SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE
(AUTONOMOUS)

(Approved by AICTE, New Delhi, Affiliated to JNTUK, Kakinada)

Accredited by NAAC with 'A+' Grade

Recognised as Scientific and Industrial Research Organisation

SRKR MARG, CHINA AMIRAM, BHIMAVARAM – 534204 W.G.Dt., A.P., INDIA

Regulation: R23	

MECHANICAL ENGINEERING (Minors)

(Applicable for AIDS, AIML, CIC, CE, CSBS,CSE, CSG, CSIT, ECE, EEE &, IT)

COURSE STRUCTURE
(With effect from 2023-24 admitted Batch onwards)

Course Code	Course Name	Year/ Sem	Cr	L	T	P	C.I.E	S.E.E	Total Marks
B23MEM101	Engineering Materials	II-II	3	3	0	0	30	70	100
B23MEM201	Manufacturing Processes	III-I	3	3	0	0	30	70	100
B23MEM301	Engineering Mechanics and Strength of Materials [For all programmes except CIVIL]	III-II	3	3	0	0	30	70	100
B23MEM302	Automobile Engineering [For CIVIL]								
B23MEM401	Thermal Engineering	IV-I	3	3	0	0	30	70	100
B23MEM501	*MOOCS-I	II-II to IV-I	3	--	--	--	--	--	100
B23MEM601	*MOOCS-II	II-II to IV-I	3	--	--	--	--	--	100
		TOTAL	**18**	**12**	**0**	**0**	**120**	**280**	**600**

*Two MOOCS courses of any **MECHANICAL ENGINEERING** related Program Core Courses from NPTEL/SWAYAM with a minimum duration of 12 weeks (3 Credits) courses other than the courses offered need to be takenby prior information to the concern. These courses should be completed between II Year II Semester to IV Year I Semester.

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23MEM101	Minors	3	--	--	3	30	70	3 Hrs.

ENGINEERING MATERIALS

(Minor Degree course in ME)

Course Objectives:

1.	To impart knowledge about the engineering materials and their properties and predict their behavior under different working conditions and methods.
2.	To impart knowledge about space lattices, crystal structures and crystal defects.
3.	To acquaint the knowledge about the cooling curves and Phase diagrams of different alloy systems.
4.	To impart knowledge about different heat treatment and surface hardening methods in improving the mechanical properties of steels.
5.	To acquaint knowledge about ferrous & Non-ferrous alloys, particularly Steel and Cast Irons.
6.	To impart knowledge about composite materials and its manufacturing processes.

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

S.No	Outcome	KL
1.	**Determine** the properties of metals with respect to crystal structure and understanding perfection in crystals.	K3
2.	**Use** different ferrous materials based on their compositions and properties for various engineering applications.	K3
3.	**Use** different nonferrous materials based on their compositions and properties for various engineering applications.	K3
4.	**Apply** the principles of composite materials to select appropriate manufacturing techniques in suitable engineering applications.	K3
5.	**Apply** the knowledge of nano materials to explain their properties, synthesis and testing techniques.	K3

SYLLABUS

UNIT-I (10 Hrs)	**Structure of crystalline solids**: Atomic structure & bonding in solids- Unit cell, Space lattice, Crystallization of metals, Crystal structures and its types , Coordination Number and Atomic Packing Factor for different cubic structures-Grain and grain boundaries, effect of grain boundaries- Imperfection in solids, point defects, Line defects, Planar defects and Volume defects-Concept of Slip & winning.
UNIT-II	**Ferrous Alloys: Steels**-Classification of Steels-Effect of alloying elements of steel -

(10 Hrs)	Properties, composition, and uses of Plain carbon, low carbon, medium & high carbon steels. stainless steels, high speed steels, Hadfield steels, tool and die steels. **Cast irons**-Structure and properties of grey CI, white CI, malleable CI, SG Cast iron, Alloy cast iron.
UNIT-III (10 Hrs)	**Non-Ferrous Alloys**- Copper & its alloys: brasses & bronzes, Properties, composition, and applications, light alloys: Al, Mg, Titanium and its alloys, Nickel and its alloys, Chromium and its alloys, magnesium, zinc, silver, gold, Bismuth, Properties, composition, and applications- Smart materials, Super alloys.
UNIT-IV (10 Hrs)	**Composites:** Introduction, classification, Manufacturing using Stir Casting,Spray Layup, Filament Winding, Resin Transfer Moulding - Applications of composites. Fabrication of ceramics by Powder Metallurgy Technique- Applications of composites.
UNIT-V (8 Hrs)	**Nanomaterials:** Introduction, salient features of Nano materials, Synthesis methods – Ballmilling, Condensation, Chemical Vapour Deposition and Sol – Gel methods, Characterization techniques for nano materials - The scanning tunneling microscopy (STM)and The atomic force microscopy (AFM), Carbon nano tubes (CNTS), Applications of Nano materials.
Text Books:	
1.	Materials Science & Engineering- An Introduction, William D.CallisterJr. Wiley IndiaPvt. Ltd. 6th Edition, 2006, New Delhi.
2.	Material Science and Metallurgy by O.P.Khanna.
Reference Books:	
1.	Material Science and Metallurgy for Engineers,Dr. V.DKodgire and S.VKodgire.
2.	Introduction to Physical Metallurgy by Sidney H AvnerTata McGraw-Hill Education 1997.
3.	Materials Science and Engineering: A First Course By V. Raghavan Phi 5th Edition 2011, NewDelhi.
Online Learning Resources:	
1.	https://archive.nptel.ac.in/courses/113/106/113106032/
2.	https://youtu.be/2rxbxNem1iI?si=OPMHsVLYIzNtVWNC
3.	https://www.coursera.org/learn/fundamentals-of-materials-science.
4.	https://www.coursera.org/learn/material-behavior.

		Course Code: B23MEM101			
		SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		II B.Tech. II Semester MODEL QUESTION PAPER			
		ENGINEERING MATERIALS			
		(Minor Degree course in ME)			
Time: 3 Hrs.					**Max. Marks: 70 M**
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**a).**	**Describe** how the atomic packing factor (APF) affects the density and strength of different crystal structures.	**1**	**2**	**2**
	b).	**Differentiate** between slip and twinning as mechanisms of plastic deformation in crystalline solids.	**1**	**2**	**2**
	c).	**Explain** the classification of plain carbon steels based on their carbon content with examples.	**2**	**2**	**2**
	d).	**Differentiate** between Grey Cast Iron and White Cast Iron in terms of structure and properties.	**2**	**2**	**2**
	e).	**Explain** why aluminium alloys are preferred in the aerospace industry.	**3**	**2**	**2**
	f).	**Differentiate** between brass and bronze based on their composition and applications.	**3**	**2**	**2**
	g).	**Explain** the difference between Polymer Matrix Composites (PMCs) and Metal Matrix Composites.	**4**	**2**	**2**
	h).	**Describe** why powder metallurgy is preferred for fabricating ceramic components.	**4**	**2**	**2**
	i).	**Explain** why nanomaterials have a high surface-to-volume ratio and how this affects their properties.	**5**	**2**	**2**
	j).	**Describe** how Scanning Tunneling Microscopy (STM) helps in studying nanomaterials.	**5**	**2**	**2**
					5 x 10 =50Marks
		UNIT-1			
2.		**Apply** the knowledge of crystal structures to determine the coordination number and explain its significance in Simple Cubic, BCC, and FCC lattices. How does the coordination number affect the physical properties of metals?	**1**	**3**	**10**
		OR			
3.		**Apply** your understanding of crystal imperfections to explain point defects, line defects in crystalline solids with neat diagrams?	**1**	**3**	**10**

		UNIT-2			
4.		**Compare** the structures and properties of Grey Cast Iron, Malleable Cast Iron, and Spheroidal Graphite (SG) Cast Iron. Apply their characteristics to suggest suitable engineering applications for each type.	**2**	**3**	**10**
		OR			
5.		**Compare** the properties, composition, and uses of low carbon, medium carbon, and high carbon steels. Apply this classification to recommend suitable steels for construction, automotive components, and cutting tools.	**2**	**3**	**10**
		UNIT-3			
6.		**Classify** copper alloys into brasses and bronzes and analyze their suitability for marine and industrial applications.	**3**	**3**	**10**
		OR			
7.		**Apply** the properties of aluminium, magnesium, and titanium alloys to suggest their use in aerospace and automotive industries.	**3**	**3**	**10**
		UNIT-4			
8.		**Explain** how composites are classified and explain briefly about metal matrix composites?	**4**	**3**	**10**
		OR			
9.		**Describe** how Stir Casting and Filament Winding are used to make different composite parts. Give one example for each.	**4**	**3**	**10**
		UNIT-5			
10.		**Explain** how carbon nanotubes are made using Chemical Vapor Deposition.	**5**	**3**	**10**
		OR			
11.		**How** are nonmaterial's useful in batteries and cleaning the environment?	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23MEM201	**Minor**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

MANUFACTURING PROCESSES

(Minor Degree course in ME)

Course Objectives:

1.	To apply the principles of metal casting for manufacturing various mechanical components.
2.	To classify the welding processes, working of different types of welding processes.
3.	To understand the principles of forming, cold and hot working process, forging processes.
4.	To give a clear understanding of various machine tools.
5.	To know about various unconventional machining processes and 3D printing.

Course Outcomes: At the end of the course students are able to

S.No	Outcome	Knowledge Level
1.	**Determine** the manufacturing process and casting parameters based on product requirements and material properties.	**K3**
2.	**Use** suitable welding process to join various materials based on their applications.	**K3**
3.	**Apply** the knowledge of metal forming and forging processes to plan metal forming sequences for engineering applications.	**K3**
4.	**Apply** the principles of machining to choose suitable machine tool for various machining tasks.	**K3**
5.	**Apply** the principles of various unconventional machining processes and 3D printing technologies to produce complex geometries.	**K3**

SYLLABUS

UNIT-I (10Hrs)	**Manufacturing concepts:** Product cycle, Job, batch and mass production, Primary and secondary manufacturing processes. **Casting**: Moulding sand: ingredients, properties, preparation, types, Moulding tools, Steps involved in making a casting, Types of patterns, pattern materials, pattern allowances, Advantages of casting.
UNIT-II (10 Hrs)	**Welding**: Introduction to Welding, Classification of welding processes, types of welded joints and their characteristics, Plastic welding (Forge, Resistance), Fusion welding (Gas: Air-acetylene, Oxy-acetylene welding, Oxy-hydrogen,Arc: Shielded Metal Arc Welding, MIG, TIG), Solid-state welding (Friction, Ultrasonic, Diffusion),

	Soldering and Brazing.
UNIT-III (10 Hrs)	**Metal Forming:** Hot &Cold working, Rolling, Extrusion, Spinning, Drawing and Piercing. **Sheet Metal Forming:** Concept of spring back, Materials, operations: embossing, coining, stretch forming. **Forging:** Forgability, Forging Materials, Classification: smith, drop, press and machine forging, Forging Operations.
UNIT-IV (10 Hrs)	**Conventional Machining:** Cutting tools, machine tools, chips and its types, tool wear and tool life, Cutting fluids, Applications. **Machine tools using single point cutting tool:** lathe, shaper, planer – parts, specifications, operations and machining parameters. **Machine tools using multi point cutting tool:** drilling, milling, broaching – parts, specifications, operations and machining parameters.
UNIT-V (10 Hrs)	**Unconventional Machining:** Introduction, Need, AJM, Wire-EDM, ECM, LBM, PAM - Principle, working, advantages, limitations, Process Parameters and applications. **3D Printing**-Principle, Procedure, Classification, Advantages and Applications

Textbooks:	
1.	Manufacturing Processes by HN Gupta, RC Gupta, Arun Mittal
2.	Elements Of Workshop Technology Volume-2 by S.K. Hajra Choudhury, Nirjhar Roy; MPP Pvt.Ltd, 16th edition,2023
Reference Books:	
1.	A.Ghosh & A.K.Malik, Manufacturing Science, East West Press Pvt. Ltd, 2010
2.	R.K. Jain, Production Technology, Khanna Publishers, 2022.
3.	Production technology by P.C.Sharma, S.Chand and company,2006
4.	Manufacturing Technology Volume 2 (machine tools) by P N Rao, 4th edition,2018
5.	Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2/e, Springer, 2015.
e-Resources	
1.	https://elearn.nptel.ac.in/shop/nptel/principles-of-metal-forming-technology/?v=c86ee0d9d7ed
2.	https://archive.nptel.ac.in/courses/112/105/112105233/

					Course Code: B23MEM201
		SAGI RAMA RISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		III B.Tech. I Semester MODEL QUESTION PAPER			
		MANUFACTURING PROCESSES			
		(Minor Degree course in ME)			
Time: 3 Hrs.					**Max. Mars: 70 M**
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**(a)**	What is the difference between primary and secondary manufacturing processes?	**1**	**1**	**2**
	(b)	List out the advantages of casting.	**1**	**1**	**2**
	(c)	Explain Soldering and Brazing	**2**	**2**	**2**
	(d)	Classify the types of welding.	**2**	**2**	**2**
	(e)	Explain the concept of spring back.	**3**	**2**	**2**
	(f)	Compare Drop forging and press forging.	**3**	**2**	**2**
	(g)	What is the difference between single and multi-point cutting tools?	**4**	**1**	**2**
	(h)	List out the specifications of a lathe machine.	**4**	**1**	**2**
	(i)	What are the applications of unconventional machining?	**5**	**1**	**2**
	(j)	List out the advantages of 3D printing.	**5**	**1**	**2**
					5 x 10 = 50 Marks
		UNIT-1	**CO**	**KL**	**M**
2.		Demonstrate the different types of patterns with neat sketches.	**1**	**3**	**10**
		OR			
3.		Use neat sketch to explain different pattern allowances.	**1**	**3**	**10**
		UNIT-2			
4.		Compute the differences between MIG and TIG welding.	**2**	**3**	**10**
		OR			
5.		Discuss shielded metal arc welding and submerged arc welding using neat sketches.	**2**	**3**	**10**
		UNIT-3			

6.		Discuss embossing, coining and stretch forming with a neat sketch.	**3**	**2**	**10**
		OR			
7.		Explain different forging operations with neat sketches.	**3**	**2**	**10**
		UNIT-4			
8.		Compute the differences between shaper and planar.	**4**	**3**	**10**
		OR			
9.		Explain about the up milling and down milling processes using a neat sketch	**4**	**3**	**10**
		UNIT-5			
10.		Demonstrate the working of laser beam machining using a neat sketch.	**5**	**3**	**10**
		OR			
11.		Determine the step by step procedure in 3D printing.	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Code	Category	L	T	P	C	C.I.E.	S.E.E.	Exam
B23MEM301	**MINOR**	**3**	**--**	**--**	**3**	**30**	**70**	**3 Hrs.**

ENGINEERING MECHANICS & STRENGTH OF MATERIALS

(Minor Degree course in ME)

Course Objectives:

1.	To learn fundamental concepts of kinematics of particles to the analysis of simple, practical
2.	To familiarize Trusses and frictional forces in mechanical applications.
3.	Apply the concept of stress and strain to analyse under axial, shear and bending loads, and

Course Outcomes

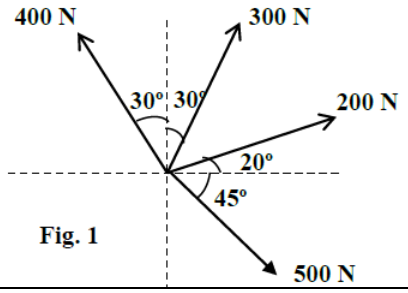
S.No	Outcome	Knowledge
1.	**Solve** for the resultant of the given force systems & Analyzeforce systems using	**K3**
2.	**Determine** centroid, center of gravity and moment of inertia of areas and	**K3**
3.	Analyze the forces of the members in trusses and **Solve** problems on frictional	**K3**
4.	Understand the concepts of simple stresses & strains and **Apply** analytical	**K3**
5.	**Determine** the flexural and Torsional stress distributions of beams subjected to	**K3**

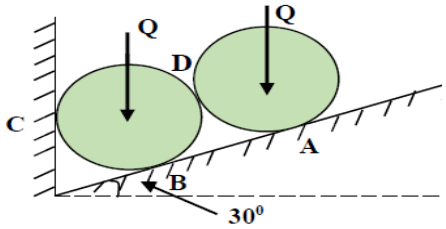
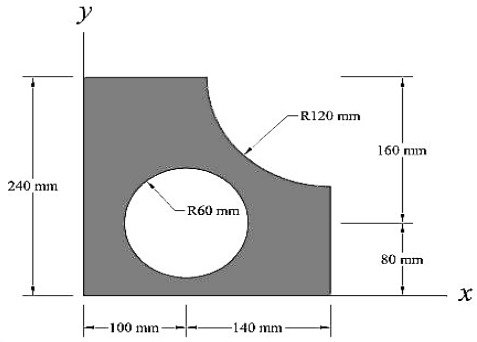
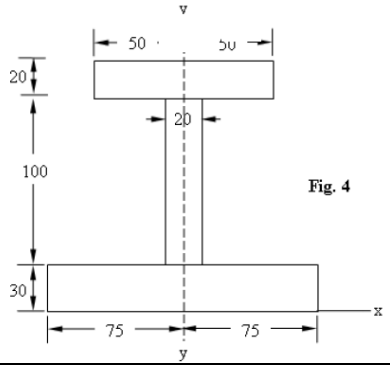
SYLLABUS

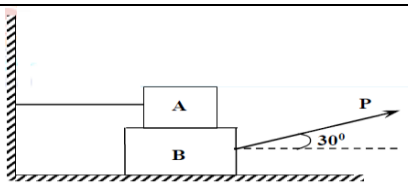
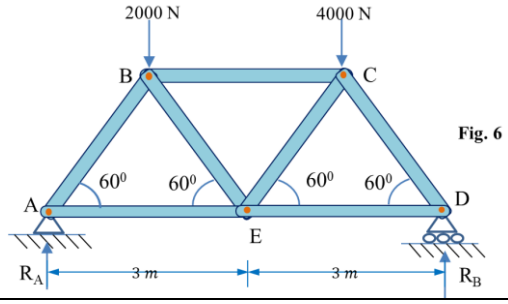
UNIT-I (10Hrs)	**Introduction to Engineering Mechanics**– Basic Concepts - Scope and Applications System of Forces: Force, Specification of force - Resultant of Force Systems - Coplanar Concurrent Forces–Free Body Diagrams, Moment of a force, Equations of Equilibrium of Coplanar Systems.
UNIT-II (10 Hrs)	**Parallel Force System:** Equilibrium Conditions- Concept of Centroid - Centroid of simple figures - Centroid of Composite Figures. **Area Moments of Inertia:** Definition - Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of rectangular, circular, I, and T sections
UNIT-III (10 Hrs)	**Equilibrium of Systems of Forces:** General case of Force system - Analysis of plane trusses, Method of Joints and Method of Sections for plane trusses. **Friction:** Introduction, limiting friction and impending motion, Coulomb's laws of dry friction, coefficient of friction, Application of Friction - wedge and ladder friction.

UNIT-IV (10 Hrs)	**Simple Stresses:** Stress, Strain, Stress-Strain curve, Lateral strain, Poisson's ratio and factor of safety; Bars of varying cross-section, Strain energy due to axial loading. **Shear Forces and Bending Moments:** Beam - types of loads, types of supports, types of beams, Shear Force and Bending Moment; S.F. and B.M. diagrams for cantilever, simply supported beams subjected to different loads
UNIT-V (10 Hrs)	**Flexure Stresses in Beams**: Theory of pure bending, Flexural formula, Section modulus of rectangular, circular, I, and T sections, Determination of bending stress. **Torsional Stresses in Shafts:** Pure torsion, Torsion formula, analysis of torsional stresses for circular cross-section parts.

Textbooks:	
1.	Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Patti. McGraw Hill
2.	Engineering Mechanics: Statics and Dynamics; A.K.Tayal
3.	Analysis of Structures byVazirani and Ratwani - Vol. 1, Khanna Publishers
Reference Books:	
1.	Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
2.	Strength of Materials by Timoshenko, CBS Publishers.
3.	Strength of Materials by Sadhu Singh, Khanna Publishers.
e-Resources	
1.	https://mechanicalc.com/reference/strength-of-materials
2.	https://nptel.ac.in/courses/122104014/
3.	https://nptel.ac.in/courses/112103108/
4.	https://nptel.ac.in/courses/112103109/

				Course Code: B23MEM301	
		SAGI RAMA RISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		III B.Tech. II Semester MODEL QUESTION PAPER			
		ENGINEERING MECHANICS & STRENGTH OF MATERIALS			
		(Minor Degree course in ME)			
Time: 3 Hrs.				**Max. Mars: 70 M**	
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
				10 x 2 = 20 Marks	
			CO	**KL**	**M**
1.	**(a)**	Distinguish between scalar and vector quantities.	**1**	**1**	**2**
	(b)	State Varignon's theorem	**1**	**1**	**2**
	(c)	Distinguish between centroid and Centre of gravity.	**2**	**2**	**2**
	(d)	State the perpendicular axis theorem	**2**	**2**	**2**
	(e)	Write the difference between perfect truss and imperfect truss.	**3**	**2**	**2**
	(f)	State laws of friction	**3**	**2**	**2**
	(g)	Define Factor of Safety	**4**	**1**	**2**
	(h)	List out different types of beams.	**4**	**1**	**2**
	(i)	Define section modulus	**5**	**1**	**2**
	(j)	Write the torsion equation and explain the terms in it.	**5**	**1**	**2**
				5 x 10 = 50 Marks	
		UNIT-1	**CO**	**KL**	**M**
2.	**a)**	Determine the resultant and its position of the force system shown in Fig 1.  Fig. 1	**1**	**3**	**6**
	b)	Two forces act at an angle of 120o. The bigger force is 40 N and the resultant is perpendicular to the smaller force. Determine the smaller force.	**1**	**3**	**4**
		OR			
3.		Two identical rollers, each weighting Q = 100 N are supported by an inclined plane and a vertical wall as shown in Fig. 2. Applying conditions	**1**	**3**	**10**

		of equilibrium, determine the reactions at points of support A, B and C. Assuming the surfaces are smooth.  **Fig.2**			
		UNIT-2			
4.		Determine the centroid of shaded region as shown in Fig. 3  Fig 3	**2**	**3**	**10**
		OR			
5.		Determine the Moment of Inertia about its centroidal axes of the composite area shown below in Fig. 4. (All dimensions are in mm).  **Fig. 4**	**2**	**3**	**10**
		UNIT-3			
6.		A block weighing 150 N is resting on another block B of weight 250 N and tied to the wall by a rope as shown in Fig**.** 5. The block B is resting on horizontal floor. The static friction between blocks A and B is 0.2 and between block B and floor is 0.25. A force P whose inclination with horizontal is 30˚, is applied to block B such that motion impends. Find the magnitude of forces P and tension in the rope.	**3**	**3**	**10**

		 Fig. 5			
		OR			
7.		Determine forces in all members of the truss shown in Fig. 6 below.  Fig. 6	**3**	**3**	**10**
		UNIT-4			
8.		A mild steel bar 25 mm diameter and 250 mm long is placed inside a brass tube, having an external diameter of 30 mm and internal diameter of 25 mm. The combination is then subjected to an axial load of 45 KN. Find (a) the stresses in the tube and the rod, (b) the shortening of rod. Take Es= 210 GPa, and E = 80 GPa.	**4**	**3**	**10**
		OR			
9.		A beam 8.5 m long rests on supports 5 m apart. The beam carries aUDL of 50 kN/m length between the supports. The beam also carries apoint load of 60 KN at the mid span. Construct the SFD and BMD.	**4**	**3**	**10**
		UNIT-5			
10.		Stating the assumptions of pure bending and derive the Flexure formula $\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$	**5**	**3**	**10**
		OR			
11.		A solid circular shaft has to transmit 120 kW at 120 rpm. Themaximum torque is 25% greater than the mean torque. Find thediameter of the shaft required if the maximum shear stress is not toexceed 80 N/mm² and the angle of twist is not to exceed 1º in a lengthof 250 cm. Take G = 8 X 104 N/mm².	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23MEM302	Minor	3	--	--	3	30	70	3 Hrs.

AUTOMOBILE ENGINEERING

(Minor Degree course in ME)

Course Objectives:

1.	To make students familiar with the constructional details of chassis and body and Electric Vehicles
2.	To understand about various steering systems, Transmission system, steering gear boxes and power steering
3.	To introduce students to the rear axles and types of suspension systems.
4.	To introduce students to braking systems, wheels and tyres and provides the information on various aspects of vehicle maintenance.
5.	To understand Trouble Shooting and Maintenance.

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

S.No	Outcome	Knowledge Level
1.	**Illustrate** the Automobile layout, Electric Vehicles	**K2**
2.	**Illustrate** various types and working principles of clutch, gearbox, drive shaft and final drive systems.	**K2**
3.	**Illustrate** key elements of Steering geometry in automobile and suspension systems, wheels, tires.	**K2**
4.	**Illustrate** the concepts of brakes, electrical and electronic systems, pollution Control methods.	**K2**
5.	**Apply** trouble shoot and maintenance in Automotive Vehicles.	**K3**

SYLLABUS

UNIT-I (10Hrs)	**Introduction to Automobile**, Automobile Layout, Chassis and body, Types of automobile engines, engine parts, Air filters, Electric vehicles(EV) and Hydrogen cells.
UNIT-II (10 Hrs)	**Clutches:** principle, Types: cone clutch, single plate clutch, , Multi plate clutch, Fluid coupling. **Gearbox:** Construction and Working Principle, , Types: Sliding mesh, Constant mesh, Synchromesh, Torque converter. **Drive shaft and Final Drive:** Differential, Power transmission: Front, Rear and Four-

	wheel drive.
UNIT-III (10 Hrs)	**Suspension System:** Leaf springs, Coil springs, Torsion bar, Shock absorber. **Steering System:** Steering geometry: camber, caster, Kingpin angle, Toe-in, and Toe-out. Steering gear ratio, Power-Steering **Wheels:** Disc and Drum type, Tires: Tire Construction, Tube and Tubeless Tires.
UNIT-IV (10 Hrs)	**Braking System:** Necessity, Parking and Power Brakes, Parts and Working Principle of Mechanical, Air and. Hydraulic Brakes: Master and Wheel cylinder, Anti-lock Braking System. **Air pollution and their control:** Catalytic Converters, **Electrical and Electronic system:** Starting System, Ignition system, battery, ECU/ECM. **Batteries**: Types of batteries.
UNIT-V (10 Hrs)	**Trouble shooting and Maintenance:** Engine and Vehicle Troubles: Descriptions and their Causes and Remedies, Periodic Maintenance, Preventive and Breakdown.
Textbooks:	
1.	Automotive Mechanics (10/e) - William H. Crouse and Donald L. Anglin, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-059054-0.
2.	Automobile Engineering – KK Jain/ RB Asthana, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-044529-X.
3.	Electric and Hybrid Vehicles, Tom Denton, Taylor & Francis,2018.
4.	Mehrdad Eshani, Yimi Gao, Sebastian E. Gay, Ali Emadi, "Modern Electric, Hybrid Electric and Fuel Cell Vehicles:Fundamentals, Theory and Design", CRC Press, 2nd Edition (Unit-I,II)
Reference Books:	
1.	Automotive Mechanics – S. Srinivasan, Tata McGraw-Hill Publishing company Limited, ISBN: 0-07-044941-6
2.	Internal Combustion Engines – Heywood, John, B. McGraw-Hill Publications Limited.
3.	Automotive Engines- S Srinivasan, Tata McGraw-Hill Publishing Company Limited, ISBN: 0-07-040265-5.
4.	Hybrid Vehicles and the future of personal transportation, Allen Fuhs, CRC Press,2011.
e-Resources:	
1.	https://nptel.ac.in/courses/107/106/107106088/
2.	https://nptel.ac.in/courses/108/103/108103009/
3.	https://www.theengineerspost.com/category/automobile-engg

					Course Code: B23MEM302
		SAGI RAMA RISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		III B.Tech. II Semester MODEL QUESTION PAPER			
		AUTOMOBILE ENGINEERING			
		(Minor Degree course in ME)			
Time: 3 Hrs.					**Max. Mars: 70 M**
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**(a)**	What is an Automobile?	**1**	**2**	**2**
	(b)	What is the function of clutch? Write its classifications.	**1**	**1**	**2**
	(c)	What is meant by hydrogen cell?	**2**	**1**	**2**
	(d)	What is the use of differential in an automobile?	**2**	**1**	**2**
	(e)	Write the difference between slip joint and U-joint.	**3**	**1**	**2**
	(f)	What are the need of engine cooling and lubrication?	**3**	**1**	**2**
	(g)	Write the use of master cylinder.	**4**	**1**	**2**
	(h)	Name the basic components of any suspension system.	**4**	**1**	**2**
	(i)	What is a spark plug and what is its role?	**5**	**1**	**2**
	(j)	What is the purpose of a radiator in a vehicle?	**5**	**1**	**2**
					5 x 10 = 50 Marks
		UNIT-1	**CO**	**KL**	**M**
2.		What are the components of an automobile? Explain some of them?	**1**	**3**	**10**
		OR			
3.		Describe the main components of an electric vehicle power train and briefly explain their functions.	**1**	**3**	**10**
		UNIT-2			
4.		Explain the principle of a clutch. Discuss its importance	**2**	**3**	**10**
		OR			
5.		What is Differential? Explain with a neat Diagram?	**2**	**3**	**10**
		UNIT-3			
6.		Explain the Ackermann Steering mechanism with neat sketch	**3**	**3**	**10**

		OR			
7.		What is meant by Wheel alignment? Write short notes on Caster and Camber?	**3**	**2**	**10**
		UNIT-4			
8.		Explain the working of hydraulic brake system with neat diagram	**4**	**3**	**10**
		OR			
9.		List the various pollutants from the automobile. List the various Technologies used to control them	**4**	**3**	**10**
		UNIT-5			
10.		Discuss the typical fault symptoms of a malfunctioning transmission system (manual or automatic). How would you test and troubleshoot it?	**5**	**3**	**10**
		OR			
11.		What is the difference between scheduled and unscheduled maintenance?	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks

Course Code	Category	L	T	P	C	I.M	E.M	Exam
B23MEM401	Minors	2	1	--	3	30	70	3Hrs.

THERMAL ENGINEERING

(Minor Degree course in ME)

Course Objectives: The objectives of the course are

1.	To impart the knowledge of thermodynamic laws and principles
2.	To enable the student to prepare an energy audit of any mechanical system that exchanges heat and work with the surroundings.
3.	To expose the basic principles of steam properties and industrial application of steam
4.	TostudythethermodynamicanalysisofRankinecycleanditsmodifications.

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

S.No	Outcome	Knowledge Level
1.	**Apply** the concepts of thermodynamics to real life systems.	**K3**
2.	**Apply** the first law of thermodynamics to compute various thermodynamic Properties subjected to different thermodynamic processes.	**K3**
3.	**Determine** the performance of heat engines and heat pumps using concepts of Second law of thermodynamics.	**K3**
4.	**Apply** the phenomena of pure substances in calculating the properties of steam in Different scenarios.	**K3**
5.	**Compute** the performance parameters of ideal and modified Rank in e cycles.	**K3**

SYLLABUS

UNIT-I (8Hrs)	**Basic Concepts**: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Thermodynamic Equilibrium, State, Property, Process, Cycle, Reversibility, Quasi static Process, Irreversible Process, Energy in StateandinTransition,Types,WorkandHeat,PointandPathfunction.Zerothlawof thermodynamics
UNIT-II (10Hrs)	**First law of thermodynamics:** Joule's Experiments-First law of thermodynamics-Isolated systems and steady flow systems- Specific heats at constant volume and pressure- Enthalpy- First law applied to flow systems- Systems undergoing a cycle and change of state. **First law applied to steady flow processes:** various non-flow processes-Properties of

	end states-Heattransferandworktransfer-Changeininternalenergy-throttlingandfree Expansion processes.
UNIT-III (10 Hrs)	**Second law of thermodynamics:** Limitations of the First Law – Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance, Second Law of Thermodynamics, Kelvin Planck and Clausius Statements and their Equivalence Corollaries, PMM of Second kind, Third Law of thermodynamics.
UNIT-IV (12Hrs)	**Properties of Pure Substance:** Definition of pure substance, phase change of a pure substance, p-T (Pressure-Temperature) diagram for a pure substance, p-V-T(PressureVolume-Temperature) surface, phase change terminology and definitions, Formation ofsteam, determining various properties like Enthalpy, Entropy, Internal energy during steam formation, Enthalpy-Entropy (h-s) charts (Mollier's diagram), Determination of dryness fraction using Tank or bucket calorimeter, throttling calorimeter, separating and throttling calorimeter.
UNIT-V (8Hrs)	**Vapor Power Cycles:** Vapor power cycle- Rankine cycle- Reheat cycle (single Reheater)-Regenerativecycle-Thermodynamicvariablesaffectingefficiencyandoutputof Rankineand Regenerative cycles (Single open feed water heater)- Improvements of efficiency, Binary vapor powe rcycle

Note: Steam Table book by RS Khurmi is allowed.

Text Books:

1.	Applied Thermodynamics-IbyR.Yadav,CentralBookHouse.
2.	EngineeringThermodynamics,PKNag6thEdition,McGrawHill.
3.	Thermal Engineering,byR.K. Rajput,LakshmiPublications.

Reference Books:

1.	A Treatise on Heat Engineering by VasandhaniandKumar.
2.	Thermodynamics-An Engineering Approach by YCengel&Boles.
3.	Thermal Science and Engineering by D.S.Kumar,S.K.Katariaand Sons.
4.	Thermal Engineering by PL Ballaney,KhannaPublishers.
5.	Thermal Engineering by M.L. Marthur&Mehta, Jainbros.Publishers.

e-Resources:

1.	https://nptel.ac.in/courses/127/106/127106135/#

2.	https://nptel.ac.in/courses/112/103/112103275/#

					Course Code: B23MEM401
		SAGI RAMA KRISHNAM RAJU ENGINEERING COLLEGE (A)			**R23**
		IV B.Tech. I Semester MODEL QUESTION PAPER			
		THERMAL ENGINEERING			
		(Minor Degree course in ME)			
Time: 3 Hrs.					**Max. Marks: 70 M**
		Answer Question No.1 compulsorily			
		Answer **ONE Question** from **EACH UNIT**			
		Assume suitable data if necessary			
					10 x 2 = 20 Marks
			CO	**KL**	**M**
1.	**a).**	State the Quasi static Process	**1**	**1**	**2**
	b).	Describe the heat and work	**1**	**2**	**2**
	c).	State the first law of thermodynamics	**2**	**1**	**2**
	d).	Define Internal Energy	**2**	**1**	**2**
	e).	Give the Clausius statement of the second law	**3**	**1**	**2**
	f).	State the PMM of Second kind	**3**	**1**	**2**
	g).	Define Dryness fraction	**4**	**1**	**2**
	h).	Define the saturated steam	**4**	**1**	**2**
	i).	What are the different components of a Rankine cycle.	**5**	**1**	**2**
	j).	What is a Binary vapor power cycle	**5**	**1**	**2**
					5 x 10 =50Marks
		UNIT-1			
2.		What do you mean by thermodynamic System? Discuss different types of systems	**1**	**2**	**10**
		OR			
3.		Discuss about Macroscopic and Microscopic viewpoints	**1**	**2**	**10**
		UNIT-2			
4.		Explain the joules experiment. State its importance in thermodynamics.	**2**	**2**	**10**
		OR			
5.		A turbine operates under study flow condition receives steam at the following state: pressure= 1.2 Mpa, Temperature =188^0C, Enthalpy= 2785 KJ/Kg, Velocity =33.3 m/sec and elevation=3m. The steam leaves the turbine at the following state: pressure= 20Kpa, Enthalpy= 2512 KJ/Kg, Velocity =100 m/sec and elevation=0m.Heat is lost to the	**2**	**3**	**10**

		surrounding at the rate of 0.29KJ/sec. If the steam flow to the turbine is 0.42 Kg/sec Determine the power output of the turbine in KW			
		UNIT-3			
6.		Discuss the limitations of first law of thermodynamics. State the various statements of second law of thermodynamics.	**3**	**2**	**10**
		OR			
7.		A fish freezing plant requires 40 tons of refrigeration. The freezing temperature is – 35°C while the ambient temperature is 30°C. If the performance of the plant is 20%of the theoretical reversed Carnot cycle working within the same temperature limits, calculate the power required. Take: 1 ton of refrigeration = 210 kJ/min.	**3**	**3**	**10**
		UNIT-4			
8.		Calculate the internal energy, enthalpy and entropy of 1kg of steam at 10 bars, when the condition of steam is (i) 0.9 dry, (ii) dry and saturated, (iii) superheated steam at 225^{o}C	**4**	**3**	**10**
		OR			
9.		Explain in detail with a neat sketch the working of throttling calorimeter.	**4**	**2**	**10**
		UNIT-5			
10.		Illustrate the working of steam power plant with reheat cycle.	**5**	**2**	**10**
		OR			
11.		In a steam turbine Steam at 20 bar & 350^{o}C is expanded to 0.08 bar. It then enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Assume ideal processes, Calculate per kg of steam the network and the cycle efficiency	**5**	**3**	**10**

CO-COURSE OUTCOME **KL-KNOWLEDGE LEVEL** **M-MARKS**

NOTE : Questions can be given as A,B splits or as a single Question for 10 marks