Department of Automobile Engineering

Academic Year 2017-18

Third and Fourth Semesters B.E
Scheme and Syllabus

VISION

To become a centre of excellence by providing good education in the field of automobile engineering embedded with human values.

MISSION

- To shape the students into the best automobile engineers by providing supportive and diverse environment.
- Encouraging the participation in industry specific domains and research work to achieve the best of their abilities.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

- To produce competent and innovative automobile engineers for fulfilling the needs of the industry.
- To provide clear understanding of the concepts, principles, analysis and implementation of automobile design, thermal and production domains.
- To promote a spirit of free and objective enquiry in different fields of knowledge to ignite the creative minds for research and innovation, enabling them for lifelong learning.
- To encourage the individual to develop excellent communication skills and leadership qualities to enable them to be professional and well rounded engineers capable of working in multi disciplinary teams.

Program Educational Outcomes	M1 (Supportive & Diverse Environment)	M2 (Industry Participation)	M3 (Research Domain)
PEO-1: To produce competent and innovative automobile engineers for fulfilling the needs of the industry.	1	2	1
PEO-2: To provide clear understanding of the concepts, principles, analysis and implementation of automobile design, thermal and production domains.	2	2	1
PEO-3: To promote a spirit of free and objective enquiry in different fields of knowledge to ignite the creative minds for research and innovation, enabling them for lifelong learning.	1	2	2
PEO-4: To encourage the individual to develop excellent communication skills and leadership qualities to enable them to be professional and well rounded engineers capable of working in multi disciplinary teams.	2	2	1

PEO-5: To inculcate in the student intellectual skills, courage and integrity, awareness of and sensitivity to the needs and aspirations of the society.	2	2	1

- To inculcate in the student intellectual skills, courage and integrity, awareness of and sensitivity to the needs and aspirations of the society.

MAPPING OF PEOs TO DEPARTMENT MISSION

PROGRAM OUTCOMES (POs)

Graduate Attributes	PO #	Program Outcomes
Engineering knowledge	1	Apply the knowledge of mathematics, science, engineering fundamentals, and engg. specialization to the solution of complex engineering problems
Problem analysis	2	Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences
Design / Development of Solutions	3	Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
Conduct Investigations of Complex Problems	4	Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
Modern tool usage	5	Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations, and servicing of automobiles.
The Engineer and society	6	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.
Environment and sustainability	7	Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of need for sustainable development.
Ethics	8	Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
Individual & team work	9	Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Communication	10	Communicate effectively on complex engineering activities with the engineering community and with society at large. Some of them are, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
Project management and finance	11	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.
Lifelong learning	12	Recognise the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

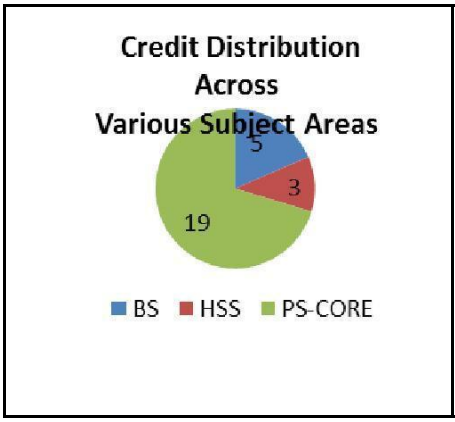
PROGRAM SPECIFIC OUTCOMES (PSOs)

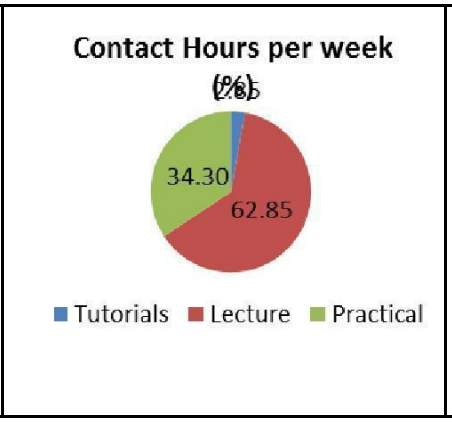
After successful completion of Automobile Engineering Program, the graduates will be able to:

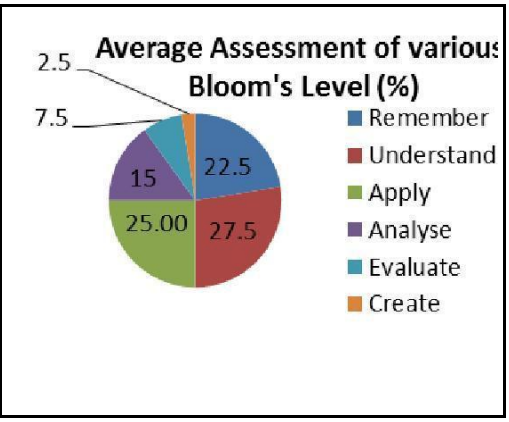
PSO1	Design and Analyze Automobile components using conventional and CAD/CAE tools
PSO2	Modify and Fabricate Automobiles as per specifications
PSO3	Fulfil the industry requirements in terms of Service and Maintenance of Automobiles

New Horizon College of Engineering
Department of Automobile Engineering
Scheme of CYCLE A

Sl. No	Course Code	Course	Credit Distribution				Overall Credits	Contact Hours weekly- Theory	Contact Hours weekly- (Lab)	Marks		
			L	P	T	S				CIE	SEE	Total
1	MAT31/41	Engineering Mathematics-3/ 4	4	0	1	0	5	6	0	50	50	100
2	HSS322/422	Life skills for engineers	2	0	0	1	3	2	0	50	50	100
3	AUT331/431	Computer Aided Machine Drawing	3	0	0	1	4	3	0	50	50	100
4	AUT341/441	Casting & Forging Technology + Lab	3	2	0	0	5	3	4	75	75	150
5	AUT351/451	Mechanics of Materials + Lab	3	2	0	0	5	3	4	75	75	150
6	AUT361/461	Material Sc. & Metallurgy + Lab	3	2	0	0	5	3	4	75	75	150
Total							**27**	**20**	**12**	**375**	**375**	**750**





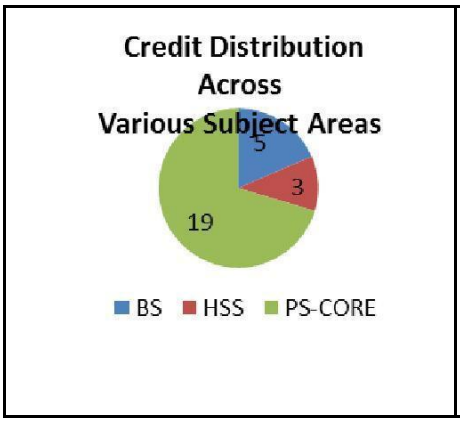


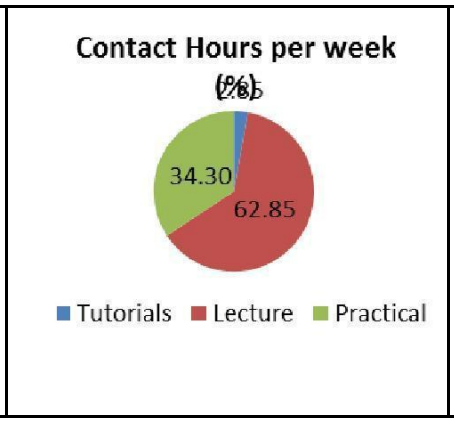
New Horizon College of Engineering

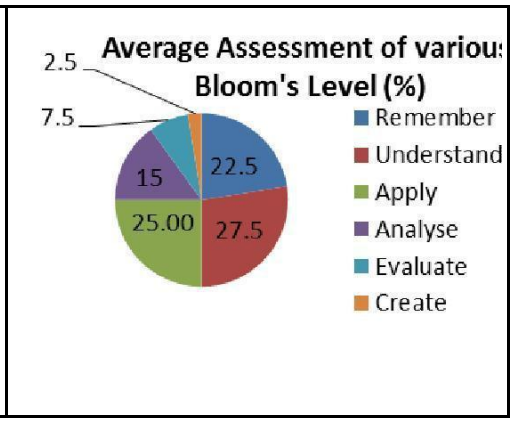
Department of Automobile Engineering

Scheme of CYCLE B

Sl.No	Course Code	Course	Credit Distribution				Overall Credits	Contact Hours weekly Theory	Contact Hours weekly (Lab)	Marks		
			L	P	T	S				CIE	SEE	Tot
1	MAT31/ 41	Engineering Mathematics-3/4	4	0	1	0	5	4	0	50	50	100
2	HSS321 /421	Economics for Engineers	2	0	0	1	3	2	0	50	50	100
3	AUT332 /432	Basic Thermodynamics	3	0	0	1	4	3	0	50	50	100
4	AUT342 /442	Machines for Manufacturing Technology+Lab	3	2	0	0	5	3	4	75	75	150
5	AUT352 /452	Mechanical Measurement& Metrology+Lab	3	2	0	0	5	3	4	75	75	150
6	AUT462 /462	Fluid Mechanics+Lab	3	2	0	0	5	3	4	75	75	150
Total							**27**	**18**	**12**	**375**	**375**	**750**







CYCLE A

(SYLLABUS)

LIFE SKILLS FOR ENGINEERS

Course Code : HSS322/ HSS422 **Credits : 3**
L:P:T:S : 2:0:0:1 **CIE Marks : 50**
Exam Hours : 03 **SEE Marks : 50**

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

CO1	Take responsibility for their actions and be accountable to themselves
CO2	Acquire Corporate etiquettes and develop their personality for their professional career
CO3	Understand and learn to manage themselves better and to work with groups
CO4	Set their personal and professional goals by themselves
CO5	Articulate effectively their ideas, thoughts and concepts

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	P010	PO11	PO12
CO1	-	-	-	-	-	3	3	3	3	3	-	-
CO2	-	-	-	-	-	3	3	3	3	3	-	-
CO3	-	-	-	-	-	3	3	3	3	3	-	-
CO4	-	-	-	-	-	3	3	3	3	3	-	-
CO5	-	-	-	-	-	3	3	3	3	3	-	-

SYLLABUS

Module	Contents of the Module	Hours	COs
1.	Taking Ownership, Being Responsible and Accountable for their own actions The meaning of ownership, responsibility and accountability, Practicing these philosophies in everyday life, how do these philosophies build credibility, Developing a 'Credible Character Impression about yourself', Self motivation, Developing healthy Self esteem, Leadership	**4**	**CO1**
2.	**Personality Development and Grooming** Expectations from the industry, building personal presence, corporate grooming, corporate etiquettes, developing personal work code, corporate code of conduct	**10**	**CO2**
3.	**Self Awareness and Self Management** Knowing your own self- understanding personality, perception, values and attitude. Interpersonal skills - Knowing others, working well with others, developing the right attitude for work, being proactive and positive.	**10**	**CO3**
4.	**GOAL Setting**	**4**	**CO4**

	Importance of Goals, Creating SMART goals , Tips for effective execution of goals		
5.	**Articulation and Group Discussion** Ideas generation, expressing thoughts in a logical flow, presenting views in a group	**8**	**CO 5**

Reference Books:

1. The 7 – Habits of Highly Effective People, Stephen R Covey, Neha Publishers.
2. Seven Habits of Highly Effective Teens, Convey Sean, New York, Fireside Publishers, 1998.
3. Emotional Intelligence, Daniel Coleman, Bantam Book, 2006.
4. How to win friends and influence people, Dale Carnegie

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category	**TEST**	**Self Study**	**Quiz**	**Assignment**
Remember			5	
Understand				5
Apply	5		5	5
Analyze	5			
Evaluate				
Create		15		5

SEE- Semester End Examination (50 Marks)

Blooms' Category	**GROUP DISCUSSION**
Remember	5
Understand	10
Apply	10
Analyse	10
Evaluate	5
Create	10

COMPUTER AIDED MACHINE DRAWING

Course Code: AUT331/431 **Credits: 03+01**
L:P:T:S: 3:0:0:1 **Exam Hours : 03**
CIE Marks: 50 **SEE Marks: 50**

Course Outcomes: At the end of the Course, the student will be able:

CO1	Evaluate problems on sections of regular solids
CO2	Analyze the conversion of pictorial views into orthographic projections
CO3	Apply the limits and tolerance on component dimensions along with GD&T and super finish symbols representation.
CO4	Creation of mechanical systems in 3D environment
CO5	Analyze the sketching of CAM profiles for different follower motions
CO6	Understand the different types of threads and joints which are used in industries

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	2	-	-	-	-	2	2	2	2
CO2	3	3	3	2	-	-	-	-	2	2	2	2
CO3	3	3	3	3	-	-	-	-	2	2	2	2
CO4	3	3	3	2	-	-	-	-	2	2	2	2
CO5	2	3	3	2	-	-	-	-	2	2	2	2
CO6	3	2	2	1	-	-	-	-	2	2	-	2

Module No.	**Module Contents**	Hours	Cos
1	**Sections of Solids**: Sections of Pyramids, Prisms, Cubes, Tetrahedrons, Cones and Cylinders resting only on their bases (No problems on axis inclinations, spheres and hollow solids), True shape of sections **Orthographic Views**: Conversion of pictorial views into orthographic projections of simple machine parts with or without section. (BIS conventions are to be followed for the drawings) Hidden line conventions, Precedence of lines (Only Sketching)	8	CO1, CO2
2	**Thread Forms & Fasteners**: Thread terminology, Popular forms of screw threads, simple assembly using stud bolts with nut and lock nut. Flanged nut, slotted nut, taper and split pin for locking, counter sunk head screw, grub screw, Allen screw **Riveted joints**: Forms and proportions of rivet heads, Single and double riveted lap joints, butt joints with single/double cover straps (Chain and Zigzag, using snap head rivets)(Software Drafting)	8	CO6
3	Limits, Fits and Tolerances: General aspects, Nominal size and basic dimensions, Definitions, Basis of fit or limit system, Systems of specifying tolerances, Designation of holes, Shafts and fits, Need of Geometrical Tolerance, Geometrical characteristics of symbols, Indication of Geometrical Tolerance, Surface finish representation (Theory/NumericalQuestion)	8	CO3

4	**Cams & Followers**: Types of cams and followers, follower motions of SHM, Uniform acceleration & retardation, uniform velocity and cycloidal motion. Disc cams with reciprocating follower having knife edge and roller (only inline). (Software Drafting)	9	CO5
5	**Assembly Drawings**: Screw jack (only demo), Plummer block, Machine vice, Tailstock of lathe, Tool head of a shaper, I.C. Engine connecting rod, Rams Bottom Safety Valve, Drilling jig (Sketching + Software Drafting)	12	CO4

NOTE: In the Semester End Examination, the examiner will set ONE question from each module 1 to 4 and TWO questions from Module 5. The students will be required to attempt first FOUR questions compulsory and any ONE question from module-5.

Text Books:

1. Machine Drawing- K.L. Narayana, P.Kannaiah & K.Venkata Reddy, New Age Publishers,4th Ed, 2017, **ISBN-13:** 978-8122440546
2. Machine Drawing- K.R. Gopala Krishna, Subhash publication. **ISBN-13** 9789383214235
3. Machine Drawing- Dhawan, S.Chand Publications, 2nd Ed, ISBN 9788121908245.

Reference Books:

1. Machine Drawing, ND Bhat, Charotar publication house, 49th Ed, **ISBN-13:** 978-9380358888
2.Theory of Machines, S S Rattan, Tata McGraw – Hill Publishing Company Limited, 4th Edition, 2014, **ISBN:** 9789351343479

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	30	10	10
Remember	5		5
Understand	5	05	5
Apply	5	5	
Analyze	5	5	
Evaluate	5		
Create			

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

CASTING AND FORGING TECHNOLOGY

Course Code : AUT341/441 | **Credits : 05**
L:P:T:S : 3:2:0:0 | **CIE Marks : 50+25**
Exam Hours. : 03+03 | **SEE Marks : 50+25**

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

CO1	Gain the basic knowledge of manufacturing process.
CO2	Know the basics of sand moulding.
CO3	Identify the various moulding processes for casting
CO4	Gain the knowledgeon the various types of melting furnaces.
CO5	Study the various concepts of forging
CO6	Aware of the basic inspection methods.

Mapping of Course Outcomes to Program Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**POI 0**	**POI I**	**PO12**
CO 1	3	2	3	1	2	2	1	1	2	2	2	1
CO 2	2	2	3	2	1	1	2	1	2	2	2	1
CO 3	2	2	3	2	1	1	2	1	2	2	2	1
CO 4	3	3	1	1	1	2	1	1	3	2	2	1
CO 5	3	2	3	1	2	2	1	1	2	2	2	1
CO 6	2	2	3	2	1	1	2	1	2	2	2	1

Module No	Module Contents	Hrs	COs
1	**Introduction:** Concept of Manufacturing process, itsimportance. Classification of Manufacturing processes.Introduction to Casting process & steps involved. Componentsproduced by casting process. Advantages & Limitations ofcasting process. **Patterns:** Definition, functions, Materials used for pattern,various pattern allowancesand theirimportance.Classification of patterns, BIS color coding of Patterns. **Binder:** Definition, Types of binder used in mouldings sand. **Additives:** Need, Types of additives used and their properties	09	**CO1**
	List of Experiments 1. Use of foundry tools and other equipment 2. Preparation of moulds using two moulding boxes with and without pattern	08	
2	**Sand Moulding:** Types of base sand, requirement of basesand. Moulding sand mixture ingredients for different sandmixtures. Method used for sand moulding, such as Greensand, dry sand and skin dried moulds. **Cores**: Definition, Need, Types. Method of making cores,Binders used, core sand moulding. **Concept of Gating & Risers**: Principle and types. **Fettling and cleaning of castings:** Basic steps, Casting defects,Causes, features and remedies. **Inspection Methods** – Methods used for Inspection of castingand welding. Visual, Magnetic particle, Fluorescent particle,Ultrasonic, Radiography, Eddy current, Holography methods ofInspection.	09	**CO2,CO3, CO6**
	List of Experiments 1. Preparation ofcasting (Aluminium or cast iron – Demonstration only). 2. Compression, shear and tensile tests on universal sandtesting machine	08	
3	**Moulding Machines**: Jolt type, Squeeze type, Jolt & Squeezetype and Sand slinger. **Special moulding Process:** Study of important	09	**CO3**

	mouldingprocesses, No bake moulds, Flask less moulds, Sweep mould,CO2 mould, Shell mould, Investment mould. **Metal moulds:** Gravity die-casting, Pressure die casting,Centrifugal casting, Squeeze Casting,Slush casting, Thixo-casting and Continuous Casting Processes.		
	List of Experiments 1. Permeability test 2. Core hardness and Mould hardness test 3. Sieve analysis to find grain fineness number of basesand.	08	
4	**Melting Furnaces:** Classification of furnaces. Constructionalfeatures & working principle of coke fired, oil fired and Gasfired pit furnace, Resistance furnace, Coreless Inductionfurnace, Electric Arc Furnace, Cupola furnace	09	**CO4**
	List of Experiments 1. Clay content determination in base sand 2. Moisture content test	08	
5	**Forging**: Introduction, Classification of forging processes.Forging machines & equipment. Forging pressure and load inopen die forging and closed die forging, concepts of frictionhill and factors affecting it. Die-design parameters. Materialflow lines in forging. Forging defects, Residual stresses inforging. Advantages and disadvantages of forging. Simpleproblems.	09	**CO5**
	List of Experiments 1. Calculation of length of the raw material required to do the model 2. Preparing forged models involvingupsetting, drawing and bending operations	8	

TEXT BOOKS:

1. "Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House, 5th RevisedEdition 2009.
2. "Manufacturing & Technology: Foundry Forming and Welding", P.N.Rao,Volume1.Tata McGraw Hill Education Private Limited, 2013, ISBN 13: 978-9383286614

REFERENCE BOOKS:

1. "Process and Materials of Manufacturing", Roy A Lindberg, Pearson Edu, 4th Ed. 2006, ISBN-13: 978-0205118175.
2. "Manufacturing Technology", SeropeKalpakjian, Steuen. R. Sechmid, PearsonEducation Asia, 7th Ed. 2013, ISBN -13: 978-9810694067.
3. "Manufacturing Process-III", Dr.K.Radhakrishna, Sapna Book House, 5th RevisedEdition 2013, ISBN: 9788128010439

CIE- Continuous Internal Evaluation for theory (50Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes**
Marks (out of 50)	**30**	**10**	**10**
Remember	5		5
Understand	5	05	5
Apply	5	5	
Analyze	5		
Evaluate	5		
Create	5		

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes/Viva**
Marks (out of 25)	**10**	**10**	**05**
Remember	2	2	01
Understand	2	2	01
Apply	2	2	
Analyze	2	2	01
Evaluate	2		01
Create		2	01

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	Tests(theory)
Remember	10
Understand	10
Apply	10
Analyze	05
Evaluate	05
Create	10

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	Tests(theory)
Remember	5
Understand	5
Apply	4
Analyze	5
Evaluate	03
Create	03

MECHANICS OF MATERIALS

Course Code : AUT351/451 **Credits : 05**
L:P:T:S : 3:2:0:0 **CIE Marks : 50+25**
Exams Hours : 03+03 **SEE Marks: 50+25**

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

CO1	Empathize with the behavior of components when subjected to various type of loading.
CO2	Extend the ability to identify a problem and apply the fundamental concepts of MOM.
CO3	Draw Shear Force Diagrams and Bending Moment Diagrams for different types of loads and support conditions.
CO4	Estimate and analyze bending and shear stresses and deflections induced in beams.
CO5	Determine stresses in thin cylinders
CO6	Resolve the Torsional stresses, stiffness of shafts

Mapping of Course outcomes to Program outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	1	2`	2	1	3	2	3	1
CO2	3	3	3	3	1	2`	2	1	3	2	3	1
CO3	3	3	3	3	3	3	2	1	3	2	3	1
CO4	3	3	3	3	3	3	2	1	3	2	3	1
CO5	3	3	3	3	3	3	2	1	3	2	3	1
CO6	3	3	3	3	3	3	2	1	3	2	3	1

Module No	**Contents of Module**	**Hrs**	**Cos**
	Simple Stress and Strain: Assumptions in MOM, stress, strain, mechanical properties of materials, Linear elasticity, Hooke's Law and Poisson's ratio, Stress-Strain curve for Mild steel, cast iron and Aluminum. Extension / Shortening of a bar, bars with cross sections varying in	**9**	**CO1,**

1	steps, bars with continuously varying cross sections (circular and rectangular), Elongation due to self weight, Principle of super position, elastic constants(only definition).		CO2
	List of Experiments: 1. To determine the hardness number of mild steel/cast iron specimen using Rockwell hardness test 2. To determine the hardness number of hardened steel specimen using Vickers's hardness test	8	
2	**Bending Moment and Shear Force in Beams:** Introduction, Types of beams, loads and reactions, shear forces and bending moments, 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, uniformly distributed load, (UDL) uniformly varying load (UVL) and couple for different types of beams.	9	C03
	List of Experiments: 1. To determine the hardness number of aluminum specimen using Brinell hardness test 2. To determine the ultimate shear strength of the given specimen in single and double shear using UTM	8	
3	**Bending and Shear Stresses in Beams:** Introduction, Theory of simple bending, assumptions in simple bending. Bending stress equation, relationship between bending stress and radius of curvature, relationship between bending moment and radius of curvature. Moment carrying capacity of a section. Shearing stresses in beams, shear stress across rectangular, circular, symmetrical I and T sections	9	CO4

	List of Experiments: 1. To determine the moment of inertia, modulus of elasticity and maximum bending stress of wood specimen by conducting bending test. 2. To determine the compressive strength, modulus of elasticity, % reduction in length and % increase in area of mild steel specimen by conducting compression test on universal testing machine**.**		
	Deflection of Beams: Introduction, Differential equation for deflection. Equations for deflection, slope and bending moment. Double integration method for cantilever and simply supported beams for point load, UDL, UVL and Couple, Macaulay's method	**9**	**C04**
4	**List of Experiments:** 1. To determine the impact energy and strength of notched specimen using Izod test 2. To determine the impact energy and strength of notched specimen using Charpy test		
	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 **Thick and Thin Cylinder**: Stresses in thin cylinders, changes in dimensions of cylinder (diameter, length and volume). Thick cylinders - Lame's equation, Problems on Lame's equation	**9**	**C05,** **CO6**
5	**List of Experiments:** 1. To determine the modulus of rigidity, Torsional strength and modulus of toughness of mild steel specimen using torsion test 2. To determine the elastic strength, ultimate tensile strength, modulus of toughness and young's modulus of mild steel specimen by conducting tensile test on universal testing machine.		

TEXT BOOKS:

1. **"**Strength of Materials", S.S. Rattan, McGraw Hill Education. 2nd Edition, 2011, ISBN-13:9780071072564.

2. "Strength of Materials", S.S.Bhavikatti, Vikas Publishing House Pvt. Ltd.-NOIDA, 3rd Ed.,2008, ISBN – 13: 9788125927914

REFERENCE BOOKS:

1. "Mechanics of Materials", by R.C.Hibbeler, Pearson Education, 11-Jan-2016, ISBN:9780134321233

2. "Mechanics of materials", James.M.Gere, Cengage Learning, 2012, ISBN-13 - 9781111577735.

3. "Mechanics of materials", in SI Units, Ferdinand Beer & Russell, Johston, 5th Ed.,McGraw-Hill Higher Education, 2009, ISBN: 0071284222, 9780071284226.

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes**
Marks (out of 50)	**30**	**10**	**10**
Remember	5		5
Understand	5	5	5
Apply	5		
Analyze	5		
Evaluate	5		
Create	5	5	

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes/Viva**
Marks (out of 50)	**10**	**10**	**05**
Remember	2	2	01
Understand	2	2	01
Apply	2	2	
Analyze	2	2	01
Evaluate	2		01
Create		2	01

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	**Tests(theory)**
Remember	10
Understand	10
Apply	10
Analyze	05
Evaluate	05
Create	10

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	Tests(theory)
Remember	5
Understand	5
Apply	4
Analyze	5
Evaluate	03
Create	03

MATERIAL SCIENCE AND METALLURGY

Course Code : AUT361/461 **Credits: 05**
L:P:T:S : 3:2:0:0 **CIE Marks: 50+25**
Exams Hours : 03+03 **SEE Marks:50+25**

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

CO1	Depute the different materials, their processing, and heat treatments in suitable application in mechanical engineering fields.
CO2	realize structure-property relationship, allow modification or engineering of materials to perform well in a specific application
CO3	Know-how of the structure-property relationships of metals can be beneficial in the study of ceramics and polymers
CO4	Recommend the suitable type of Heat treatment which helps in steel applications in tools and dies, crankshafts, connecting rods, fabrications, spring etc

CO5	Knowledge of Extraction process of different ferrous and nonferrous metals,nonmetallic materials like polymers, ceramics helps in preparation of polymer, ceramic application of composites
CO6	Evaluate the mechanical properties and deformation mechanism

Mapping of Course outcomes to Program outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	2	1	2	2	1	1	3	2	2	1
CO2	3	3	1	1	2	1	1	1	3	2	2	1
CO3	3	3	1	1	2	1	1	1	3	2	2	1
CO4	3	3	3	1	3	2	1	1	3	2	2	1
CO5	3	3	2	1	2	2	1	1	3	2	2	1
CO6	3	3	2	1	2	2	1	1	3	2	2	1

Syllabus			
Module	**Contents of the Module**	**Hours**	**COs**
1	**Crystal Structure:** BCC, FCC and HCP Structures, coordination number and atomic packing factors, crystal imperfections -point lin and surface imperfections. Atomic Diffusion: Phenomenon, Ficks laws of diffusion, factors affecting diffusion. **Fracture**: Types, Griffith's criterion of brittle fracture, **Creep**: Description of Creep phenomenon with examples. three stages of creep, creep properties, stress relaxation. **Fatigue**: Types of fatigue loading with examples, Mechanism of fatigue, fatigue properties, fatigue testing and S-N diagram	**9**	**CO1, CO2**
	List of Experiments: 1. Scratch analysis of non-ferrous materials using scratch hardness tester 2. Determination of coating thickness for ferrous materials		
2	**Phase Diagram I:** Solid solutions Hume Rothary rule substitutional, and interstitial solid solutions, intermediate phases, Gibbs phase		**CO2**

	rule. **Phase Diagram II** Construction of equilibrium diagrams involving complete and partial solubility, lever rule. Different types invariant reactions – Eutectic, Eutectoid, Peritectic, Peritectectoid reactions	**9**	
	List of Experiments: 1. Preparation of specimen for metallographic examination and identification of microstructures of ferrous materials 2. Preparation of specimen for metallographic examination an identification of microstructures of non-ferrous materials		
3	**Iron carbon equilibrium diagram** Description of phases, solidification of steels and cast irons, invariant reactions. **Heat treating** of metals TTT curves, continuous cooling curves, description of the following heat treatment processes with industri applications: annealing and its types. normalizing, hardening, tempering, martempering, austempering, hardenability, surface hardening methods like carburizing, cyaniding, nit riding	**9**	**CO5**
	List of Experiments: 1. Microstructure studies on heat treated (annealing, normalizin hardening, tempering) ferrous materials 2. Microstructure studies on heat treated (annealing, normalizing, hardening, tempering) non-ferrous materials.		
4	Ferrous and non ferrous materials Properties, Composition and uses of • Grey cast iron, malleable iron, SG iron and steel • Copper alloys-brasses and bronzes. • Aluminum alloys-Al-Cu,Al-Si,Al-Zn alloys. • Titanium alloys	**9**	**CO3, CO5**
	List of Experiments: 1. Determination of defects in given material using magnetic crack detector 2. Determination of cracks in given material using dye penetrant test 3. Determination of defects in given material using ultrasonic inspection test		
5	**Ceramics:** Introduction to ceramics, nature of ceramics, types of ceramics, comparison of ceramics and non ceramics phases, properties of ceramics materials, ceramic forming techniques, applications of	**9**	**CO6**

	ceramics **Powder Metallurgy:** Definition and concept, applications, powder metallurgy process, Production of metal powders, characteristics of metal powders, compacting, presintering and sintering.		
	List of Experiments: 1. Determination of coating thickness for non- ferrous materials 2. Comparative study on microstructures for the given specimen before and after heat treatment and identification of defects in the same using appropriate tests		

TEXT BOOKS:

1. "Introduction to Physical Metallurgy" Sidney H Avner, Mcgraw Hill Education, 1997, ISBN 13: 9780074630068.
2. Fundamentals of Material Science and Engineering" David G Rethwisch William D Callister Jr. Rethwisch Callister , John Wiley & Sons Publishers, 4th Edition, 2012, ISNB 13: 9781118061602

REFERENCES:

1. "Materials Science and Engineering", V. RAGHAVAN, PHI Learning, 2004, ISBN: 9788120324558
2. "Engineering Materials", Kenneth G. Budinski, Michael K. Budinski, Prentice Hall, 9th edition, 2010, ISBN: 9780137128426.

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes**
Marks (out of 50)	**30**	**10**	**10**
Remember	5		5
Understand	5	05	5
Apply	5	5	

Analyze	5		
Evaluate	5		
Create	5		

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes/ Viva**
Marks (out of 50)	**10**	**10**	**05**
Remember	2	2	01
Understand	2	2	01
Apply	2	2	
Analyze	2	2	01
Evaluate	2		01
Create		2	01

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	**Tests(theory)**
Remember	10
Understand	10
Apply	10

Analyze	05
Evaluate	05
Create	10

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	**Tests(theory)**
Remember	5
Understand	5
Apply	4
Analyze	5
Evaluate	03
Create	03

CYCLE B

(Syllabus)

ECONOMICS FOR ENGINEERS

Course Code : HSS321/421 **Credits: 03**
L:P:T:S : 2:0:0:1 **CIE : 50**
Exam Hour : 03 **SEE : 50**

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

CO1	Gain knowledge about importance of economics in decision making processes in day to day life.
CO2	Analyze business environment at micro and macroeconomic level and its impact on industries in country's economy.
CO3	Acquire knowledge about costing and estimation of projects for profit making.
CO4	Apply principles of budgeting and finance for entrepreneurial success.

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	2	1	-	1	-	1	2	2	-	2	2
CO2	2	2	1	-	1	-	1	2	2	-	2	2
CO3	2	2	1	-	1	-	1	2	2	-	2	2
CO4	2	2	1	-	1	-	1	2	2	-	2	2

Module	Contents of Module	Hours	COs
I	**Introduction to Economics**: Role of Engineer as an Economist, Types and problem of economies, Basics of economics (GDP, National income, inflation, business cycle, fiscal and monetary policies, balance of payment).	**4**	**1,3**
II	**Basic concepts of Microeconomics**: concept of Demand & Elasticity of Demand. Concept of Supply & Elasticity of Supply, Meaning of Production and factors of production, Production Possibility Curve, Law of variable proportions and returns to scale. Relevance of Depreciation towards industry, Depreciation computing methods.	**5**	**2,3**
III	**Concepts of cost of production**: different types of cost; accounting cost, sunk cost, marginal cost and opportunity cost. Break even analysis, Make or Buy decision. Cost estimation, Elements of cost as Direct Material Costs, Direct Labor Costs, Fixed Over-Heads, Factory cost, Administrative Over-Heads.	**4**	**3,4**
IV	**Capital budgeting**: Traditional and modern methods, Payback period method, IRR, ARR, NPV, PI. . Interest and Interest factors: Interest rate, Simple interest, Compound interest, Cash - flow diagrams, Personal loansand EMI	**4**	**1,3,4**

	Payment. Present worth, Future worth.		
V	**Book Keeping and Accounts**: Journal, Ledger, Trial balance, asset Types, profit & loss account, balance sheet.	**5**	**1,2,3,4**

TEXT BOOKS:

1. Riggs J.L, Engineering Economy, TMH, 2012 edition
2. Jain T.R., Economics for Engineers, VK Publications
3. IM PANDEY,Finacial Management, Vikas Pub. House
4. D N Dwivedi, Mangerial Economics , Vikas Pub. House

REFERENCE BOOKS:

1.Thuesen H.G, Engineering Economy. PHI
2. Prasanna Chandra, Financial Mangement,TMH
3. Singh Seema, Economics for Engineers, IK International
4. Chopra P. N, Principle of Economics, Kalyani Publishers
5. Dewett K K, Modern Economic Theory, S. Chand
6. H. L. Ahuja, Modern Economic Theory, S. Chand
7. Mishra S. K, Modern Micro Economics, Pragathi Publications
8. Gupta Shasi K, Management Accounting, Kalyani Publications

Assessment pattern

CIE –Continuous Internal Evaluation (50 Marks, Theory)

Bloom's category	**Test**	**Assignments**	**SSR**
Marks (out of 50)	**20**	**15**	**15**
Remember	5		
Understand	5		
Apply	5		
Analyze	5	5	5
Evaluate		5	5
Create		5	5

SEE –Semester Ending Examination (50 Marks)

Bloom's category	**SEE Theory(50)**
Remember	20
Understand	10
Apply	10
Analyze	10
Evaluate	
Create	

BASIC THERMODYNAMICS

Course Code : AUT332/432 | **Credits : 04**
L: P: T: S : 3:0:0:1 | **CIE Marks : 50**
Exam Hours : 03 | **SEE Marks :50**

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

CO1	Empathize with the basic concepts of thermodynamics like systems, equilibrium, process etc. and its applications
CO2	Realize the laws of thermodynamics and apply to solve engineering, problems.
CO3	Identify the different types of work and heat transfer mechanisms.
CO4	Differentiate reversible and irreversible process using second law and entropy concepts
CO5	classify the quantities used to describe the composition of a gas mixture, such as mass fraction, mole fraction, and volume fraction
CO6	Understand the behavior of real gases at various conditions

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	3	1	1	1	1	1	2	2	3	1
CO2	3	3	3	3	1	1	1	1	1	2	2	3	1
CO3	3	3	3	3	1	2	1	1	1	2	2	3	1
CO4	3	3	3	3	1	2	1	1	1	2	2	3	1
CO5	3	3	3	3	1	3	1	1	1	2	2	3	1
CO6	3	3	3	3	1	3	1	1	1	2	2	3	1

Module No	Module Contents	Hrs	Cos
1	**Fundamental Concepts & Definitions:** Thermodynamics: definition and scope, Microscopic and Macroscopic approaches. Applications of Thermodynamics: Power generation, Power absorption, Pollution control, **Thermodynamic Concepts:** System and its types, Surroundings, boundary and its types, Thermodynamic properties: definition and units, Intensive and extensive properties. Thermodynamic state, state Diagram, path and process, quasi-static process:definition and illustration, cyclic and non-cyclic processes; **Thermodynamic equilibrium:** definition and conditions, Zeroth law of thermodynamics: Statement, and significance. Temperature: concept, two point scales and one point scale, International fixed points. Temperature measurements: Constant volume gas thermometer, Electrical resistance thermometer, thermocouple.Numerical on temperature scales.	09	**CO1,CO 2**
2	**Work and Heat:** Mechanics definition of work and its limitations. Thermodynamic definition of work; examples, sign convention. Displacement work explanation, expressions for displacement work in various processes through p-V diagrams. Shaft work, Spring work, Heat: definition, sign convention, Modes and laws of heat transfer. problems on work transfer and heat transfer. **First Law of Thermodynamics for closed systems:** Joules experiment, equivalence of heat and work. Statement of the First law of thermodynamics, extension of the First law to non - cyclic processes, Internal energy, To prove energy is a property of the system, modes of energy, Specific heat at constant volume, enthalpy, specific heat at constant pressure. Heat transfer for various quasistatic process. Numerical on closed systems	09	**CO1,CO 2,C03**
3	**First Law of Thermodynamics for open systems:** Extension of the First law to control volume; steady state-steady flow energy	09	**CO2,CO**

	equation, Assumptions for SFEE, important applications - Nozzle, Compressors, turbines, boilers, throttling device, Heat exchangers. Analysis of unsteady processes such as filling and evacuation of vessels with and without heat transfer. Problems. **Second Law of Thermodynamics:** Thermal reservoir. Direct heat engine; schematic representation and efficiency. Devices converting work to heat in a thermodynamic cycle; reversed heat engine, schematic representation, coefficients of performance. Kelvin - Planck statement of the Second law of Thermodynamics; PMM I and PMM II, Clausius statement of Second law of Thermodynamics, Equivalence of the two statements; Reversible and irreversible processes; factors that make a process irreversible, reversible heat engines, Carnot cycle, Carnot Theorem-1, 2 and 3 .Numerical		**4**
4	**Entropy:** Clausius theorem, Clausius inequality; Statement, proof, application to a reversible cycle. Entropy; definition, a property, change of entropy for irreversible process, principle of increase in entropy of the universe, entropy as a quantitative test for irreversibility, calculation of entropy using Tds relations, Available and unavailable energy, Numericals. **Pure Substances:** P-T and P-V diagrams, triple point and critical points. Sub cooled liquid, saturated liquid, mixture of saturated liquid and vapour, saturated vapour and superheated vapour states of pure substance with water as example. Enthalpy of change of phase (Latent heat). Dryness fraction (quality), T-S and H-S diagrams, Numerical.	09	**CO4**
5	**Ideal gas mixtures:** Kinetic theory of gases assumptions, Avogadro's law, Gas laws-Boyle's and Charles law. Ideal gas equation of state. Different forms of Ideal gas equation. Gas constant: Universal and particular .Ideal gas mixture; Dalton's laws of partial pressures, Amagat's law of additive volumes, evaluation of mass fractions, mole fractions, Expressions for C_P,C_V and Gas constant of the mixture. Numerical on mixtures. **Real Gases:** Introduction. Van-der Waal's Equation of state,	09	**CO5,CO 6**

	Van-der Waal's constants in terms of critical properties, Law of corresponding states, compressibility factor; compressibility chart. Numerical on real gases.		

SELF STUDY:

Student has to conduct Energy analysis for Air conditioners, IC Engines and Refrigerators.

Data Handbook:

1. **Thermodynamics data hand book,** B.T. Nijaguna.B.S & Samaga, Sudha publication, 2006

TEXT BOOKS:

1. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill Publication, 2nd edition, 2014, ISBN:9780070151314.

2. Basic Thermodynamics, B.K Venkanna, Swati B. Wadavadagi, PHI Learning Private Limited, 2010, ISBN 13 – 9788120341128.

REFERENCE BOOKS:

1. Fundamentals of Engineering Thermodynamics, Moran J Shapiro., John wiley Pub.2006,ISBN – 9780470032091.
2. Thermodynamics, An Engineering Approach, YunusA.Cenegal and Michael A.Boles, TataMcGraw Hill publications, 2007, ISBN - 9780073305370
3. Fundamentals of Thermodynamics**,** Claus Borgnakke, Richard Edwin Sonntag, 8th Edition,WILEY, ISBN - 9781306947732

CASTING AND FORGING TECHNOLOGY

Course Code	**: AUT341/441**	**Credits**	**: 05**
L:P:T:S	**: 3:2:0:0**	**CIE Marks**	**: 50+25**
Exam Hours.	**: 03+03**	**SEE Marks**	**: 50+25**

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

CO1	Gain the basic knowledge of manufacturing process.
CO2	Know the basics of sand moulding.
CO3	Identify the various moulding processes for casting
CO4	Gain the knowledgeon the various types of melting furnaces.
CO5	Study the various concepts of forging
CO6	Aware of the basic inspection methods.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**POI0**	**POII**	**PO12**
CO1	3	2	3	1	2	2	1	1	2	2	2	1
CO2	2	2	3	2	1	1	2	1	2	2	2	1
CO3	2	2	3	2	1	1	2	1	2	2	2	1
CO4	3	3	1	1	1	2	1	1	3	2	2	1
CO5	3	2	3	1	2	2	1	1	2	2	2	1
CO6	2	2	3	2	1	1	2	1	2	2	2	1

Module No	**Module Contents**	**Hrs**	**COs**
1	**Introduction:** Concept of Manufacturing process, itsimportance. Classification of Manufacturing processes.Introduction to Casting process & steps involved. Componentsproduced by casting process.	09	**CO1**

	Advantages & Limitations ofcasting process. **Patterns:** Definition, functions, Materials used for pattern,various pattern allowancesand theirimportance.Classification of patterns, BIS color coding of Patterns. **Binder:** Definition, Types of binder used in mouldings sand. **Additives:** Need, Types of additives used and their properties		
	List of Experiments 1. Use of foundry tools and other equipment 2. Preparation of moulds using two moulding boxes with and without pattern	08	
2	**Sand Moulding:** Types of base sand, requirement of basesand. Moulding sand mixture ingredients for different sandmixtures. Method used for sand moulding, such as Greensand, dry sand and skin dried moulds. **Cores**: Definition, Need, Types. Method of making cores,Binders used, core sand moulding. **Concept of Gating & Risers**: Principle and types. **Fettling and cleaning of castings:** Basic steps, Casting defects,Causes, features and remedies. **Inspection Methods** – Methods used for Inspection of castingand welding. Visual, Magnetic particle, Fluorescent particle,Ultrasonic, Radiography, Eddy current, Holography methods ofInspection.	09	**CO2,CO3, CO6**
	List of Experiments 1. Preparation ofcasting (Aluminium or cast iron – Demonstration only). 2. Compression, shear and tensile tests on universal sandtesting machine	08	
3	**Moulding Machines**: Jolt type, Squeeze type, Jolt & Squeezetype and Sand slinger. **Special moulding Process:** Study of important mouldingprocesses, No bake moulds, Flask less moulds, Sweep mould,CO2 mould, Shell mould, Investment mould. **Metal moulds:** Gravity die-casting, Pressure die casting,Centrifugal casting, Squeeze Casting,Slush casting, Thixo-casting and Continuous Casting Processes.	09	**CO3**
	List of Experiments	08	

	4. Permeability test 5. Core hardness and Mould hardness test 6. Sieve analysis to find grain fineness number of basesand.		
4	**Melting Furnaces:** Classification of furnaces. Constructionalfeatures & working principle of coke fired, oil fired and Gasfired pit furnace, Resistance furnace, Coreless Inductionfurnace, Electric Arc Furnace, Cupola furnace	09	**CO4**
	List of Experiments 3. Clay content determination in base sand 4. Moisture content test	08	
5	**Forging**: Introduction, Classification of forging processes.Forging machines & equipment. Forging pressure and load inopen die forging and closed die forging, concepts of frictionhill and factors affecting it. Die-design parameters. Materialflow lines in forging. Forging defects, Residual stresses inforging. Advantages and disadvantages of forging. Simpleproblems.	09	**CO5**
	List of Experiments 3. Calculation of length of the raw material required to do the model 4. Preparing forged models involvingupsetting, drawing and bending operations	8	

TEXT BOOKS:

3. "Manufacturing Process-I", Dr.K.Radhakrishna, Sapna Book House, 5th RevisedEdition 2009.
4. "Manufacturing & Technology: Foundry Forming and Welding", P.N.Rao,Volume1.Tata McGraw Hill Education Private Limited, 2013, ISBN 13: 978-9383286614

REFERENCE BOOKS:

4. "Process and Materials of Manufacturing", Roy A Lindberg, Pearson Edu, 4th Ed. 2006, ISBN-13: 978-0205118175.
5. "Manufacturing Technology", SeropeKalpakjian, Steuen. R. Sechmid, PearsonEducation Asia, 7th Ed. 2013, ISBN -13: 978-9810694067.
6. "Manufacturing Process-III", Dr.K.Radhakrishna, Sapna Book House, 5th RevisedEdition 2013, ISBN: 9788128010439

CIE- Continuous Internal Evaluation for theory (50Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes**
Marks (out of 50)	**30**	**10**	**10**
Remember	5		5
Understand	5	05	5
Apply	5	5	
Analyze	5		
Evaluate	5		
Create	5		

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes/Viva**
Marks (out of 25)	**10**	**10**	**05**
Remember	2	2	01
Understand	2	2	01
Apply	2	2	
Analyze	2	2	01
Evaluate	2		01
Create		2	01

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	**Tests(theory)**
Remember	10

Understand	10
Apply	10
Analyze	05
Evaluate	05
Create	10

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	**Tests(theory)**
Remember	5
Understand	5
Apply	4
Analyze	5
Evaluate	03
Create	03

MECHANICAL MEASUREMENTS AND METROLOGY

Course Code : AUT352/452 **Credits : 05**
L: P: T: S : 3: 2: 0: 0 **CIE Marks: 50+25**
Exam Hours : 03+03 **SEE Marks: 50+25**

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

CO1	Realize the basic concepts of Metrology.
CO2	Recall the various measuring instruments for linear and angular measurement.
CO3	Describe basic concepts of mechanical measurement and errors in Measurements.
CO4	Use appropriate measuring instruments for measurement of force, torque and pressure
CO5	Select appropriate measuring instruments for measurement of temperature and strain
CO6	Empathize the concepts of geometric dimensioning and tolerances (GD&T), Limits, fits, gauges etc.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	2	2	1	1	1	2	2	2	1
CO2	3	3	3	3	2	1	1	1	2	1	1	1
CO3	3	3	2	3	2	1	1	1	1	2	2	1
CO4	3	3	2	3	2	1	1	1	1	1	1	1
CO5	3	3	2	3	2	1	1	1	1	1	1	1
CO6	3	3	2	3	2	1	1	1	1	1	1	1

Module No	Module Contents	Hrs	COs
1	**Standards of measurement:** Definition and Objectives of metrology, Material standards-International Prototype meter, Imperial standard yard, Airy points, Wave length standard, subdivision of standards, line and end standard, calibration of end bars , Indian Standards (M-45,M-87 M-112) of Slip gauges,	09	

	Wringing phenomena, Numerical problems on building of slip gauges. **Measurements and measurement systems:** generalized measurement system, basic definitions, Errors in measurement, classification of errors.		**CO1,CO2 ,C03**
	List of Experiments: 1. Calibration of micrometer using slip gauge 2. Measurement of Taper angle using sine bar and slip gauge 3. Calibration of load cell using standard weights		
2	**Limits, Fits, Tolerance and Gauge:** Definition of tolerance, Specification in assembly, Principle of interchangeability and selective assembly limits of size, Indian standards, concept of limits of size and tolerances, compound tolerances, accumulation of tolerances, definition of fits, types of fits and their designation (IS 919-1963), geometrical tolerance, hole basis system, shaft basis system, classification of gauges, brief concept of design of gauges (Taylor's principles), Wear allowance on gauges, Types of gauges- plain plug gauge, ring gauge, and gauge materials.	09	**CO6**
	List of Experiments: 1. Measurement of displacement using LVDT 2. Comparison and measurement of temperature using thermocouple and RTD		
3	**Comparators:** Introduction to comparators, characteristics, classification of comparators, mechanical comparators- Johnson's Mikrokator, Sigma comparator, Dial gauge, optical comparator- Ziess ultra-optimeter LVDT, pneumatic comparator-Solex pneumatic gauge, **Angular measurements:** Bevel protractor, sine principle and use of sine bars, sine centre, angle gauges, numerical on building of angles using angle gauges.	09	

	List of Experiments: 1. Measurement of gear parameters using gear tooth vernier 2. Measurement of alignment of surface plate using roller set 3.Calibration of pressure gauge.		**CO1, CO2**
4	**Form Measurement:** Terminology of screw threads, measurement of major diameter, minor diameter, pitch, angle and effective diameter of screw threads by 2-wire and 3-wire methods, best size wire. Tool maker's microscope, gear tooth terminology, gear tooth vernier caliper.	09	**CO2**
	List of Experiments: 1. Measurement of screw thread parameters using Tool makers' microscope. 2. Measurement of surface roughness of component using mechanical comparator 3. Measurement of screw thread parameters using floating carriage micrometer by 2-wire method.		
5	**Measurement of force, torque, pressure:** Principle of analytical balance, platform balance, proving ring. Torque measurement- Prony brake, hydraulic dynamometer. Pressure measurements- McLeod gauge, Pirani gauge. **Measurement of Temperature and strain:** Resistance thermometers, thermocouple, law of thermo couple, Strain measurements, electrical strain gauge.	09	**CO4,CO5**
	List of Experiments: 1. Measurement of cutting forces and torque using drill tool Dynamometer 2. Measurement of cutting force and power using Lathe tool Dynamometer 3. Determination of young s modulus using strain gauge.		

TEXT BOOKS:

1. Engineering Metrology, R.K. Jain, Khanna Publishers, 2009, ISBN-13: 978-8174091536.
2. Mechanical Measurements, Beckwith Marangoni and Lienhard, Pearson Education, 6th Ed., 2007, ISBN 13: 978-8131717189.
3. Metrology and Measurement, Dr. T Chandrashekar, Subhas publication, 2013, ISBN: 9789383214198

REFERENCE BOOKS:

1. Engineering Metrology, I.C. Gupta, Dhanpat Rai Publications, Delhi. 7th Edition, 2012, ISBN 13: 9788189928452
2. Mechanical and Industrial Measurements, R.K. Jain, Khanna Publishers, 2008, ISBN: 9788174091918
3. Metrology & Measurement, Anand K. Bewoor& Vinay A. Kulkarni, Tata McGraw Hill Pvt. Ltd., New Delhi, 2009, ISBN: 9781259081323
4. Engineering Metrology and Measurement, N V Raghavendra and Krishnamurthy, Oxford University Press, 2013, ISBN: 9780198085492

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	**30**	**10**	**10**
Remember	5		5
Understand	5	5	5
Apply	5		
Analyze	5		
Evaluate	5		

Create	5	5	

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	**Tests**	**Assignments**	**Quizzes/Viva**
Marks (out of 50)	**10**	**10**	**05**
Remember	2	2	01
Understand	2	2	01
Apply	2	2	
Analyze	2	2	01
Evaluate	2		01
Create		2	01

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	**Tests(theory)**
Remember	10
Understand	10
Apply	10

Analyze	05
Evaluate	05
Create	10

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	**Tests(theory)**
Remember	5
Understand	5
Apply	4
Analyze	5
Evaluate	03
Create	03

FLUID MECHANICS

Course Code : AUT362/462 **Credits : 05**
L: P: T: S : 3:2:0:0 **CIE Marks: 50+25**
Exam Hours : 03+03 **SEE Marks: 50+25**

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

CO1	Investigation of different fluid properties.
CO2	Analyze the types of fluid flows and different flow description
CO3	Apply continuity equation and energy equation in solving problems on flow through conduits
CO4	Compute the frictional loss in laminar and turbulent flows and Analyze flow between reservoirs
CO5	Correctly apply the course content to new situations so as to evaluate potential industrial applications of fluid theory through both physical induction and mathematical analysis.
CO6	Evaluate as to when to use ideal flow concepts and the Bernoulli equation.

Mapping of Course Outcomes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	-	-	-	-	-	-	-	2
CO2	3	1	2	3	-	-	-	-	-	-	-	2
CO3	3	3	3	3	-	-	-	-	-	-	-	2
CO4	3	3	3	3	-	-	-	-	-	-	-	2
CO5	3	3	2	3	-	-	-	-	-	-	-	2
CO6	3	3	2	3	-	-	-	-	-	-	-	2

Module No	Module Contents	Hrs	Cos
1	**Fluid Properties :-** Types of fluids, Mass Density, Specific Weight, Specific Gravity, Newton's Law of Viscosity, Dynamic Viscosity, Surface Tension, Capillarity, Compressibility, Vapour pressure ,numerical **Fluid Statics:** Pascal's law, pressure variation in a static fluid in 2D.	09	**CO1** **CO2**
	List of Experiments: ***1.Determination of viscosity of given oil using Saybolt /Redwood/Torsion Viscometer.*** **2.**Calibration of given Venturimeter and plotting the suitable calibration curve		
2	**Buoyancy:** Buoyancy, center of buoyancy, archimede's principle, principle of floatation, metacentre and metacentric height, stability of floating and submerged bodies, determination of Metacentric height by experimental method. **Fluid Kinematics**:: fluid flow description by Langrangian and Eulerian method, Types of Flow- steady, unsteady, uniform, non-uniform, laminar, turbulent, one, two and three dimensional, compressible, incompressible, rotational, irrotational, stream lines, path lines, streak lines, Continuity equation in 2D and 3D (Cartesian Co-ordinates only), velocity and acceleration, velocity potential function and stream function (simple numerical).	09	**CO2,** **CO3,** **CO5**

	List of Experiments: **1.** Calibration of given Orifice meter and plotting the suitable calibration curve. ***2.To Determine the Metacentric Height Of a Ship Model.***		
3	**Fluid Dynamics :-** Introduction to Navier-Stroke's Equation, derivation of Euler equation of motion along a stream line, and Bernoulli's equation from Euler's equation and first principles, application of Bernoulli's equation to pitot tube, venturi meter, orifices, orifice meter (No Derivation). (numerical)	09	**CO3** **CO4** **CO5**
	List of Experiments: ***1.To verify Bernoulli's equation by demonstrating the relationship between pressure head and kinetic head*** **2.**Calibration of given V-notch, Rectangular, Trapezoidal Notch and plotting the suitable calibration curve		
4	**Flow Through Pipes :-** Energy losses through pipe, Major losses, Darcy-Weisbach equation, Chezy's Equation, Minor losses in pipes-sudden enlargement, sudden contraction, TEL, HGL, pipes in series and parallel, Siphons, Transmission of power. (numerical). **Laminar And Turbulent Flow :-** Definition, Relation between pressure and shear stresses, Laminar flow through circular pipe, Fixed parallel plates, Turbulent flow and velocity distribution. (Numerical)	09	**CO4,** **CO5**
	List of Experiments: **1.** Determination of coefficient of friction and Chezy's constant for Turbulent flow in pipes. **2.** Determination of minor losses coefficient in flow through pipes due to sudden contraction and sudden expansion.		
5	**Flow around Immersed Bodies: -**Force exerted by flowing fluid on stationary body, expression for Lift and Drag, Classification of Drag, Flow around circular cylinder and Aerofoil, Development of lift on Aerofoil. **Boundary Layer Theory :-** Development of Boundary Layer on a thin plate and its characteristics, boundary layer thickness, boundary condition for velocity profile, Laminar and Turbulent, Boundary Layers, Laminar Sub Layer, Separation of Boundary Layer.	08	**CO5** **CO6**
	List of Experiments: ***1.Wind tunnel testing to determine the static pressure on cambered aerofoil.*** ***2.Determination of the Reynolds Number and hence the Type of Flow using the Reynolds apparatus***		

TEXT BOOKS:

1. Fluid Mechanics and Hydraulic Machines, Dr. R.K. Bansal, Laxmi Publication (P) Ltd. New Delhi, 2011, ISBN - 13: 9788131808153
2. Fluid Mechanics & Hydraulic Machines, R.K. Rajput, S. Chand & Company Ltd, 2008, ISBN - 9788121916684.

REFERENCE BOOKS:

1. Fluid Mechanics and Fluid Power Engineering, Dr. D.S. Kumar, S.K. Kataria& sons, 2013, ISBN - 9789350143926
2. Fluid Mechanics, Frank M. White, McGraw Hill Publication, 7th Edition, 2011, ISBN - 9780071311212
3. Fluid Mechanics, Cengel&Cimbla, Tata McGraw Hill, 3rd Edition, 2014, ISBN – 9789339204655

Assessment Pattern

CIE- Continuous Internal Evaluation for theory (50 Marks)

Bloom's Category	Tests	Assignments	Quizzes
Marks (out of 50)	30	10	10
Remember	5		5
Understand	5	5	5
Apply	5	5	
Analyze	5	5	
Evaluate	5		
Create			

CIE- Continuous Internal Evaluation for lab (25 Marks)

Bloom's Category	Tests	Assignments	Quizzes/Viva
Marks (out of 50)	10	10	05
Remember	2	2	01
Understand	2	2	01
Apply	2	2	
Analyze	2	2	01
Evaluate	2	1	01
Create		1	01

SEE – Semester End Examination (50 Marks - Theory)

Bloom's Category	**Tests(theory)**
Remember	10
Understand	10
Apply	10
Analyze	10
Evaluate	10
Create	

SEE – Semester End Examination (25 Marks - Lab)

Bloom's Category	Tests(theory)
Remember	5
Understand	5
Apply	5
Analyze	5
Evaluate	5
Create	

COMMON SUBJECTS
(Syllabus)

ENGINEERING MATHEMATICS – III

Course Code	**: MAT31**	**Credits**	**: 05**
L:P:T:S	**: 4:0:1:0**	**CIE Marks**	**: 50**
Exam Hours	**: 3**	**SEE Marks**	**: 50**

Course Outcomes: At the end of the Course, the student will be able:

CO1	Solve the Fourier series expansion of functions analytically and numerically.
CO2	Solve the Continuous model problems using Fourier transform.
CO3	Solve the discrete model problems using Z-transforms and Fast Fourier transform.
CO4	Fit a suitable curve by the method of least squares and determine the lines of regression for a set of statistical data.
CO5	Use appropriate numerical methods to solve algebraic and transcendental equations and also to calculate a definite integral numerically.
CO6	Use appropriate numerical methods to solve Boundary Value Problems in Partial differential equations.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**POI0**	**POII**	**PO12**
CO1	3	3	1	1	1	-	-	-	2	1	-	2
CO2	3	3	1	1	1	-	-	-	1	1	-	2
CO3	3	3	2	3	3	-	-	-	2	1	-	2
CO4	2	3	2	2	2	-	-	-	1	3	-	1
CO5	2	2	3	3	2	-	-	-	1	2	-	1
CO6	3	3	3	2	3	-	-	-	2	1	-	1

Module No	**Module Contents**	**Hours**	**COs**
1	**Fourier series**: Periodic function, Dirichlet's conditions, Fourier series of periodic functions of period 2π and arbitrary period $2l$, half range series. Fourier series and half Range Fourier series of periodic square wave, half wave rectifier, full wave rectifier, Saw-tooth wave with graphical representation, practical harmonic analysis.	9	CO1

2	**Fourier Transforms:** Infinite Fourier transforms, Fourier Sine and Cosine transforms, Inverse Fourier transform. **Z - Transform:** Definition, Z-transforms of some standard functions, properties, damping rule, shifting rule (without proof), initial and final value theorems, inverse Z- transforms. **Applications:** Solving difference equations using Z-transform.	9	CO2, CO3
3	**Statistical Methods:** Fitting of the curves of the form $y = a + b\,x$, $y = a + b\,x + c\,x^2$, $y = a\,e^{bx}$, $y = a\,x^b$, and $y = a\,b^x$ by the method of least square**,** Correlation and Regression , Regression coefficients, line of regression – problems. **Discrete Fourier Transform and Fast Fourier Transform**: Definition of N-Point DFT, problems for 4-Points and inverse DFT for four points only. FFT algorithm to compute the Fourier transforms 4-Point only.	9	CO3, CO4
4	**Numerical Methods-1:** Numerical solution of algebraic and transcendental equations; Rugula- falsi method and Newton Raphson's method. Solution of a system of equations using Gauss-seidel and Relaxation method. Interpolation & extrapolation – Newton's forward and backward formulae for equal intervals, Newton divided difference and Lagrange's formulae for unequal intervals.	9	CO5
5	**Numerical Methods-2**: Numerical integration - Simpson's 1/3rd rule, Simpson's 3/8th rule, Weddle's rule (without proof)-Problems. Numerical solution of Boundary value problems-Solution of one dimensional wave equation and heat equation, Numerical solution of two dimensional Laplace's equation and Poisson's equation.	9	CO5 CO6

TEXT BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley-India publishers, 10th edition, 2014.
2. Higher Engineering Mathematics, B.S.Grewal, Khanna Publishers, 43rd edition, 2014.

REFERENCE BOOKS:

1. Advanced Modern Engineering Mathematics, Glyn James, Pearson Education, 4th edition, 2015.
2. Advanced Engineering Mathematics, Dennis G. Zill, Michael R. Cullen, Jones and Barlett Publishers Inc., 4th edition, 2015,.
3. Engineering Mathematics, B.V.Ramana, Tata McGraw Hill Publications, 4th edition, 2005.
4. Engineering Mathematics, Anthony Craft, Pearson Education, 4th edition, 2013.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Taxonomy	**Tests**	**Assignments**	**Quizzes**
Marks (out of 50)	30	10	10
Remember	10	3	5
Understand	5	5	5
Apply	5	2	-
Analyze	5	-	-
Evaluate	5	-	-
Create	-	-	-

SEE – Semester End Examination (50 Marks)

Bloom's Taxonomy	**Tests**
Marks (Out of 50)	
Remember	10
Understand	10
Apply	20
Analyze	5
Evaluate	5
Create	-

ENGINEERING MATHEMATICS – IV

Course Code: MAT41 **Credits: 05**
L: P: T: S : 4:0:1:0 **CIE Marks: 50**
Exam Hours: 03 **SEE Marks : 50**

Course Outcomes: At the end of the Course, the Student will be able to do the following:

CO1	Solve initial value problems using appropriate numerical methods.
CO2	Understand the concepts of Complex variables and transformation for solving Engineering Problems.
CO3	Understand the concepts of complex integration, Poles and Residuals in the stability analysis of engineering problems.
CO4	Gain ability to use probability distributions to analyze and solve real time problems.
CO5	Apply the stochastic process and Markov Chain in prediction of future events.
CO6	Analyze, interpret, and evaluate scientific hypotheses and theories using rigorous probability and statistical methods.

Mapping of Course Outcomes to Program Outcomes:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	3	2	2	-	-	-	2	1	-	2
CO2	3	3	3	2	2	-	-	-	1	1	-	1
CO3	3	3	2	3	2	-	-	-	2	1	-	2
CO4	3	2	2	2	3	-	-	-	1	3	-	1
CO5	2	2	3	3	2	-	-	-	1	3	-	1
CO6	3	3	3	2	3	-	-	-	2	2	-	1

Module No.	**Module Contents**	**Hours**	**COs**
1	**Numerical Methods:** Numerical solution of ordinary differential equations of first order and of first degree: single step methods- Picard's Method, Taylor's series method, modified Euler's metho and Runge-Kutta method of fourth-order. Multi step methods- Milne's and Adams- Bashforth predictor and corrector methods. Numerical solution of simultaneous first order differential equations ; Picard's Method and Runge-Kutta Method of fourth-order(no derivation of formulae)	9	CO1
2	**Complex Variables**: Functions of complex Variables, Analytical		CO2

	functions, Cauchy's Riemann Equations in Cartesian and Polar forms, Harmonic functions and Construction of analytic function Discussion of Transformations: $w = z^2$, $w = e^z$ and $w = z + (1 / z)$ and Bilinear Transformations.	9	
3	**Complex Integrations:** Complex line integrals – Cauchy's theorem and Cauchy's Integral formula. Power Series, Laurent's series. Singularities, Poles and Residuals, Residual Theorem-problems (Without proof).	9	CO3
4	**Probability distributions:** Random variables (discrete and continuous), probability density function, cumulative density function. Discrete Probability distributions: Binomial and Poisson distributions. Continuous Probability distributions; Exponential and normal distributions. **Joint Probability distributions:**, Mathematical expectation, correlation, covariance (discrete random variables only).	9	CO4
5	**Sampling Theory:** Sampling, Sampling distributions, standard error, test of hypothesis for means and proportions, confidence limits for means, student's t-distribution, Chi-square distribution for test of goodness of fit. **Stochastic Processes:** Stochastic processes, Probability Vectors, Stochastic matrix, Regular stochastic matrix, Markov chains, Higher transition probabilities, Stationary distribution of regular Markov chains and absorbing states	9	CO5, CO6

TEXT BOOKS:

1. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley-India publishers, 10th edition, 2014.
2. Higher Engineering Mathematics, B.S.Grewal, Khanna Publishers, 43nd edition, 2014.

REFERENCE BOOKS:

1. Advanced Modern Engineering Mathematics, Glyn James, Pearson Education, 4th edition, 2015.
2. Advanced Engineering Mathematics, Dennis G. Zill, Michael R. Cullen, Jones and Barlett Publishers Inc, 4th edition, 2015,
3. Engineering Mathematics, B. V. Ramana, Tata McGraw Hill Publications, 4th edition, 2005.
4. Engineering Mathematics, Anthony Craft, Pearson Education, 4th edition, 2013.

Assessment Pattern

CIE- Continuous Internal Evaluation (50 Marks)

Bloom's Category / **Marks (Out of 50)**	**Tests (30 Marks)**	**Assignments (10 Marks)**	**Quizzes (10 Marks)**
Remember	10	3	5
Understand	5	5	5
Apply	5	2	-
Analyze	5	-	-
Evaluate	5	-	-
Create	-	-	-

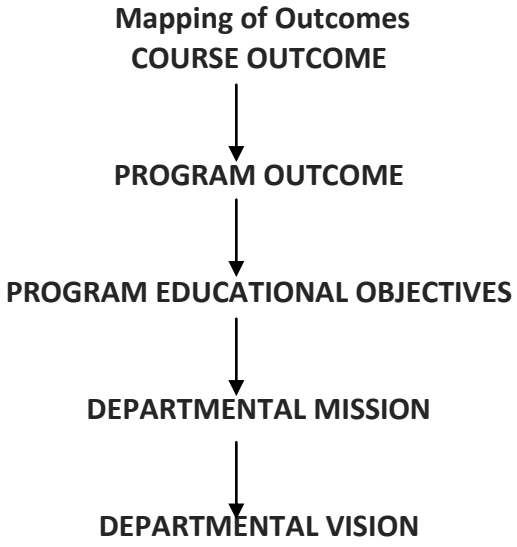
SEE- Semester End Examination (50 Marks)

Bloom's Category / **Marks (Out of 50)**	**Test (50 Marks)**
Remember	10
Understand	10
Apply	20
Analyze	5
Evaluate	5
Create	-

APPENDIX A

Outcome Based Education

Outcome-based education (OBE) is an educational theory that bases each part of an educational system around goals (outcomes). By the end of the educational experience each student should have achieved the goal. There is no specified style of teaching or assessment in OBE; instead classes, opportunities, and assessments should all help students achieve the specified outcomes.
There are three educational Outcomes as defined by the National Board of Accreditation:
Program Educational Objectives: The Educational objectives of an engineering degree program are the statements that describe the expected achievements of graduate in their career and also in particular what the graduates are expected to perform and achieve during the first few years after graduation. [nbaindia.org]
Program Outcomes: What the student would demonstrate upon graduation. Graduate attributes are separately listed in Appendix C
Course Outcome: The specific outcome/s of each course/subject that is a part of the program curriculum. Each subject/course is expected to have a set of Course Outcomes



APPENDIX B

The Graduate Attributes of NBA

Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialisation to the solution of complex engineering problems.

Problem analysis: Identify, formulate, research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

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.

Conduct investigations of complex problems: The problems that cannot be solved by straightforward application of knowledge, theories and techniques applicable to the engineering discipline that may not have a unique solution. For example, a design problem can be solved in many ways and lead to multiple possible solutions that require consideration of appropriate constraints/requirements not explicitly given in the problem statement (like: cost, power requirement, durability, product life, etc.) which need to be defined (modeled) within appropriate mathematical framework that often require use of modern computational concepts and tools.

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.

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.

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.

Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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.

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.

Life-long learning: Recognise the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

APPENDIX C

BLOOM'S TAXONOMY

Bloom's taxonomy is a classification system used to define and distinguish different levels of human cognition—i.e., thinking, learning, and understanding. Educators have typically used Bloom's taxonomy to inform or guide the development of assessments (tests and other evaluations of student learning), curriculum (units, lessons, projects, and other learning activities), and instructional methods such as questioning strategies. **[eduglosarry.org]**