectures (e-Resources):

1) https://www.youtube.com/watch?v=DzyIEz3dKXQ
2) https://www.youtube.com/watch?v=2PM4mT3nKwk
3) https://www.youtube.com/watch?v=--d22GM6wMQ
4) https://www.youtube.com/watch?v=sP34uzn7diA
5) https://www.youtube.com/watch?v=r0YA2Nr6bxQ

Course Outcomes (COs):

1. Develop an understanding of behavior of components when subjected to various type of loading.
2. Compile fundamentals of MOM for engineering applications.
3. Develop ability to identify a problem and apply the fundamental concepts of MOM.
4. Develop competence to design and analyze problems of engineering involving design of components subjected to stresses and strains.
5. Demonstrate ability to have the competence for undergoing knowledge up gradation in the
6. Advanced subjects of Machine Design, FEM,Theory of Elasticity and Vibrations.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Surprise test	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

MATERIAL SCIENCE & METALLURGY	
Course Code: ME35	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. RAJENDRA P	

Course Content

Unit I

Structure of Crystalline solids: Fundamental concepts of Unit cell, space lattice, Bravais space lattices, Coordination Number and Atomic Packing Factor for different cubic and HCP structures. Crystal imperfections: Classification, point, line, surface & volume defects,

Diffusion: Diffusion mechanisms, and factors affecting diffusion, Fick's laws of diffusion, Stress vs. Strain diagrams to show ductile & brittle behavior of metals.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Unit Cells - Number of Atoms in a Unit Cell-https://www.youtube.com/watch?v=qAeaHYSX0hs
- Links: Crystal imperfections-https://www.youtube.com/watch?v=HuMQqSj8zdo

Unit II

Mechanical Behavior of Materials: Linear & non-linear elastic properties, Concept of true stress and true strain. Plastic deformation of metals by Slip and Twinning, strain hardening and strengthening mechanisms in crystalline materials.

Fatigue: Definition of Fatigue, types of fatigue loading, mechanism of fatigue failure, fatigue properties, S-N diagram, factors affecting fatigue strength

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Plastic deformation of metals by Slip and Twinning-https://www.youtube.com/watch?v=LifL-DNdtpU
- Links: Fatigue cycles-https://www.youtube.com/watch?v=OlexdbPETPw

Unit III

Fracture and Creep Fracture, types, transition from ductile to brittle fracture. Creep - Definition, three stages of creep, creep properties, Creep mechanisms

Solidification, **Solid solutions & Phase diagrams:** Nucleation, homogeneous & heterogeneous nucleation, crystal growth, cast metal structures. Solid solutions, Types, Rules governing the formation of solids solutions.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Creep-https://www.youtube.com/watch?v=zH05sDLKMoU
- Links: Nucleation-https://www.youtube.com/watch?v=Od5yT-l7aK4

Unit IV

Phase diagrams: Basic terms, phase rule, Lever rule, cooling curves, construction of phase diagrams, Types of phase diagrams, interpretation of equilibrium diagrams - eutectic, eutectoid, peritectic & peritectoid, problems in phase diagrams.

Iron carbon equilibrium diagram& TTT diagram: Equilibrium phases in the Fe-C system, Microstructure of slowly cooled steels, TTT diagram, construction of TTT diagram, Superimposing cooling curves on TTT diagram, non-equilibrium phases in Fe-C system,

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Phase Diagrams-https://www.youtube.com/watch?v=7hmF3WoQkTg
- Links: Iron-carbon equilibrium diagram-https://www.youtube.com/watch?v=Izhv87GIL4U

Unit V

Heat Treatment: Annealing and its types, Normalizing, Hardening, Tempering, Martempering, Austempering, Surface hardening like case hardening, carburizing, cyaniding, nitriding, Induction hardening, Age hardening taking the example of duralumin.

Alloys and composites: Ferrous alloys and its classification, Important Aluminum, Magnesium, Titanium and Copper alloys. Composites materials and its classification, advantages, and applications of composites.

- Pedagogy/Course delivery tools:-Chalk and talk, Power point presentation, animated videos
- Links: Heat Treatment types-https://www.youtube.com/watch?v=8H3TiU-Uks8
- Links: Composite Materials-https://www.youtube.com/watch?v=wrnuljdwpjo

Text Books:

1. Introduction to Material Science for Engineering, 6th edition, James F.Shackel Ford, Pearson, Prentice Hall, New Jersey, 2006.
2. Physical Metallurgy, Principles & Practices, V.Raghavan, PHI, 2nd edition, 2006,New Delhi.

Reference Books:

1. Materials Science & Engineering- An Introduction, William D.Callister Jr., Wiley, India Pvt. Ltd., 6th edition, 2006, New Delhi.
2. Essentials of Materials for Science And Engineering, Donald R. Askeland, Pradeep P.Phule Thomson-Engineering, 2nd edition 2006
3. Foundation of Material Science and Engineering, Smith, 3rdEdition, McGraw ill,1997 edition.

Course Outcomes (COs):

At the end of the course, students will be able to

1. **Discuss** the concept of crystal structure, crystal imperfections and Mechanical properties in metals. [PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]
2. **Explain** the concept of true stress and true strain, plastic deformation and various modes of failure. [PO1,PO2,PO4,PO7,PO8,PO11 & PSO2]
3. **Summarize** the solidification of metals and alloys and classify draw phase diagrams. [PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]
4. **Distinguish** between various heat treatment processes for metals and alloys [PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]
5. **Examine** composite manufacturing processes and list advantages and applications of engineering and composite materials[PO1,PO2,PO4,PO7,PO8,PO11, PSO1 & PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Surprise test	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

MATERIALS TESTING LABORATORY	
Course Code: MEL36	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. GIRISH V KULKARNI	

Course Content

Unit I

PART - A

Conduct the following experiments

1. Rockwell Hardness Test
2. Brinell Hardness Test
3. Vickers Hardness Test (Demo)
4. Charpy Impact Test
5. Izod impact test
6. Study of Metallurgical Microscope – Calibration of eyepiece reticle
7. Microstructure Examination

PART - B

Conduct the following experiments

1. Tensile Test
2. Compression Test
3. Shear Test
4. Bending Test
5. Torsion Test
6. Wear Test
7. Fatigue Test(Demo)

Reference Books:

1. Mechanics of materials James M. Gere, Barry J. Goodno Publication CL Engineering; 8 edition, 2012. [PO1,PO3,PO7,PO8,PO10, PO12,PSO1 &PSO2]
2. Materials Science & Engineering- An Introduction, William D. Callister Jr. Publication Wiley, 9 edition , 2013[PO1,PO3,PO7,PO8,PO10, PO12,PSO1 &PSO2]
3. Materials testing laboratory manual, Department of Mechanical Engineering, MSRIT[PO1,PO3,PO7,PO8,PO10, PO12,PSO1 &PSO2]

WEB LINKS AND VIDEO LECTURES:

1. https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test/videos.html
2. https://sm-nitk.vlabs.ac.in/exp/brinell-hardness-test/videos.html
3. https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test/videos.html
4. https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/videos.html
5. https://sm-nitk.vlabs.ac.in/exp/izod-impact-test/videos.html
6. https://sm-nitk.vlabs.ac.in/exp/tensile-test-mild-steel/videos.html
7. https://sm-nitk.vlabs.ac.in/exp/compression-test-mild-steel/videos.html

8. https://sm-nitk.vlabs.ac.in/exp/direct-shear-test-steel-rod/videos.html
9. https://sm-nitk.vlabs.ac.in/exp/bending-test-mild-steel/videos.html
10. https://sm-nitk.vlabs.ac.in/exp/torsion-test-mild-steel/videos.html

Course Outcomes (COs):

At the end of the course, the student will be able to

1. **Demonstrate** the knowledge and the skills required with respect to the procedure conduction and analysing the results with respect to Tensile, Shear and Compression, Torsion Test, Bending Test etc.
2. **Knowledge** of various heat treatment processes, hardness test, and wear test.
3. Microstructures examination and identification of metals.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE) : 50 Marks		
Assessment Tool	**Marks**	**Course Outcomes addressed**
Weekly evaluation of laboratory journals/ reports after the conduction of every experiment	**30**	**CO-1,CO-2 & CO-3**
Practical Test	**20**	**CO-1,CO-2 & CO-3**
Semester End Examination (SEE):	**50**	**CO-1,CO-2 & CO-3**

COMPUTER AIDED MACHINE DRAWING	
Course Code: MEL37	**Credits: 0:0:1**
Pre – requisites: CAED	**Contact Hours: 14P**
Course Coordinator: Dr. C M RAMESHA	

Course Content

PART A

Systems of dimensioning: Linear, Radial, Angular, Ordinate, Arc length, Baseline and Continued, Concepts of Limits Fits and Tolerance.

3D Modeling and Orthographic Views: Conversion of Pictorial Views into 3D Models and converting 3D Models into Orthographic projections (Drafting) of simple machine parts with and without section, (ISO - Technical Drawings and Specifications) Hidden Lines. (3D CAD Software)

Sections of Solids: Sections of pyramids, Prisms, cubes, Tetrahedron, cones and cylinders resting only on their bases. (No problems on axis inclinations, spheres and hollow solids). True shape of sections. (3D CAD Software)

- Pedagogy/Course delivery tools-Chalk and talk, Powerpoint presentation, Animated videos
- Lab Component / Practical Topics-Machine Components in Machine Shop
- Links-https://www.youtube.com/watch?v=3j2YEuTiAOc
- Links -https://www.youtube.com/watch?v=AzFz8A5HgiQ

PART B

Parametric Modeling: Parametric Modeling of Washer, Base Plate, Bracket and simple machine parts (Sketch Work – Show orthographic views only) with parametric equations. Input based on Excel Sheet. (3D CAD Software)

- Pedagogy/Course delivery tools-Chalk and talk, PowerPoint presentation, Animated videos
- Lab Component / Practical Topics-Creation of 3D CAD Models
- Creation of parametric models
- Links-https://www.youtube.com/watch?v=JvsJf1huMXQ
- Links -https://www.youtube.com/watch?v=SDFjnAsBqLU

PART C

Assembly Drawings – Wheel Assembly, Screw Jack, Plummer Block. (3D CAD Software)

- Pedagogy/Course delivery tools-Chalk and talk, PowerPoint presentation, Animated videos
- Lab Component / Practical Topics-Subassemblies in Machines at Machine Shop
- Links-https://www.youtube.com/watch?v=mSWGCpZW3xg
- https://www.youtube.com/watch?v=b6h_ZiGoLY0

Text Books:

1. Computer Aided Machine Drawing K.R. Gopalakrishna, Subhash Publications, 2nd edition 2012.
2. Computer Aided Machine Drawing, Tryambaka Murthy.

Reference Books:

1. SOLIDWORKS 2021 for Designers, 19th Edition Paperback – 8 February 2021, Publisher : CADCIM Technologies (8 February 2021), Language : English, Paperback : 1040 pages, ISBN-10 : 1640571035, ISBN-13 : 978-1640571037

Course Outcomes (COs):

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

1. Acquire the skills needed to draw the orthographic and sectional views of the solid and develop its lateral surface.
2. Create 3D Models and Present sectional view, orthographic views and Isometric views of the part that can be read by a shop floor engineer.
3. Create and assemble the 3-D part models using a CAD tool and draw the sectional view, orthographic views, and Isometric view of the assembly including the bill of materials, section plane, and ballooning.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	20	CO1, CO2 and CO3
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment, Sketch Work and Printout	30	CO1, CO2 and CO-3
Semester End Examination (SEE): 50 Marks		
Semester End Examination	50	CO1, CO-2, CO-3

Exam Pattern - Answer any ONE out of TWO Questions from PART A, B and C
Part A - 15 Marks ; Part B - 10 Marks ; Part C - 25 Marks ; Total - 50 Marks Duration of Exam: 3Hrs

UNIVERSAL HUMAN VALUES	
Course Code: UHV38	**Credits: 2:0:0**
Pre – requisites: Nil	**Contact Hours: 28L**
Course Coordinator: Dr.R.Kumar	

Course Content

Unit I

Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? – it's content and process; 'Natural Acceptance' and Experiential Validation- as the mechanism for self-exploration.
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations
4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority.
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario.
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Lab component / Practical Topics: Survey/polls for self-exploration
- Links: Holistic Development and Role of Education: https://youtu.be/sGZtTPe-lhQ

Unit II

Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human beings as a co-existence of the sentient 'I' and the material 'Body'.
2. Understanding the needs of Self ('I') and 'Body' - Sukh and Suvidha.
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer).
4. Understanding the characteristics and activities of 'I' and harmony in 'I'.
5. Understanding the harmony of I with the Body: Sanyam and Swasthya; correct appraisal of Physical needs, the meaning of Prosperity in detail.
6. Programs to ensure Sanyam and Swasthya - Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Lab component / Practical Topics: Survey and polls for self-exploration
- Links: Harmony in Human Being- Self and Body: https://youtu.be/0ERSMkRPQBM
- Links: Harmony in Human Being- Self: https://youtu.be/83oGJ4oDeIg
- Links: Harmony between Self and Body Prosperity: https://youtu.be/aJ_BU2OgpKs

Unit III

Understanding Harmony in the Family and Society- Harmony in Human- Human Relationship

1. Understanding Harmony in the family – the basic unit of human interaction.
2. Understanding values in a human-human relationship; the meaning of Nyaya and the program for its fulfillment to ensure Ubhay-tripti; Trust (Vishwas) and Respect (Samman) as the foundational values of relationship.

3. Understanding the meaning of Vishwas; Difference between intention and competence.
4. Understanding the meaning of Samman, the Difference between respect and differentiation; the other salient values in the relationship.
5. Understanding the harmony in the society (society being an extension of the family): Samadhan, Samridhi, Abhay, Sah-astitva as comprehensive Human Goals.
6. Visualizing a universal harmonious order in society- Undivided Society (Akhand Samaj), Universal Order (Sarvabhaum Vyawastha)- from family to world family!

Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey and polls for self-exploration
- Links: Harmony in Family- Trust: https://youtu.be/F2KVW4WNnS8
- Links: Harmony in family- Respect: https://youtu.be/iLqNRPuv0_8
- Links: Harmony in family- Other Feeling Justice: https://youtu.be/TcYJB7reKnM
- Links: Harmony in the Society: https://youtu.be/BkWgFinrnPw

Unit IV

Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature.
2. Interconnectedness and mutual fulfillment among the four orders of nature- recyclability and self-regulation in nature.
3. Understanding Existence as Co-existence (Sah-astitva) of mutually interacting units in all-pervasive space.
4. Holistic perception of harmony at all levels of existence - Practice Exercises and Case Studies will be taken up in Practice Sessions.

- Pedagogy / Course delivery tools: Chalk and talk, PowerPoint presentation, Videos.
- Lab component / Practical Topics: Survey and polls for self-exploration
- Links: Harmony in Nature: https://youtu.be/K1Jpd_ojydw
- Links: Harmony in Existence: https://youtu.be/mormUeZ_RUE

Unit V

Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values.
2. Definitiveness of Ethical Human Conduct.
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
4. Competence in professional ethics:

a) Ability to utilize the professional competence for augmenting universal human order
b) Ability to identify the scope and characteristics of people-friendly and eco- friendly production systems,
c) Ability to identify and develop appropriate technologies and management patterns for above production systems.

5. Case studies of typical holistic technologies, management models and production systems.
6. Strategy for transition from the present state to Universal Human Order:

a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers.

b) At the level of society: as mutually enriching institutions and organizations.

- Pedagogy / Course delivery tools: Chalk and talk, Power point presentation, Videos.
- Lab component / Practical Topics: Survey and polls for self-exploration

Text Books:

1. R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and Professional Ethics, Excel books, New Delhi, 2010, ISBN 978-8-174-46781-2

Reference Books:

1. B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, Science and Humanism, Commonwealth Publishers.
3. Sussan George, 1976, How the Other Half Dies, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, Energy & Equity, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, limits to Growth, Club of Rome's Report, Universe Books.
6. Subhas Palekar, 2000, How to practice Natural Farming, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, Jeevan Vidya ek Parichay, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, Small is Beautiful: a study of economics as if people mattered, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, Human Values, New Age International Publishers.

Course Outcomes (COs):

At the end of the course, students will be able to

1. Apprehend the need of Value Education over Human aspirations. [PO6]
2. Assimilate Harmony over the physical needs and to overcome the self- needs for a prosperous life. [PO6]
3. Recognize the need of Harmony in the Family and Society for a better World. [PO6]
4. Explain the need of mutual understanding for Holistic Harmony in all the Levels of Human Existence. [PO6]
5. Explain the Holistic understanding of Harmony and Professional Ethics at Individual Level and Society. [PO6, PO8]

Web links and Video Lectures (e-Resources):

1. https://www.youtube.com/channel/UCQxWr5QB_eZUnwxSwxXEkQw
2. https://www.youtube.com/watch?v=P4vjfE-YnVk&list=PLWDeKF97v9SP7wSlapZcQRrT7OH0ZlGC4
3. Course handouts: https://drive.google.com/drive/folders/1zioX_4L2fCNX4Agw282PN86pcZZT3Osr?usp=sharing

IV SEMESTER

NUMERICAL METHODS, COMPLEX ANALYSIS AND PROBABILITY METHODS	
Course Code: ME41	**Credits: 2:1:0**
Pre – requisites: Calculus & Probability	**Contact Hours: 28L +14T**
Course Coordinator: Dr G Neeraja, Dr Vijay Kumar & Dr A Sreevallabha Reddy	

Course Content

Unit I

Finite Differences and Interpolation: Forward and backward differences, Interpolation, Newton Gregory forward and backward interpolation formulae, Lagrange's interpolation formula, Newton's divided difference interpolation formula (no proof).

Numerical Differentiation and Numerical Integration: Derivatives using Newton-Gregory forward and backward interpolation formulae, Newton-Cote's quadrature formula, Trapezoidal Rule, Simpson's $(1/3)^{rd}$ rule, Simpson's$(3/8)^{th}$ rule

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links:https://nptel.ac.in/courses/111/106/111106101/
- Impartus recording: https://a.impartus.com/ilc/#/course/96127/452

Unit II

Statistics: Curve fitting by the method of least squares, Fitting linear, quadratic and geometric curves. Correlation and Regression, Multiple regression.

Probability Distributions: Random variables. Binomial distribution, Poisson distribution, Exponential distribution, Normal distribution.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: https://nptel.ac.in/courses/111/105/111105035/
- impartus recording: https://a.impartus.com/ilc/#/course/96127/452
- https://a.impartus.com/ilc/#/course/132243/636
- https://a.impartus.com/ilc/#/course/119635/593

Unit III

Sampling and Statistical Inference: Sampling distributions, Concepts of standard error and confidence interval, Central Limit Theorem, Type-1 and Type-2 errors, Level of significance, One tailed and two tailed tests, Z-test: for single mean, Student's t –test: for single mean, for difference between two means, F – test: for equality of two variances, Chi-square test: for goodness of fit.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: https://nptel.ac.in/courses/111/107/111107119/
- impartus recording: https://a.impartus.com/ilc/#/course/96151/1112

Unit IV

Complex Differential Calculus: Functions of complex variables, Analytic function, Cauchy-Riemann Equations in Cartesian and polar coordinates (without proof), Construction of analytic

functions. Transformations: Conformal transformation, Discussion of the transformations $w = e^z$, $w = z^2$ and $w = z + \frac{1}{z}$, $(z \neq 0)$,
Bilinear transformations.

- Pedagogy/Course delivery tools: Chalk and talk, PowerPoint Presentation, Videos
- Links: https://nptel.ac.in/courses/111/107/111107119/
- Impartus recording: https://a.impartus.com/ilc/#/course/619570/1030

Unit V

Complex Integral Calculus: Complex integration, Cauchy's theorem, Cauchy's integral formula, Taylor's and Laurent's series (statements only), Singularities, poles and residues, Cauchy residue theorem.

- Pedagogy/Course delivery tools:-Chalk and talk, PowerPoint Presentation, Videos
- Links:-https://nptel.ac.in/courses/111/107/111107119/
- impartus recording: -https://a.impartus.com/ilc/#/course/619570/1030

Text Books:

1. **Erwin Kreyszig** –Advanced Engineering Mathematics, Wiley publication, 10th edition, 2015
2. **B.S. Grewal** – Higher Engineering Mathematics, Khanna Publishers, 44th edition, 2017.

Reference Books:

1. **George B. Thomas, Maurice D. Weir, Joel R. Hass** - Thomas' Calculus, Pearson, 13th edition, 2014.
2. **Peter V. O' Neil** – Advanced Engineering Mathematics, Thomson Brooks/Cole, 7th edition, 2011.
3. **Glyn James & Phil Dyke** – Advanced Modern Engineering Mathematics, Pearson Education,5th edition, 2018.
4. **Srimanta Pal & Subobh C Bhunia -** Engineering Mathematics, Oxford University Press, 3rd Reprint, 2016.

Course Outcomes (COs):

At the end of the course the student will be able to

1. find functional values, derivatives, areas and volumes numerically from a given data **(PO–1,2 & PSO–1, 2).**
2. fit a least squares curve to the given data and analyze the given random data and their probability distributions (**PO–1,2 & PSO–1, 2).**
3. Choose an appropriate test of significance and make inference about the population from a sample **(PO–1,2 & PSO–1, 2).**
4. examine and construct the analytic functions **(PO–1,2 & PSO–1, 2).**
5. classify singularities of complex functions and evaluate complex integrals **(PO–1,2 & PSO–1, 2).**

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment Tool	**Marks**	**Course outcomes addressed**
Internal test – I	30	CO1,CO2,CO3
Internal test – II	30	CO3,CO4,CO5
Average of the two internal tests will be taken for 30 marks.		
Other components	**Marks**	**Course outcomes addressed**
Quiz	10	CO1,CO2,CO3
Assignment	10	CO1,CO2,CO3,CO4,CO5
Semester End Examination (SEE):		
Course end examination(Answer any one question from each unit – Internal choice)	100	CO1,CO2,CO3,CO4,CO5

MACHINE DESIGN-I	
Course Code: ME42	**Credits: 3:0:1**
Pre – requisites: Nil	**Contact Hours: 42L+14P**
Course Coordinator: Dr. Mahantesh S Matur	

Course Content

Unit I

Introduction: Design considerations: codes and standards, Static Strength, Static loads and Factor of safety. Impact loads, Impact stresses due to axial and bending.
Theories of failure: Maximum normal stress theory, Maximum shear stress theory, Distortion energy theory. Failure of brittle materials, Failure of ductile materials.
Stress concentration: Determination of Stress concentration factor for axial, bending, torsion.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/ Practical topics: Simulation & stress analysis of simple machine components using software
- Links: https://a.impartus.com/ilc/#/video/id/1620141
- Links: https://www.youtube.com/watch?v=-SA4D098u-Q

Unit II

Design for Fatigue Load: Introduction- S-N Diagram, Low cycle fatigue, High cycle fatigue, Endurance limit, Endurance limit modifying factors: size effect, surface effect, Stress concentration effects; Fluctuating stresses, Goodman and Soderberg relationship; stresses due to combined loading,

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos, Demonstration using IC engine models
- Lab component/ Practical topics: Simulation & fatifue analysis of simple machine components using software
- Links: Fatigue loading: https://a.impartus.com/ilc/#/course/130428/636

Unit III

Shafts: ASME & BIS codes for design of transmission shafting, shafts under fluctuating loads and combined loads.
Cotter and Knuckle joints: Design of Cotter and Knuckle joints.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: Design and Drawing of Cotter joint and Knuckle joint using 3D Modelling Software
- Links: Shafts-https://a.impartus.com/ilc/#/video/id/1654576

Unit IV

Keys: Types of keys, Design of keys and design of splines. Couplings, Rigid and flexible couplings, Flange coupling, Bush and Pin type coupling.
Riveted Joints – Types, rivet materials, failures of riveted joints, Joint Efficiency, Boiler Joints, Tank and Structural Joints, Riveted Brackets

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: Design and Drawing of Couplings using 3D Modelling Software
- Design and drawing of different types of riveted joints
- Links: https://a.impartus.com/ilc/#/video/id/1568859

Unit V

Welded Joints: Types, strength of butt and fillet welds, eccentrically loaded welded joinits.
Power Screws: Mechanics of power screw, Stresses in power screws, efficiency and self-locking, Design of Power Screw**.**

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: Design and Drawing of welded joints, 3D Modelling Software
- Design and drawing of screw jack (Bottle Type)
- Links: https://a.impartus.com/ilc/#/video/id/1603316

DESIGN DATA HAND BOOKS:

1. Design Data Hand Book vol.1 & 2 – K. Lingaiah, McGraw Hill, 2nd Ed. 2003.
2. Design Data Hand Book by K. Mahadevan and Balaveera Reddy, CBS Publication

Text Books:

1. Mechanical Engineering Design: Joseph E Shigley and Charles R. Mischke McGraw Hill International edition, 6th Edition 2003.
2. Design of Machine Elements: V.B. Bhandari, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2nd Edition 2007.

Reference Books:

1. Machine Design: Robert L. Norton, Pearson Education Asia, 2001.
2. Design of Machine Elements: M.F.Spotts, T.E. Shoup, L.E. Hornberger, S.R. Jayram and C.V. Venkatesh, Pearson Education, 2006.
3. Machine Design: Hall, Holowenko, Laughlin (Schaum's Outlines series) Adapted by S.K. Somani, Tata McGraw Hill Publishing Company Ltd., New Delhi, Special Indian Edition, 2008.
4. Fundamentals of Machine Component Design: Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

Web links and video lectures (e-Resources):

1) https://youtu.be/ofmbhbVCUqI
2) https://youtu.be/m9l1tVXyFp8
3) https://youtu.be/jolY82CpmGo
4) https://www.digimat.in/nptel/courses/video/112105124/L10.html
5) https://a.impartus.com/ilc/#/video/id/1603316

Course Outcomes (COs):

1. Apply concepts of static loads, stress concentration and theories of failure in the design of machine components [PO1,PO2,PO3,PO4,PO12,PSO1,PSO2]
2. Understand concepts of Fatigue loads and design of machine element. [PO1,PO2,PO3,PO4,PO12,PSO1,PSO2]
3. Develop the ability to understand the procedural design of shafts, cotter joints & knuckle joints [PO1,PO2,PO3,PO4, PO12,PSO1,PSO2]
4. Demonstrate the ability to analyze the problems of keys and rivetted joints. [PO1,PO2, PO3,PO4,PO12,PSO1,PSO2]
5. Develop competence to design of welded joints and power screws. [PO1,PO2,PO3,PO4,PO12,PSO1,PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Experimental conduction and record writing	10	CO-1,CO-2, CO-3
Viva -voce and assignment	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

APPLIED THERMODYNAMICS	
Course Code: ME43	**Credits: 2:1:0**
Pre – requisites: ME33	**Contact Hours: 28L+14P**
Course Coordinator: Dr. P.B. NAGARAJ	

Course Content

Unit I

Combustion in SI and CI engines: Ignition limits, stages of combustion in SI engine, Effect of engine variables on Ignition lag, abnormal combustion, Detonation or knocking and its effect, stages of combustion in CI engines, Delay period in CI engines and variables affecting the delay period, diesel knock and methods of controlling the diesel knock, Testing and Performance of Single Cylinder and Multi cylinder Engines, measurement of performance parameters, heat balance sheet. Numerical problems

- Pedagogy/Course delivery tools: Chalk and talk, animated videos
- Lab component/Practical topics: ATD lab-2S & 4S test rigs.
- Links: Fundamentals of combustion: https://nptel.ac.in/courses/101104070
- Links: Performance of I C Engine: https://www.youtube.com/watch?v=2b0YaDrdO1I

Unit II

Gas power cycles: Air standard cycles, Otto, Diesel, Dual , p v and T s diagrams, description, efficiencies and mean effective pressures, comparison of otto, diesel and dual combustion cycles

Gas turbines and Jet propulsion: Classification of gas turbines, analysis of open cycle gas turbine cycle, methods to improve thermal efficiency (no numerical on this topic), Jet propulsion and Rocket propulsion

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: ATD lab-Computerized 4S Petrol & Diesel engine
- Links: Gas turbines and I C engines: https://nptel.ac.in/courses/112103262
- Links: Introduction to Air breathing propulsion: https://onlinecourses.nptel.ac.in/noc20_ae13/preview

Unit III

Steam Nozzles: Introduction, types of nozzles, steady flow energy equation in nozzles, entropy changes with friction, nozzle efficiency, mass discharge through nozzle, throat pressure for maximum discharge, critical pressure ratio for adiabatic and frictionless expansion from a given initial velocity, numerical problems

Vapour power cycles: Carnot vapour power cycle, drawbacks as a reference cycle, simple Rankine cycle; description, T-S diagram, analysis for performance, comparison of carnot and rankine cycles. Effects of pressure and temperature on Rankine cycle performance. Actual vapour power cycles, numerical problems

- Pedagogy/ Course delivery tools: Chalk and talk, animated videos
- Lab component/Practical topics: Turbo Machinery lab- Nozzles
- Links: Introduction to Steam nozzles-https://www.youtube.com/watch?v=AXcb3TBLETY
- Links: Use of h-s diagram -https://www.youtube.com/watch?v=iZQlt1kp1dw

Unit IV

Reciprocating Compressors: Operation of a single stage reciprocating compressors, work input through p-v diagram, effect of clearance and volumetric efficiency, adiabatic, isothermal and mechanical efficiencies. Multi-stage compressor, saving in work, optimum intermediate pressure, inter-cooling, minimum work for compression.

Refrigeration: Principle, methods of refrigeration, units of refrigeration, COP, Vapour compression refrigeration (VCR) system; description, analysis, refrigerating effect, capacity, power required, Thermodynamic analysis of VCR cycle, operating parameters affecting the COP of VCR cycle.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: ATD lab & Heat transfer lab-Air compressor test rig, Refrigeration tutor & Air conditioning test rig
- Links: Air compressor: https://www.youtube.com/watch?v=VO0IVe9ZHY0& list=PL07gcSkcblxqX3itLTFpPAcX7B_SSRYSr
- Links: Refrigeration-https://www.youtube.com/watch?v=nlsNmhiID74& list=PLfUUbFVTz-XcXbSUD0BXdPxGXFGkcdLXa

Unit V

Psychrometrics: Atmospheric air and psychrometric properties: DBT, WBT, DPT, partial pressures, specific and relative humidity and relation between the two, enthalpy and adiabatic saturation temperatures, Construction and use of psychrometric chart. Analysis of various processes: Heating, cooling, dehumidifying and humidifying. Adiabatic mixing of stream of moist air. Summer and winter air conditioning.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Lab component/Practical topics: Heat transfer lab- Air conditioning test rig
- Links: Basic concepts of Psychrometric processes: https://www.youtube.com/watch?v=YoN5251ta18
- Links: Psychrometric chart: https://www.youtube.com/watch?v=e2IryaMQQ6A

Text Books:

1. Basic and Applied thermodynamics by P K Nag, Tata McGraw Hill pub co., 2nd edition 2002
2. Thermodynamics- An Engineering Approach-Yunus, A Cenegal and Michael A Boles, Tata McGraw Hill Publications.,1st edition 2002

Reference Books:

1. Internal combustion engines- M L Mathur and R P Sharma, Dhanpat Rai Publications.,3rd edition 2007
2. Thermal Engineering- R K Rajput, Laxmi Publications,3rd edition 2003

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=cQnj8DOc9B8
2. https://www.youtube.com/watch?v=30-FdRgygI0
3. https://www.youtube.com/watch?v=PoiFmnFiTS4
4. https://www.youtube.com/watch?v=4liAb3LiOXo
5. https://www.youtube.com/watch?v=r6uN3f9o5PQ

Course Outcomes (COs):

At the end of the course, the student will be able to

1. **Analyze** the combustion phenomenon and solve the practical problems associated with the performance parameters of the Internal combustion engine and create awareness of current advancement in I C engines [PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
2. **Apply** the knowledge of thermodynamics in the analysis of air standard and gas turbine cycles and determine cycle efficiency, work output and heat supply. [PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
3. **Solve** practical problems on steam nozzles, gas turbines and make modifications to improve Rankine cycle efficiency[PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
4. **Evaluate** the performance parameters of single and multistage air compressors and analyze the different types of refrigeration systems for given comfort conditions. [PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2]
5. **Solve** the problems on design of air conditioning systems with the use of psychrometric chart and develop ability to apply the concept of air conditioning systems to solve design problems of real systems. [PO1,PO2,PO3,PO4,PO7,PO12,PSO1 & PSO2].

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 &CO-2
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

MECHANICAL MEASUREMENTS & METROLOGY	
Course Code: ME44	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Dr. JYOTHILAKSHMI. R	

Course Content

Unit I

Standards of Measurement: Definition and Objectives of metrology, Standards of length– International prototype meter, Imperial Standard yard, Wave length standard, subdivision of standards, line and end standard, comparison, transfer from line standard to end standard, calibration of end bars (Numerical), Slip gauges, wringing phenomena, Indian Standards (M-81,M-112), Numerical Examples on building of slip gauges.

System of limits, Definition of tolerance, Specification in assembly, Principle of inter changeability and selective assembly limits of size, Indian Standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Lab component/Practical topics: Slip Gauge, Micrometer
- Links: Standards of Measurement https://www.youtube.com/watch?v=U8y48L_qn6E&t=214s
- Links: Slip Gauges: https://www.youtube.com/watch?v=CnSRaTTeNrk

Unit II

Fits, Tolerances and gauging & Comparators: Definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, positional – tolerances, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (principles), Wear allowance on gauges, Types of gauges – Plain plug gauge, ring Gauge, snap gauge, limit gauge and gauge materials.

Introduction to Comparators, Characteristics, classification of comparators, mechanical comparators –Sigma Comparators, dial indicator, Optical comparators – principles, Zeiss ultra Optimeter.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Lab component/Practical topics: LVDT, Pneumatic Comparator
- Links: Limits, Fits and Tolerances: https://www.youtube.com/watch?v=G8TSfAeQRaw
- Links: Mechanical Comparators: https://www.youtube.com/watch?v=bKLUtRLL8tY

Unit III

Angular measurement, Interferometer and Screw thread gear measurement: Angular measurements, Bevel Protractor, Sine Principle and use of Sine bars, Sine center, use of angle gauges, (numericals on building of angles) Clinometers. Interferometer Principle of interferometery, autocollimator. Optical flats. Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire method, Best size wire.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Lab component/Practical topics: Sine Bar, Sine Centre, 2 Wire and 3 Wire Method, Autocollimator, Screw thread measurement using Tool maker’s microscope, Gear Tooth Vernier Caliper,

- Links: Angular Measurement: https://www.youtube.com/watch?v=saoOUXYXde0
- Links: Autocollimator: https://www.youtube.com/watch?v=joKSUJm2v2Q

Unit IV

Measurements and Measurement systems, Intermediate modifying and terminating devices: Definition, Significance of measurement, generalized measurement system, definitions and concept of accuracy, precision, calibration, threshold, sensitivity, hysteresis, repeatability, linearity, loading effect, system response-times delay. Errors in Measurements, classification of errors. Transducers, Transfer efficiency, Primary and Secondary transducers, Electrical, Mechanical, Electronic transducers, advantages of each type transducers. Mechanical systems, inherent problems, Electrical intermediate modifying devices, Input circuitry, Ballast, Ballast circuit and telemetry. Terminating devices, Mechanical, Cathode Ray Oscilloscope, Oscillographs.

- Pedagogy/ Course delivery tools:-Chalk and talk, Power point presentation, Animated Videos
- Lab component/Practical topics:-Calibration of Pressure Transducer, Micrometer, Load Cell
- Links: Generalized Measurement System:https://www.youtube.com/watch?v=PEpL0ukTWhs
- Links: Intermediate modifying and terminating devices, inherent problems: https://www.youtube.com/watch?v=5wqaGZICdTI

Unit V

Measurement of Force and Torque, Pressure Temperature and Strain Measurement: Principle, Analytical balance, platform balance,Hydraulic dynamometer. Pressure Measurements, Principle, use of elastic members, Bridgeman gauge, McLeod gauge.Temperature and Strain Measurement: Resistance thermometers, thermocouple, law of thermocouple, materials used for construction, Pyrometer, Optical Pyrometer. Strain Measurements, Strain gauge, preparation and mounting of strain gauges, gauge factor, methods of strain measurement.

Coordinate measuring machine: Introduction, design, types and its applications.

- Pedagogy/ Course delivery tools: Chalk and talk, Power point presentation, Animated Videos
- Lab component/Practical topics: Thermocouple, Coordinate Measuring Machine
- Links: Torque Measurement: https://www.youtube.com/watch?v=ydyVsVk96z8
- Links: Coordinate Measuring Machine: https://www.youtube.com/watch?v=xgDpq4orAFM

Text Books:

1. Mechanical measurements, by Beckwith Marangoni and Lienhard, Pearson Education, 6thEd., 2006.
2. Engineering Metrology, by R.K.Jain, Khanna Publishers,5th edition 2006.

Reference Books:

1. Engineering Metrology, by I.C.Gupta, Dhanpat Rai Publications, Delhi. 2nd edition 2006 edition.
2. Industrial Instrumentation, Alsutko, Jerry.D.Faulk, Thompson Asia Pvt. Ltd.1st edition 2002.
3. Measurements Systems Applications and Design, by Ernest O. Doblin, McGraw Hill Book Co. 2nd edition. 2006

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=Pn7VHO1LOAw
2. https://www.youtube.com/watch?v=HpIEeBtJupY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA
3. https://www.youtube.com/watch?v=8DTt-f6wQxE&list=PL41FA714195562989
4. https://www.youtube.com/watch?v=tN7iAzVEqa0&list=PLwdnzlV3ogoXJLQ8lSGb1hsztt24l9kZZ
5. https://www.youtube.com/watch?v=_tFL-oOyVtM

Course Outcomes (COs):

1. Explain the concept of measurements in engineering. [PO1,PO2,PO4,PO7,PO8, PSO1,PSO2]
2. Examine the applications of Limits, Fits, Tolerances and Analyse comparators for different engineering applications. [PO1,PO2,PO4,PO6,PO7,PO8,PSO1,PSO2]
3. Identify the uses of Gauges for Angular measurement, Screw thread and Gear Measurement. [PO1,PO2,PO3,PO4,PO6,PO12,PSO1,PSO2]
4. Understand the significance of measurement system, Errors, Transducers, Intermediate modifying and terminating devices. [PO1,PO2,PO3,PO4,PO6,PO7,PO8,PSO1,PSO2]
5. Apply the techniques for force, torque, pressure, temperature and strain measurement systems[PO1,PO2,PO3,PO4,PO6,PO7,PO8,PO12,PSO1,PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 ,CO-2 and CO3
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

MANUFACTURING PROCESSES-II	
Course Code: ME45	**Credits: 3:0:0**
Pre – requisites: Nil	**Contact Hours: 42L**
Course Coordinator: Mr. Rajendra P	

Course Content

Unit I

Fundamentals of Metal Cutting: Introduction, Basic elements of machining, Orthogonal and oblique cutting, Classification of cutting tools, Principal angles of single point cutting tools, Tool signature, Chip formation, Types of chips, Chip thickness ratio, chip breakers, Velocity relationships, Force relationship in orthogonal cutting, Stress and strain in chip, Work done in cutting, Horse power calculation, Sources of heat in metal cutting, Numerical problems.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Nomenclature of Single point cutting tool: https://www.youtube.com/watch?v=BHEYrGrvp6U
- Links: Chip formation, Types of chips, Chip thickness ratio: https://www.youtube.com/watch?v=u7lpccLxuMI

Unit II

Cutting Tool Materials: Tool failure, Mechanism of wear, Tool life, Factors affecting tool life, desirable properties of cutting tool materials, Machinability, Machinability index. Cutting fluids, functions, requirements, types of cutting fluids

Turret & Capstan lathes and Automatic machines: Introduction, Main parts of a Turret & capstan lathe, Differences between Turret & capstan lathe, Classification of Turret lathe, Primary and secondary motions, bar feed mechanism, Turret index and stop drum mechanisms

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Tool failure, mechanism of wear: https://www.youtube.com/watch?v=eCD2g1njeZQ
- Links: Turret & Capstan lathes: https://www.youtube.com/watch?v=hbNmMYoIAtg

Unit III

Milling: Introduction, working principle in milling, milling cutter nomenclature, Types of milling machines-horizontal, vertical and fixed bed type plain milling machines, milling operations, Indexing or dividing head, Indexing methods and Numerical problems.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Types of milling machines: https://www.youtube.com/watch?v=aeOaAZRwpfY
- Links: milling indexing: https://www.youtube.com/watch?v=a-GkDjXGJI0

Unit IV

Drilling: Introduction, Twist drills parts and nomenclature, Types of drilling Machines-Bench and Radial, drilling operations, cutting speeds, feeds and depth of cut time with Numerical.

Grinding: Introduction, Common forms of abrasive tools, Wheel material, Symbolic representation of bonds, Grain, Grade, Structure, Loading, glazing Trueing and dressing of grinding wheels, Wheel balancing, Use of coolants, centerless grinder, cylindrical Grinder-Plain and universal.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Types of drilling machine: https://www.youtube.com/watch?v=w08kcbMhBho
- Links: Loading, glazing Trueing and dressing of grinding wheels, https://www.youtube.com/watch?v=p-B-Qs-jCxI

Unit V

Jigs and Fixtures: Introduction, Differences between jigs and fixtures, important consideration in jigs and fixture design, Main elements of jigs and fixtures, types of locating and clamping devices, basic requirements.

Powder Metallurgy: Basic steps in Powder metallurgy, Production of metal powders, blending of metal powders, Compaction, Sintering and Finishing, Application, advantages and limitations of powder metallurgy.

- Pedagogy/Course delivery tools: Chalk and talk, Power point presentation, animated videos
- Links: Jigs and Fixtures: https://www.youtube.com/watch?v=ko0_d7EDsTQ
- Links: Powder Metallurgy: https://www.youtube.com/watch?v=AZMbSBVVWhI

Text Books:

1. A Course in Workshop Technology, Volume II (Machine Tools), B.S. Raghuwanshi, Dhanpat Rai Publication, 2012
2. Processes and Materials of Manufacture, 4th Edition, Roy A. Lindberg, PHI Learning Publication, 2008

Reference Books:

1. Fundamentals of Metal Machining and Machine Tools, 3rd Edition, Winston A. Knight, Geoffrey Boothroyd, Taylor and Francis Publication, 2005
2. Production Technology, Volume I, O.P.Khanna, Dhanpat Rai Publication, 2015.

Course Outcomes (COs):

At the end of the course, the student will be able to

1. **Recognize** the various cutting forces acting in metal cutting on cutting tool materials and their tool life [PO1,PO2,PO3 & PSO1]
2. **Understand** the working of Capstan and Turret lathes, drilling machine, reaming machine, milling machine and grinding machines. [PO1,PO2 & PSO1]
3. **Apply** the design aspects of jigs and fixture and the recent advancement in the areas of machining in terms of numerically controlled machine tool. [PO1,PO2,PO3 & PSO1]
4. **Comprehend** the preparation of powders, mixing, compaction and sintering of various components using powders metallurgy techniques. [PO1,PO2,PO6, PO7 & PSO1]
5. **Demonstrate** the knowledge in machining and newer techniques adopted in industries to solve the real-world problems in production. [PO1,PO2,PO6, PO7 & PSO1]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	30	CO-1 ,CO-2 and CO3
Internal test-II	30	CO-3, CO-4 & CO-5
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment	10	CO-1,CO-2, CO-3
Quiz	10	CO-4 & CO-5
Semester End Examination (SEE): 100 Marks		
Semester End Examination	100	CO-1,CO-2, CO-3, CO-4 & CO-5

APPLIED THERMODYNAMICS LABORATORY	
Course Code: MEL46	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. P B NAGARAJ	

Course Content

Unit I

Experiment No Description

PART A

1. Determination of Flash and Fire point of Light, medium and heavy oils.
2. Determination of solid fuel calorific value using Lewis Thomson Calorimeter
3. Determination of viscosity of oil using Redwood Viscometer.
4. Determination of viscosity of oil using Torsion Viscometer.
5. Determination of liquid and gaseous fuel calorific value using Boy's gas Calorimeter
6. Valve timing diagram for I C Engine.
7. Measurement of an irregular area using Planimeter

PART B

1. Two stroke Petrol engine test rig (Mechanical loading)
2. Two stroke Petrol engine test rig (Electrical loading)
3. Computerized Four stroke Petrol engine test rig
4. Computerized Four stroke Diesel (VCR) engine test rig
5. Multi cylinder petrol engine – Morse Test
6. Performance testing of a 2 stage reciprocating Air Compressor
7. Performance testing of Centrifugal Blower

Students are required to do experiments individually from Part A and in a group of 4 to 5 students from Part B

Text Books:

1. Applied Thermodynamics Manual, Department of Mechanical Engineering, MSRIT

Reference Books:

1. Basic and Applied Thermodynamics by P K Nag, Tata-Mc-Graw Hill publications, 2008
2. Applied thermodynamics, Kestoor praveen, SUGGi Publishing, 2014

Web links and video lectures (e-Resources):

1. https://www.youtube.com/watch?v=2ths8kOkqPU
2. https://www.youtube.com/watch?v=SHdESVROvVs
3. https://www.youtube.com/watch?v=30-FdRgygI0
4. https://www.youtube.com/watch?v=H_RgFXjg-5s
5. https://www.youtube.com/watch?v=1_Jw6XUScvo

Course Outcomes (COs):

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

1. **Determine** properties such as flash and fire point, viscosity and calorific value of various types of fuels. [PO1,PO2,PO4,PO6,PO7,PO10,PO12,PSO1,PSO2]
2. **Demonstrate** the use of Valve timing diagram of I C Engines and use of Planimeter[PO1,PO2,PO3,PO4,PO10,PO12,PSO1,PSO2]
3. **Conduct** experiments on I C Engines, Blowers and Air compressors to determine performance parameters [PO1,PO2,PO3,PO4,PO5,PO6,PO7,PO10,PO11,PO12,PSO1,PSO2]

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory records after the conduction of every experiment	30	CO-1,CO-2 & CO-3
Practical test	20	CO-1,CO-2 & CO-3
Semester End Examination (SEE): 100 Marks		
Semester End Examination	50	CO-1,CO-2 & CO-3

MECHANICAL MEAUREMENTS AND METROLOGY LAB	
Course Code: MEL47	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 14P**
Course Coordinator: Dr.Nagesh S N	

Course Content

Tests conducted are listed below:

A. Conduct the following Experiments.

1. Calibration of pressure transducer
2. Calibration of thermocouple
3. Calibration of LVDT
4. Determination of material constants, E & G.
5. Calibration of stroboscope
6. Calibration of micrometer using slip gauges
7. Double flank test using gear roll tester
8. Determination of gear tooth profile using gear tooth tester
9. Measurement of tool-tip temperature
10. Digimatic miniprocessor

B. Conduct the following Experiments.

1. Measurements using tool makers microscope
2. Measurements using profile projector
3. Measurement of angles using sine center, sine bar and bevel protractor
4. Determination form tolerance of a ground product using pneumatic comparators
5. Drawing of Merchant's circle diagram
6. Determination of screw thread parameters using floating carriage diameter measuring machine.
7. Measurement of alignment using autocollimator

C. Conduct the following Experiments.

1. Monochromatic checklite
2. Surface finish measurement

- Pedagogy/Course delivery tools: Chalk and Talk, laboratory Manuals,
- Links: https://www.youtube.com/watch?v=up-itS3jefQ
  https://www.youtube.com/watch?v=DC5u_SvO8r4
  https://www.youtube.com/watch?v=qwhc2pGco_Y
  https://www.youtube.com/watch?v=kMFZfH-8DeQ
  https://www.youtube.com/watch?v=MdCifxRSzMk
  https://www.youtube.com/watch?v=3CFXzctvHAo
  https://www.youtube.com/watch?v=moFETpF7Ezo

Text Books:

1. Mechanical measurements, by Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2006.
2. Engineering Metrology, by R.K.Jain, Khanna Publishers, 1st edition 1994.

Reference Books:

1. Engineering Metrology, by I.C.Gupts, Dhanpat Rai Publications, Delhi. 2nd edition 2006 edition.
2. Mechanical measurements, by R.K.Jain. 5th edition 2006.
3. Industrial Instrumentation, Alsutko, Jerry.D.Faulk, Thompson Asia Pvt. Ltd.1st edition 2002.
4. Measurements Systems Applications and Design, by Ernest O. Doblin, McGraw Hill Book Co. 2nd edition. 2006

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Weekly evaluation of laboratory records after the conduction of every experiment	30	CO-1,CO-2 & CO-3
Practical test	20	CO-1,CO-2 & CO-3
Semester End Examination (SEE): 100 Marks		
Semester End Examination	50	CO-1,CO-2 & CO-3

MANUFACTURING PROCESS LABORATORY	
Course Code: MEL48	**Credits: 0:0:1**
Pre – requisites: Nil	**Contact Hours: 14P**
Course Coordinator: Dr. MOHANDAS K N	

Course Content

PART A

Conduct the following experiments:

1. Casting: Preparing mould cavity, melting and pouring of molten metal and finishing the cast metal.
2. Forging: Forging the given workpiece to required shape and dimension and subjecting the same workpiece to heat treatment (Quenching - water, oil, air, etc.)

- Pedagogy/Course delivery tools: Chalk and talk, Powerpoint presentation, animated videos
- Lab Component / Practical Topics: Foundry models and forging exercises
- Links: https://www.youtube.com/watch?v=PkjpmPLNKZs
- Links: https://www.youtube.com/watch?v=j-xk2FvcAz4

3. Lathe: Step turning, thread cutting (V-thread, Square thread, left hand and Right hand threads) Eccentric turning.
4. Milling Machine: Indexing, cutting of gear tooth (Spur gear, Helical gear), face milling and grooving.
5. Shaping Machine: Cutting of V groove and Dovetail.
6. Surface Grinding: Finishing of the obtained cast metal using surface grinding machine.

- Pedagogy/Course delivery tools: Chalk and talk, Powerpoint presentation, animated videos
- Lab Component / Practical Topics: Subassemblies in Machines at Machine Shop
- Links: https://www.youtube.com/watch?v=wL9AHJkvCiY
  https://www.youtube.com/watch?v=Bc0wZLVKI6U
  https://www.youtube.com/watch?v=kwI52jtmm3w
  https://www.youtube.com/watch?v=7f_LIJMpLGo

Reference Books:

1. Serope Kalpakjian, Joyjeet Ghose, Steven R. Schmid "Manufacturing Processes for Engineering Materials" Sixth Edition, Pearson Publication, 2018.
2. Manufacturing Process laboratory manual, Department of Mechanical Engineering, RIT.

Video Links:

1. https://www.youtube.com/watch?v=x1N1mpxGB0Y
2. https://www.youtube.com/watch?v=ZhCmhzC6PyI
3. https://www.youtube.com/watch?v=_viYnlfXAEA
4. https://www.youtube.com/watch?v=XTU0Z-FkhtU
5. https://www.youtube.com/watch?v=6jQ4y0LK1kY
6. https://www.youtube.com/watch?v=c8M_xYOceLg
7. https://www.youtube.com/watch?v=xarj36BpiB4

8. https://www.youtube.com/watch?v=Bc0wZLVKI6U
9. https://www.youtube.com/watch?v=Gun5Kr-lmls
10. https://www.youtube.com/watch?v=7tN_uGHNknM
11. https://www.youtube.com/watch?v=qxBTSUtKl1M

Course Outcomes (COs):

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

1. Acquire the skill to create machine parts based on dimensions and assemble the parts to create assemblies
2. Generate assemblies from part files and generate the relevant views
3. Create and assemble the 3-D part models using a CAD tool and draw the sectional view, orthographic views and Isometric view of the assembly including the bill of materials, section plane and ballooning.

Course Assessment and Evaluation:

Continuous Internal Evaluation (CIE): 50 Marks		
Assessment tool	**Marks**	**Course outcomes addressed**
Internal test-I	20	CO1, CO2 and CO3
Average of the two internal tests will be considered for evaluation of 30 Marks		
Other components- 20 Marks		
Assignment, Sketch Work and Printout	30	CO1, CO2 and CO-3
Semester End Examination (SEE): 50 Marks		
Semester End Examination	50	CO1, CO-2, CO-3