Maharashtra State Board of Technical Education, Mumbai

Teaching And Examination Scheme For Post S.S.C. Diploma Courses

Program Name : Diploma in Mechatronics

Program Code : MK **With Effect From Academic Year: 2019 - 20**

Duration of Program : 6 Semesters **Duration : 16 Weeks**

Semester : Second **Scheme - I**

S. N.	Course Title	Course Abbreviation	Course Code	Teaching Scheme			Credit (L+T+P)	Examination Scheme												Grand Total
								Theory						Practical						
								Exam Duration in Hrs.	ESE		PA		Total		ESE		PA		Total	
				L	T	P			Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	Max Marks	Min Marks	
1	Applied Science – Physics	ASM	22202	2	-	4	8	90 Min	70*#	28	15*	00	100	40	25@	10	25	10	50	20	200
	Applied Science – Chemistry			2	-						15*	00			25@	10	25	10	50	20	
2	Applied Mechanics	AME	22203	3	1	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	150
3	Applied Mathematics	AMP	22206	4	2	-	6	3	70	28	30*	00	100	40	--	--	--	--	--	--	100
4	Engineering Drawing	EDR	22207	3	-	4	7	4	70	28	30*	00	100	40	25#	10	25	10	50	20	150
5	Business Communication Using Computers	BCC	22009	-	-	2	2	--	--	--	--	--	--	--	35@^	14	15~	06	50	20	50
6	Mechatronics Workshop	MWO	22069	1	-	4	5	--	--	--	--	--	--	--	50#	20	50~	20	100	40	100
	Total			**15**	**3**	**16**	**34**	--	**280**	--	**120**	--	**400**	--	**185**	--	**165**	--	**350**	--	**750**

Student Contact Hours Per Week: **34 Hrs.** Medium of Instruction: **English**

Theory and practical periods of 60 minutes each. Total Marks : **750**

Abbreviations: ESE- End Semester Exam, PA- Progressive Assessment, L - Lectures, T - Tutorial, P - Practical

@ Internal Assessment, # External Assessment, *# On Line Examination, ^ Computer Based Assessment

* Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

~ For the courses having ONLY Practical Examination, the PA marks Practical Part - with 60% weightage and Micro-Project Part with 40% weightage

- **It is mandatory for the candidate to appear for practical (ESE) of both the part of Applied Science (Physics & Chemistry). Candidate remaining absent in exam of any one part, will be considered as absent for the head ESE (PR) of Applied Science.**
- **If Candidate not securing minimum marks for passing in the "PA" part of practical of any course of any semester then the candidate shall be declared as "Detained" for that semester.**

Program Name : **Mechanical and Civil Engineering Program Group**

Program Code : **AE/CE/FG/ME/PT/PG/MK**

Semester : **Second**

Course Title : **Applied Science (Physics & Chemistry)**

Course Code : **22202**

1. RATIONALE

Diploma engineers have to deal with various materials and machines. The study of concepts and principles of science like elasticity, viscosity, surface tension, motion, thermo couples, photo-sensors, LASERs, X-Rays, metals, alloys, cement, lime, refractory materials water treatment and analysis, fuel and combustion will help the student to select and use relevant materials and methods which will be economical and eco-friendly.

2. COMPETENCY

This aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve broad-based engineering problems using principles of advanced physics and chemistry.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Select relevant material in industry by analyzing its physical properties.
b. Apply laws of motion in various applications.
c. Use LASERs, X-Rays and photo electric sensors..
d. Select the relevant metallurgical process related to industrial applications.
e. Use relevant water treatment process to solve industrial problems.
f. Use relevant fuel in relevant applications.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
2	-	4	8	90 Min	70*#	28	15*	00	100	40	25@	10	25	10	50	20
2	-						15*	00			25@	10	25	10	50	20

(*): *Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment (5 marks each for Physics and Chemistry) to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.*

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment*

Note: *Practical of Chemistry and Physics will be conducted in alternate weeks for each batch.*

5. COURSE MAP with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

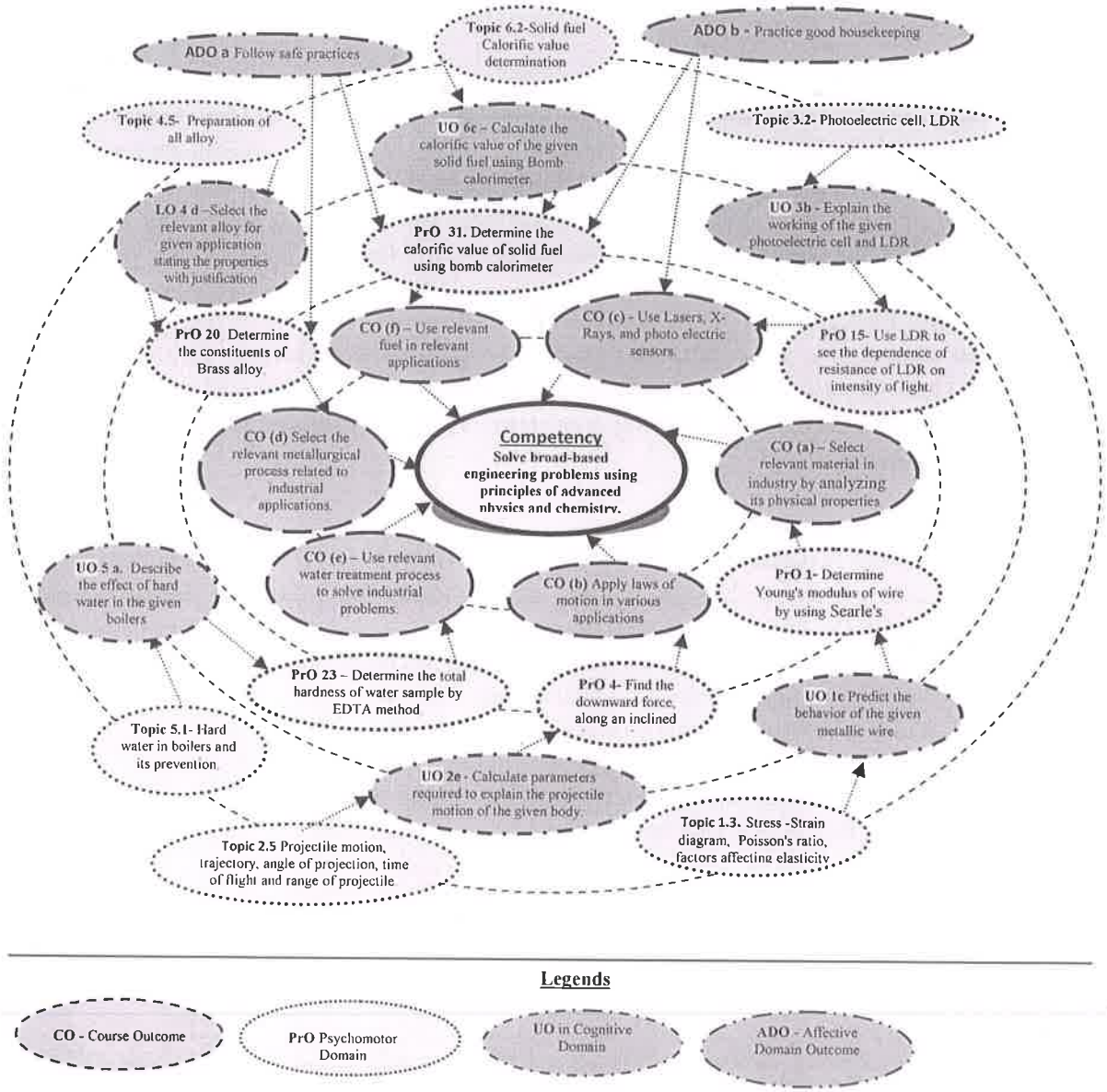

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	Physics		
1	Use Searle's method to determine the Young's modulus of given	1	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	wire		
2	Apply Archimedes' principle to determine the buoyancy force on a solid immersed in liquid.	I	02
3	Determine the coefficient of viscosity of given liquid by Stoke's method.	I	02
4	Find the downward force, along an inclined plane, acting on a roller due to gravity and its relationship with the angle of inclination.	I	02
5	Predict the range of the projectile from the initial launch speed and angle.	II	02*
6	i) Find the dependence of the stopping potential on the frequency of light source in photo electric effect experiment. ii) Find the dependence of the stopping potential on the intensity of light source in photo electric effect experiment.	III	02
7	Determine the I-V characteristics of photoelectric cell and LDR.	III	02*
8	Determine the divergence of laser beam.	III	02
	Chemistry		
9	Standardization of $KMnO_4$ solution using standard oxalic acid and Determine the percentage of iron present in given Hematite ore by $KMnO_4$ solution.	IV	02*
10	Determine the percentage of copper in given copper ore .	IV	02
11	Determine total hardness, temporary hardness and permanent hardness of water sample by EDTA method.	V	02*
12	Determine the alkalinity of given water sample.	V	02
13	Determine the turbidity of given water sample by Nephelometric method.	V	02
14	Determine the moisture and ash content in given coal sample using proximate analysis.	VI	02*
15	Determine the calorific value of given solid fuel using Bomb calorimeter.	VI	02*
16	Determine the percentage of Sulphur in given coal sample by ultimate analysis.(Gravimetric analysis)	VI	02
		Total	**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20

S. No.	Performance Indicators	Weightage in %
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Searle's apparatus(with slotted mass of 0.5 kg each)	1
2	Liquid container	2
3	Solid body (different size and materials)	3,4
4	Stoke's apparatus (glass tube, viscous liquid, spherical balls of varying sizes)	3
5	Stop watch	4,5
6	Photo transducer	4
7	Timer	4
8	Projectile motion detector	5
9	Photo electric effect apparatus	6
10	Experimental setup for characteristics of photoelectric cell	7
11	Experimental setup for characteristics of LDR	7
12	Laser Source (He Ne, diode laser)	8
13	Electronic balance, with the scale range of 0.001g to 500g. pan size 100 mm; response time 3-5 sec.; power requirement 90-250 V, 10 watt.	All
18	Electric oven inner size 18''x18''x18''; temperature range 100 to 250^0 C with the capacity of 40 lt.	14,16
19	Bomb calorimeter	15

S. No.	Equipment Name with Broad Specifications	Exp. No.
20	Muffle furnace, Temperature up to 900^0C,digital temperature controller with an accuracy of +/- 3^0C	14,16
21	Nephelometer ; Auto-ranging from 20-200 NTU,+/- 2% of reading plus 0.1 NTU, power 220 Volts +/- 10% AC 50 Hz	13

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	Physics	
Unit – I Properties of matter and Non-Destructive Testing	1a. Explain concept of elasticity and plasticity for the given material. 1b. Establish relation between given types of modulii of elasticity. 1c. Predict the behavior of the given metallic wire.	1.1 Deforming Force and Restoring Force, Elasticity, Plasticity, Rigidity 1.2 Stress and Strain and their types, Elastic limit and Hooke's law, types of moduli of elasticity 1.3 Stress -Strain diagram, Poisson's ratio, factors affecting elasticity
	1d. Explain pressure-depth relation for the given law. 1e. Explain Newton's law of viscosity for the given liquid. 1f. Explain Stokes' law for the free fall of the body through the given viscous medium.	1.4 Fluid friction, pressure, pressure- depth relation, Pascal's law, Archimedes' principle 1.5 Viscosity, velocity gradient, Newton's law of viscosity. 1.6 Free fall of spherical body through viscous medium and Stokes' law, derivation of coefficient of viscosity 'η' by Stokes' method, effect of temperature and adulteration on viscosity of liquids.
	1g. Describe the salient features of the given NDT method.	1.7 Non-destructive testing (NDT),Various NDT methods used, Criteria for the selection of NDT method, merits and demerits of NDT
Unit– II Types of Motion	2a. Explain the equations of motion for the given body moving in the given type of path. 2b. Calculate the angular velocity of the given body. 2c. Explain the relevant Newton's laws of motion for the given moving object. 2d. Calculate the work/power/ energy for the given situation. 2e. Calculate the given	2.1 Displacement, velocity, acceleration and retardation, equations of motion, equations of motion under gravity. 2.2 Angular displacement, angular velocity, angular acceleration, three equations of angular motion 2.3 Momentum, impulse, impulsive force, Newton's laws of motion and their Applications 2.4 Work, power and energy: potential energy, kinetic energy, work -energy principle.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	parameters for the given projectile in motion.	2.5 Projectile motion, trajectory, angle of projection, time of flight and range of projectile with formulae.
Unit– III Photoelectricity, X-Rays and LASERs	3a. Explain the concept of the given parameters of the given material. 3b. Explain the working of the given photoelectric device.	3.1 Planck's hypothesis, properties of photons, Photo electric effect: threshold frequency, threshold wavelength, stopping potential, Work function, characteristics of photoelectric effect, Einstein's photoelectric equation. 3.2 Photoelectric cell and LDR: principle, working and applications.
	3c. Explain the production of X-Rays of the given material with properties and applications.	3.3 Production of X-rays by modern Coolidge tube, properties and applications.
	3d. Differentiate between LASER and given colour of light 3e. Explain the given terms with examples.	3.4 Laser: properties, absorption, spontaneous and stimulated emission, applications of Laser 3.5 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser.
Chemistry		
Unit-IV Metals, alloys, Cement, and Refractory materials	4a. Describe construction and working of the given type of furnace. 4b. Describe the extraction process of the given ore with chemical reaction. 4c. Explain purposes and preparation methods of making the given alloy. 4d. Select the relevant alloy for the given application stating the properties with justification. 4e. Describe the constituents, hardening and setting process of the given type of cement. 4f. Select the relevant refractory for given application stating the properties with justification.	4.1 Metallurgy: Mineral, ore, gangue, flux, slag. 4.2 Types of furnace: Muffle furnace, Blast furnace. 4.3 Extraction processes of Haematite, copper pyrite ores: Crushing, concentration, reduction, refining. 4.4 Properties of iron and copper: Hardness, tensile strength, toughness, malleability, ductility, refractoriness, fatigue resistance. specific gravity, specific heat, brazing, castability, stiffness. 4.5 Preparation of alloys (Fusion and compression method). 4.6 Ferrous alloys: Low carbon, medium carbon, high carbon steels. 4.7 Non-ferrous alloy: Brass, Bronze, Duralumin, Tinman Solder, Woods metal. 4.8 Cement: Types; Biocement and Portland cement; constituents, setting and hardening, applications 4.9 Lime: classification, constituents, setting and hardening, applications.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		4.10 Refractory material: Types, properties.
Unit –V Water treatment	5a. Describe the given terminologies related to hard water and their effects 5b. Describe the given process for softening of the given water sample. 5c. Describe with sketches the purification of the given type of water. 5d. Describe the given type of of waste water treatment.	5.1 Hardness; Classification 5.2 Hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges. 5.3 Water softening: lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process (cation exchange and anion exchange). 5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization. 5.5 Waste water treatment: sewage treatment, BOD and COD of sewage water; Reverse Osmosis, recycling of waste water.
Unit-VI Fuels and Combustion	6a. Describe salient properties of the given type of fuel. 6b. Explain the given type of analysis of the given type of coal. 6c. Calculate the calorific value of the given solid fuel using Bomb calorimeter. 6d. Describe composition, properties of given gaseous fuel with their applications. 6e. Calculate the mass and volume of air required for complete combustion of the given fuel.	6.1 Fuel: Calorific value and ignition temperature, classification. 6.2 Solid fuels: Coal, Classification and composition , proximate analysis, Ultimate analysis, Bomb calorimeter. Carbonization of coke by Otto Hofmann's oven. 6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, properties. Knocking, cracking, octane number and cetane number. 6.4 Gaseous fuels: Biogas, LPG, and CNG. Combustion equation of gaseous fuels, mass and volume of air required for complete combustion.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
	Physics					
I	Properties of matter and NDT	14	03	05	06	14
II	Types of motion	09	02	02	06	10
III	Photoelectricity, X-Ray and LASER,	09	03	04	04	11
	Chemistry					

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
IV	Metals, alloys, cement, refractory materials	12	02	04	06	12
V	Water treatment	10	02	03	06	11
VI	Fuels and combustion.	10	03	04	05	12
Total		**64**	**15**	**22**	**33**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Seminar on any relevant topic.
b. Library survey regarding engineering material used in different industries.
c. Prepare power point presentation or animation for showing applications of lasers.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies which the teacher can use to accelerate the attainment of the various learning outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every

student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Elasticity:** Prepare working model to demonstrate the stress – strain behavior of different wires of different thickness and material.
b. **Viscosity:** Collect 3 to 5 liquids and prepare a working model to differentiate liquids on the basis of viscosity and demonstrate their applications.
c. **Motion:** Prepare model of ball rolling down on inclined plane to demonstrate the conservation of energy and motion of an object in inclined plane.
d. **Photo Sensors**: Prepare simple photo sensor using LDR.
e. **Properties of Laser**: Use Key chain laser to differentiate laser with ordinary light.
f. **Water analysis**: Collect water samples from different water sources and find the characteristics like acidity, conductivity, dissolved solids, suspended particles.
g. **Water treatment:** Collect 3 to 5 water samples to find the dosage of bleaching powder required for its sterilization.
h. **Water analysis:** Prepare model to find the soap foaming capacity of bore water on addition of soda ash.
i. **Fuels:** Prepare chart showing different types of liquid fuels showing their calorific values and uses.
j. **Cement:** Collect different samples of cement and find their initial and final setting time.
k. **Refractory materials**: Prepare chart showing properties of refractory materials.
l. **Metal properties:** Prepare chart showing different industrial application of metal and relate it with required property or properties using internet.
m. **Alloy steel:** Find the effect of alloying elements like Mn, Cr, Ni, W, V, Co on properties of steel. Prepare chart of showing percentage composition, properties and industrial applications of different types of steel based on above alloying elements using internet.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Physics Textbook Part I and Part - Class XI	Narlikar, J. V.; Joshi, A. W.; Mathur, Anuradha; *et al*	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
2	Physics Textbook Part I and part II - Class XII	Narlikar, J.V.; Joshi, A. W.; Ghatak A.K. *et al*	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
3	Engineering Physics	Bhattacharya, D. K.; Tandon Poonam	Oxford Publishing, New Delhi, ISBN:0199452814
4	Principles of Engineering Physics -I	Md. Nazoor Khan and Simanchala Panigrahi	Cambridge university press; New Delhi, 2016 ISBN : 9781316635643
5	Engineering Physics	Palanisamy, P. K.	SCITECH Publications, Chennai, ISBN: 9788183711012
6	Principles of Physics	Walker, J.; Halliday, D; Resnick, R	Wiley Publications, New Delhi, 10th edition ISBN: 9788126552566
7	Textbook of Engineering Physics	Avadhanulu, M. N.; Kshirsagar, P. G.	S. Chand and Co., New Delhi, 2015 ISBN: 9788121908177
8	Engineering Chemistry	Agarwal, Shikha	Cambridge university press ; New Delhi, 2015 ISBN : 9781107476417

S. No.	Title of Book	Author	Publication
9	Engineering Chemistry	Dara, S. S.; Umare S.S.	S.Chand and Co. Publication, New Delhi, 201, ISBN: 8121997658
10	Engineering Chemistry	Jain & Jain	Dhanpat Rai and sons; New Delhi, 2015, ISBN : 9352160002
11	Engineering Chemistry	Vairam, S.	Wiley India Pvt. Ltd. New Delhi, 2013, ISBN: 9788126543342
10	Chemistry for engineers	Agnihotri, Rajesh	Wiley India Pvt.Ltd. New Delhi, 2014, ISBN: 9788126550784

14. SOFTWARE/LEARNING WEBSITES

a. http://nptel.ac.in/course.php?disciplineId=115
b. http://nptel.ac.in/course.php?disciplineId=104
c. http://hperphysics.phy-astr.gsu.edu/hbase/hph.html
d. www.physicsclassroom.com
e. www.fearofphysics.com
f. www.sciencejoywagon.com/physicszone
g. www.science.howstuffworks.com
h. https://phet.colorado.edu
i. www.chemistryteaching.com
j. www.visionlearning.com
k. www.chem1.com
l. www.onlinelibrary.wiley.com
m. www.rsc.org
n. www.chemcollective.org
o. www.wqa.org
p. www.em-ea.org

Program Name : **Mechanical, Civil Chemical and Fabrication Technology and Erection Engineering Program Group**

Program Code : **AE/CE/CH/FG/ME/PT/PG/MK**

Semester : **Second**

Course Title : **Applied Mechanics**

Course Code : **22203**

1. RATIONALE

In day-to-day working we come across different types of structures created for different purposes and functions. While designing the structures, analysis of forces and stresses' is an important and prerequisite step. Correct analysis is possible only when one knows the types and effects of forces acting on the structures. This course provides the scope to understand fundamental concepts of laws of mechanics and their applications to different engineering problems. This course is designed to provide basic understanding about the different types of forces, moments and their effects on structural elements, which will analysing different structural systems.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Use principles of applied mechanics to solve broad-based engineering related problems.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Identify the force systems for given conditions by applying the basics of mechanics.
b. Select the relevant simple lifting machine(s) for given purposes.
c. Determine unknown force(s) of different engineering systems.
d. Check the stability of various force systems.
e. Apply the principles of friction in various conditions for useful purposes.
f. Find the centroid and centre of gravity of various components in engineering systems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme													
				Theory							Practical						
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total		
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	
3	1	2	6	3	70	28	30*	00	100	40	25@	10	25	10	50	20	

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

Legends: ***L****-Lecture;* ***T*** *– Tutorial/Teacher Guided Theory Practice;* ***P*** *- Practical;* ***C*** *– Credit,* ***ESE*** *- End Semester Examination;* ***PA*** *- Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

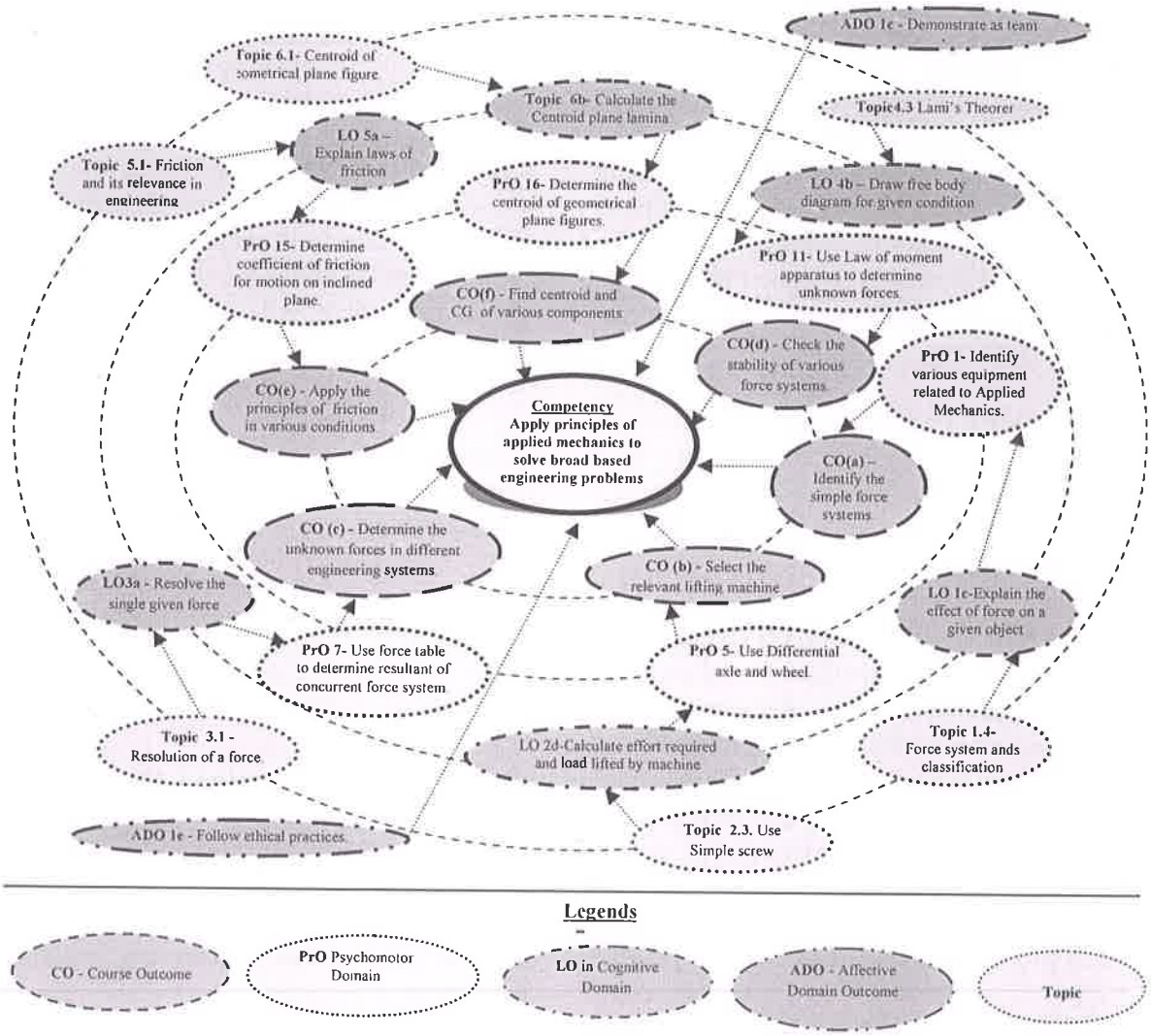

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Identify various equipment related to Applied Mechanics.	I to VI	02

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
2	Use Differential axle and wheel.	II	02*
3	Use Simple screw jack.	II	02
4	Use worm and worm wheel.	II	02
5	Use single or double purchase crab.	II	02
6	Use Weston's differential or wormed geared pulley block.	II	02
7	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-I)	III	02*
8	Use force table to determine resultant of concurrent force system applying Law of Polygon of forces. (Part-II)	III	02*
9	Graphically determine resultant of concurrent force system.	III	02
10	Graphically determine resultant of parallel force system.	III	02
11	Use Law of moment apparatus to determine unknown forces.	IV	02*
12	Apply Lami's theorem to determine unknown force.	IV	02
13	Determine support reactions for simply supported beam.	IV	02
14	Determine coefficient of friction for motion on horizontal plane.	V	02*
15	Determine coefficient of friction for motion on inclined plane.	V	02
16	Determine centroid of geometrical plane figures.	VI	02
	Total		**32**

Note

i. A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical need to be performed, out of which, the practicals marked as '' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S.No.	Performance Indicators	Weightage in %
1	Preparation of experimental set up	20
2	Setting and operation	20
3	Safety measures	10
4	Observations and Recording	10
5	Interpretation of result and Conclusion	20
6	Answer to sample questions	10
7	Submission of report in time	10
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/a team member.
d. Maintain tools and equipment.
e. Follow ethical practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year.
- 'Organising Level' in 2nd year.
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Differential axle and wheel (wall mounted unit with the wheel of 40 cm diameter and axles are insteps of 20 cm and 10 cm reducing diameter .	2
2	Simple screw Jack (Table mounted metallic body , screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	3
3	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; with necessary slotted weights, hanger and thread)	4
4	Single Purchase Crab winch (Table mounted heavy cast iron body. The effort wheel is of C.I. material of 25 cm diameter mounted on a shaft of about 40mm dia. On the same shaft a geared wheel of 15 cm dia.	5
5	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement.)	5
6	Weston's Differential pulley block (consisting of two pulleys; one bigger and other smaller.	6
7	Weston's Differential worm geared pulley block (Consists of a metallic (preferably steel) cogged wheel of about 20 cm along with a protruded load drum of 10 cm dia to suspend the weights of 10 kg, 20 kg-2 weights and a 50 kg weights)	6
8	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories..	7, 10
9	Law of moments apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at centre.	9
10	Beam Reaction apparatus (The apparatus is with two circular dial type 10 kg.	11
11	Friction apparatus for motion along horizontal and inclined plane (base to which a sector with graduated arc and vertical scale is provided. The plane may be clamped at any angle up to 45 degrees. pan. Two weight boxes (each of 5 gm,10 gm, 2-20 gm, 2-50 gm, 2-100 gm weight),	12
12	Models of geometrical figures.	13

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Mechanics and force system	1a. Explain concepts of the given terms. 1b. Use the relevant units of various quantities in the given situations. 1c. Explain effects of a force on the given object. 1d. Identify the force system for the given situation.	1.1. Significance and relevance: Mechanics, applied mechanics, statics, dynamics. 1.2. Space, time, mass, particle, body, rigid body. 1.3. Scalar and vector quantity, Units of measurement (SI units)- Fundamental units and derived units. 1.4. Force – unit, representation as a vector and by Bow's notation, characteristics and effects of a force, Principle of transmissibility of force, Force system and its classification.
Unit – II Simple lifting machine	2a. Describe the components of the given lifting machine. 2b. Differentiate the working principle of the given two types of simple lifting machines. 2c. Determine velocity ratio, efficiency and law of the given simple lifting machine. 2d. Calculate effort required and load lifted by the given simple lifting machine. 2e. Interpret the graphs after drawing them with the given data. 2f. Select the relevant simple lifting machine required for the given purpose with justification.	2.1 Simple lifting machine, load, effort, mechanical advantage, applications and advantages. Velocity ratio, efficiency of machines, law of machine. 2.2 Ideal machine, friction in machine, maximum Mechanical advantage and efficiency, reversible and non-reversible machines, condition for reversibility 2.3 Velocity ratios of Simple axle and wheel, Differential axle and wheel, Worm and worm wheel, Single purchase and double purchase crab winch, Simple screw jack, Weston's differential pulley block, geared pulley block. 2.4 Graphs of Load verses Effort, Load verses ideal Effort, Load verses Effort lost in friction, Load verses MA, Load verses Efficiency.
Unit- III Resolution and compositio n	3a. Resolve the given single force. 3b. Calculate the resultant of the given force system analytically. 3c. Determine graphically the resultant of the given force system. 3d. Find the resultant of the given force system using law of triangle and law of	3.1 Resolution of a force - Orthogonal and Non Orthogonal components of a force, moment of a force, Varignon's Theorem, 3.2 Composition of forces – Resultant, analytical method of determination of resultant for concurrent, non concurrent and parallel co-planar force systems – Law of triangle, parallelogram and polygon of forces. 3.3 Graphic statics: graphical representation of force, Space diagram, force diagram,

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	parallelogram.	polar diagram and funicular polygon, Graphical method of determination of resultant for concurrent and parallel co-planar force systems.
Unit– IV Equilibrium	4a. Draw the free body diagram for the given condition. 4b. Determine unknown force in the given situation using Lami's theorem. 4c. Identify the types of beams required for the given situation. 4d. Determine reactions in the given type of beam analytically and graphically.	4.1 Equilibrium and Equilibrant, Free body and Free body diagram, Analytical and graphical conditions of equilibrium, 4.2 Equilibrium of force systems analytically 4.3 Lami's Theorem, 4.4 Types of beam, supports (simple, hinged, roller and fixed) and loads acting on beam (vertical and inclined point load, UD load, couple), span of beam. 4.5 Beam reaction for cantilever, simply supported beam with or without overhang – subjected to combination of Point load and UD load or Vertical Point load and couple. 4.6 Beam reaction graphically for simply supported beam subjected to vertical loads only.
Unit– V Friction	5a. Determine force of friction and coefficient of friction for the given condition. 5b. Describe the conditions for friction for the give situation. 5c. Determine friction force in the given situation. 5d. Identify the various forces acting on a ladder for the given conditions using free body diagram.	5.1 Friction and its relevance in engineering, types and laws of friction, limiting equilibrium, limiting friction, co-efficient of friction, angle of friction, angle of repose, relation between co-efficient of friction and angle of friction. 5.2 Equilibrium of bodies on level surface subjected to force parallel and inclined to plane. 5.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only. 5.4 FBD of ladder in friction
Unit– VI Centroid and centre of gravity	6a. Determine the centroid of geometrical plane figures and centre of gravity of the given simple solid. 6b. Calculate centroid of the given composite plane lamina 6c. Determine centre of gravity of the given solids. 6d. Determine centre of gravity of the given composite solid.	6.1 Centroid of geometrical plane figures (square, rectangle, triangle, circle, semi-circle, quarter circle) 6.2 Centroid of composite figures composed of not more than three geometrical figures 6.3 Centre of Gravity of simple solids (Cube, cuboid, cone, cylinder, sphere, hemisphere) 6.4 Centre of Gravity of composite solids composed of not more than two simple solids.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Mechanics and Force System	04	02	02	02	06
II	Simple Lifting Machines.	08	02	04	06	12
III	Resolution and Composition	10	02	04	08	14
IV	Equilibrium	10	02	02	10	14
V	Friction	08	02	04	06	12
VI	Centroid and Centre of Gravity	08	02	02	08	12
Total		**48**	**12**	**18**	**40**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Collect five different photographs indicating concurrent, parallel, general force system in equilibrium.
b. Prepare a table of type of machine and relevant industrial application.
c. Collect five different situations where law of moment plays an important role.
d. Prepare models representing various types of supports (hinged, roller and fixed)
e. Illustrate situations wherein friction is essential and not essential.
f. Prepare models in the form of geometrical figures and solids and locate centroid and centre of gravity of them.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in

fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Types of Forces**: Prepare chart showing real-life examples indicating various types of forces
b. **Lifting Machine**: Collect photographs of specific simple lifting machine and relate these machines with the machines being studied and prepare models of simple lifting machines using tools in "MECHANO" and "MECHANIX"
c. **Types of support:** Prepare chart showing actual and corresponding schematic diagram of various type of support
d. **Beams:** Prepare models of beam subjected to point loads, uniformly distributed loads, simply supported, overhang and cantilever type beam.
e. **Friction:** Prepare chart regarding type of friction in various field conditions and collect data regarding coefficient of friction by referring books, Determine coefficient of friction for three different types of surfaces
f. **Centre of Gravity:** Prepare a chart of situations wherein concept of Centre of Gravity is vital.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Applied Mechanics	Khurmi, R.S.	S.Chand & Co. New Delhi 2014 ISBN: 9788121916431
2	Engineering Mechanics	Ramamrutham, S.	S Chand & Co. New Delhi 2008 ISBN:9788187433514
3	Foundations and Applications of Applied Mechanics	Ram, H. D.; Chauhan, A. K.	Cambridge University Press, Thomson Press India Ltd., New Delhi, 2015, ISBN: 9781107499836
4	Engineering Mechanics-Statics, Vol. I	Meriam, J. L.; Kraige, L.G.	Wiley Publication, New Delhi, ISBN: 978-81-265-4396

14. SOFTWARE/LEARNING WEBSITES

a. http://www.asnu.com.au
b. www.youtube.com for videos regarding machines and applications, friction
c. www.nptel.ac.in
d. www.discoveryforengineers.com

Program Name : **Mechanical and Chemical Engineering Program Group**

Program Code : **AE / CH / FG / ME / PT / MK**

Semester : **Second**

Course Title : **Applied Mathematics**

Course Code : **22206**

1. RATIONALE

Subject of applied mathematics is being introduced in diploma courses to provide mathematical background to the students. This course follows in developing theory and competency needed for a wide range of engineering applications. In particular the technique of calculus, differentiation, integration, differential equations and probability distribution for modeling and analysis in a wide range of applications. This course further develops the skills and understanding of mathematical concepts which underpin the investigative tools used in Mechanical engineering.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Solve mechanical engineering related problems using the principles of applied mathematics.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Calculate the equation of tangent, maxima, minima, radius of curvature by differentiation.
b. Solve the given problem(s) of integration using suitable methods.
c. Apply the concept of integration to find area and volume.
d. Solve the differential equation of first order and first degree using suitable methods.
e. Utilize basic concepts of probability distribution to solve elementary engineering problems.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
4	2	--	6	3	70	28	30*	00	100	40	--	--	--	--	--	--

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** – Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP(with sample COs, Unit Outcomes i.e. UOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

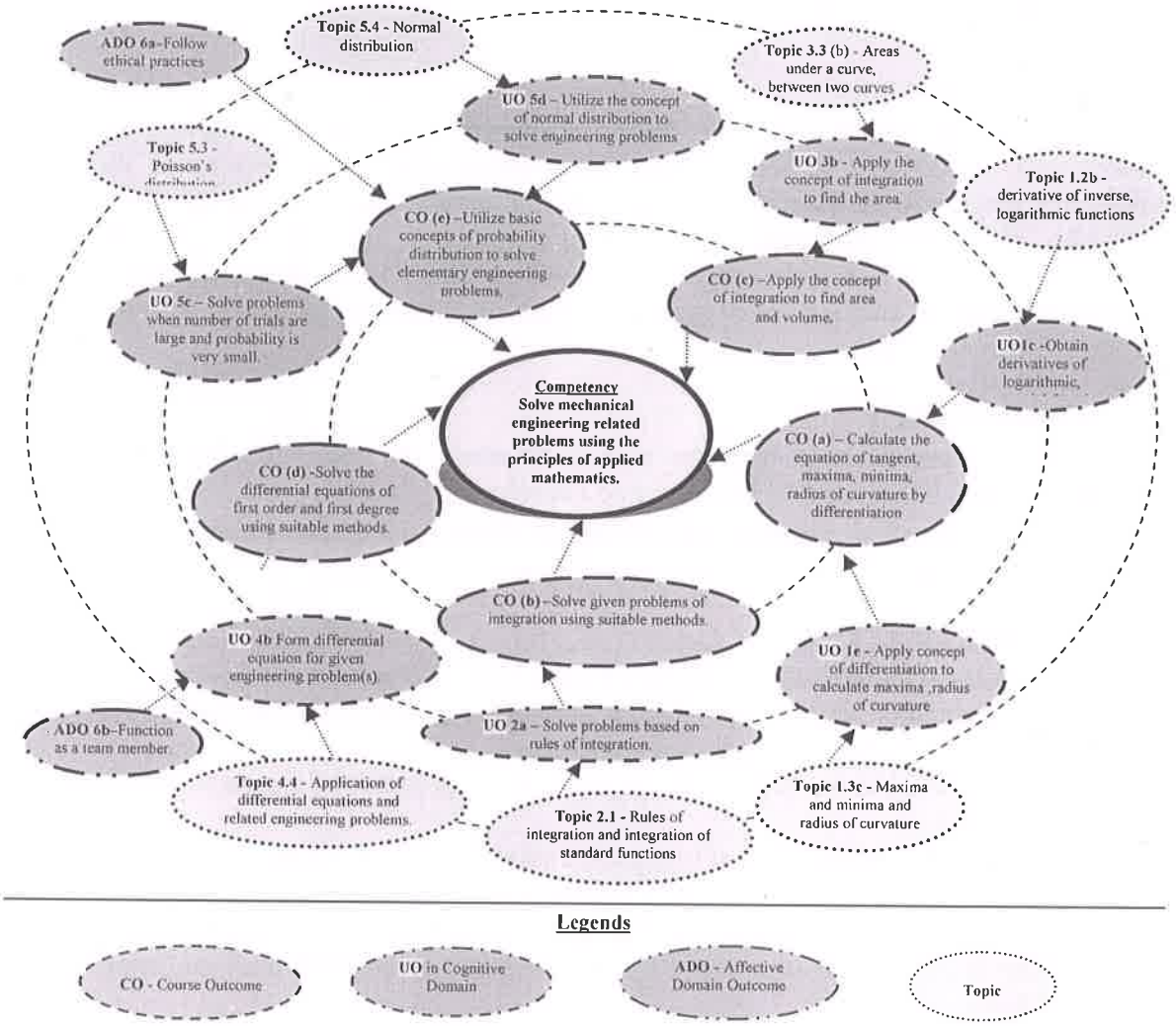

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The tutorials in this section are sub-components of the COs to be developed and assessed in the student to lead to the attainment of the competency.

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
1	Solve problems based on finding value of the function at different points.	I	2
2	Solve problems to find derivatives of implicit function and parametric function	I	2
3	Solve problems to find derivative of logarithmic and exponential functions.	I	2

S. No.	Tutorials	Unit No.	Approx. Hrs. Required
4	Solve problems based on finding equation of tangent and normal.	I	2
5	Solveproblems based on finding maxima, minima of function and radius of curvature at a given point.	I	2
6	Solve the problems based on standard formulae of integration.	II	2
7	Solve problems based on methods of integration, substitution, partial fractions.	II	2
8	Solve problems based on integration by parts.	II	2
9	Solve practice problems based on properties of definite integration.	III	2
10	Solve practice problems based on finding area under curve, area between two curves and volume of revolutions.	III	2
11	Solve the problems based on formation, order and degree of differential equations.	IV	2
12	Develop a model using variable separable method to related engineering problem.	IV	2
13	Develop a model using the concept of linear differential equation to related engineering problem.	IV	2
14	Solve problems based on Binomial Distribution related to engineering problems.	V	2
15	Solve problems based on Poisson Distribution related to engineering problems.	V	2
16	Solve problems based on Normal Distribution related to engineering.	V	2
Total			32

Note: *The above tutorial sessions are for guideline only. The remaining tutorial hours are for revision and practice.*

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

- Not applicable –

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Differential Calculus	1a. Solve the given simple problems based on functions. 1b. Solve the given simple problems based on rules of differentiation. 1c. Obtain the derivatives of logarithmic, exponential functions. 1d. Apply the concept of differentiation to find given	1.1 Functions and Limits : a) Concept of function and simple examples b) Concept of limits without examples. 1.2 Derivatives : a) Rules of derivatives such as sum, product, quotient of functions. b) Derivative of composite functions (chain Rule), implicit and

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
	equation of tangent and normal 1e. Apply the concept of differentiation to calculate maxima and minima and radius of curvature of given problem.	parametric functions. c) Derivatives of inverse, logarithmic and exponential functions. 1.3 Applications of derivative : a) Second order derivative without examples. b) Equation of tangent and normal c) Maxima and minima d) Radius of curvature
Unit– II Integral Calculus	2a. Solve the given simple problem(s) based on rules of integration. 2b. Obtain the given integral(s) using substitution method. 2c. Integrate given simple functions using the integration by parts. 2d. Evaluate the given simple integral by partial fractions.	2.1 Simple Integration: Rules of integration and integration of standard functions. 2.2 Methods of Integration: a) Integration by substitution. b) Integration by parts c) Integration by partial fractions.
Unit– III Applications of Definite Integration	3a. Solve given simple problems based on properties of definite integration. 3b. Apply the concept of definite integration to find the area under the given curve(s). 3c. Utilize the concept of definite integration to find area between given two curves. 3d. Invoke the concept of definite integration to find the volume of revolution of given surface.	3.1 Definite Integration: a) Simple examples b) Properties of definite integral (without proof) and simple examples. 3.2 Applications of integration : a) Area under the curve. b) Area between two curves. c) Volume of revolution.
Unit-IV First Order First Degree Differential Equations	4a. Find the order and degree of given differential equations. 4b. Form simple differential equations for simple given engineering problem(s). 4c. Solve given differential equations using the method of variable separable. 4d. Solve the given simple problem(s) based on linear differential equations.	4.1 Concept of differential equation 4.2 Order, degree and formation of differential equation. 4.3 Solution of differential equation a. Variable separable form. b. Linear differential equation. 4.4 Application of differential equations and related engineering problems.

Unit –V Probability Distribution	5a. Make use of probability distribution to identify discrete and continuous probability distribution 5b. Solve given problems based on repeated trials using Binomial distribution. 5c. Solve given problems when number of trials are large and probability is very small. 5d. Utilize the concept of normal distribution to solve related engineering problems.	5.1 Probability distribution a. Discrete Probability distribution b. Continuous Probability distribution. 5.2 Binomial distribution. 5.3 Poisson's distribution. 5.4 Normal distribution.

Note: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Differential calculus	20	04	08	12	24
II	Integral calculus	14	02	06	08	16
III	Applications of Definite Integration.	10	02	02	04	08
IV	First Order First Degree Differential Equations	08	02	02	04	08
V	Probability distribution.	12	02	05	07	14
Total		**64**	**12**	**23**	**35**	**70**

Legends: *R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
Note: *This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess with respect to attainment of UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Identify engineering problems based on real world problems and solve with the use of free tutorials available on the internet.
b. Use graphical software's: EXCEL, DPLOT, and GRAPH for related topics.
c. Use Mathcad as Mathematical Tools and solve the problems of Calculus.
d. Identify problems based on applications of differential equations and solve these problems.
e. Prepare models to explain different concepts of applied mathematics.
f. Prepare a seminar on any relevant topic based on applications of integration.
g. Prepare a seminar on any relevant topic based on applications of probability distribution to related engineering problems.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the UOs/COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare models using the concept of tangent and normal to bending of roads in case of sliding of a vehicle.
b. Prepare models using the concept of radius of curvature to bending of railway track.
c. Prepare charts displaying the area of irregular shapes using the concept of integration.
d. Prepare charts displaying volume of irregular shapes using concept of integration.
e. Prepare models using the concept of differential equations for mixing problem.
f. Prepare models using the concept of differential equations for radio carbon decay.
g. Prepare models using the concept of differential equations for population growth.
h. Prepare models using the concept of differential equations for thermal cooling.
i. Prepare a chart of binomial distribution by collection of suitable manufacturing industry base data.
j. Prepare a chart of normal distribution by collection of suitable manufacturing industry base data
k. Prepare a chart of Poisson distribution by collection of suitable manufacturing industry base data

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Higher Engineering Mathematics	Grewal, B.S.	Khanna publications, New Delhi , 2013 ISBN: 8174091955
2	A Text Book of Engineering Mathematics	Dutta, D.	New Age Publications, New Delhi, 2006, ISBN-978-81-224-1689-3
3	Advanced Engineering Mathematics	Krezig, Ervin	Wiley Publications, New Delhi, 2016 ISBN:978-81-265-5423-2,
4	Advanced Engineering Mathematics	Das, H.K.	S. Chand Publications, New Delhi, 2008, ISBN:9788121903455
5	Engineering Mathematics, Volume 1 (4th edition)	Sastry, S.S.	PHI Learning, New Delhi, 2009 ISBN-978-81-203-3616-2,
6	Comprehensive Basic Mathematics, Volume 2	Veena, G.R.	New Age Publications, New Delhi, 2005 ISBN: 978-81-224-1684-8
7	Getting Started with MATLAB-7	Pratap, Rudra	Oxford University Press, New Delhi, 2009, ISBN: 10: 0199731241
8	Engineering Mathematics (3rd edition).	Croft, Anthony	Pearson Education, New Delhi,2010 ISBN: 978-81-317-2605-1

14. SOFTWARE/LEARNING WEBSITES

a. www.scilab.org/ - SCI Lab
b. www.mathworks.com/products/matlab/ - MATLAB
c. Spreadsheet applications
d. www.dplot.com/ - DPlot
e. www.allmathcad.com/ - MathCAD
f. www.wolfram.com/mathematica/ - Mathematica
g. http://fossee.in/
h. https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaAoddHoPig
i. www.easycalculation.com
j. www.math-magic.com

Program Name : **Mechanical Engineering Program Group**

Program Code : **AE/ME/PT/PG/MK**

Semester : **Second**

Course Title : **Engineering Drawing**

Course Code : **22207**

1. RATIONALE

Engineering drawing is the language of engineers. The concepts of drawing language are used in visualizing the situation, materializing the ideas, conveying the instructions which are used in carrying out engineering jobs. The course aims at developing the ability to draw and read projections of lines/planes/solids and develops imagination and translating skills in drawing orthographic sectional, missing views and auxiliary views of common engineering components. Knowledge of conventional representation of various joints helps to read and draw various production drawings. This course also aims at building foundation for further courses related to engineering drawing and other allied courses in coming semesters.

2. COMPETENCY

This aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Prepare engineering drawings using prevailing drawing standards and instruments**.

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above mentioned competency:

a. Draw projections of 2D and 3D standard regular entities.
b. Draw sectional views of objects.
c. Draw orthographic sectional and missing views.
d. Draw auxiliary views of objects.
e. Use various drawing codes, conventions and symbols as per IS SP-46.
f. Draw free hand sketches of given engineering elements.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
3	-	4	7	3	70	28	30*	00	100	40	25#	10	25	10	50	20

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain LOs required for the attainment of the COs.

***Legends: L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** – Practical; **C** – Credit, **ESE** - End Semester Examination; **PA** - Progressive Assessment*

4. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

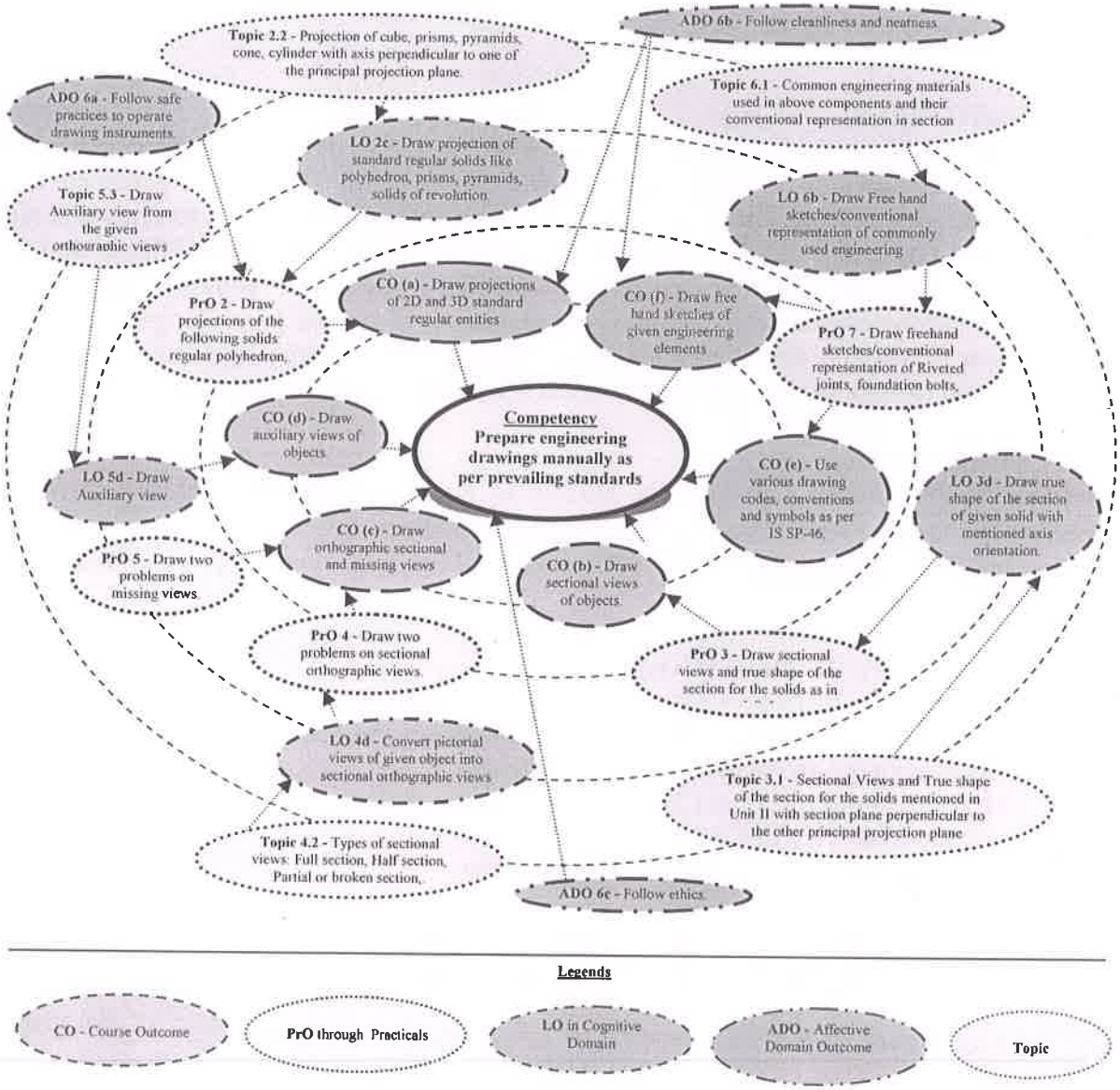

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
1.	Draw two problems on projection of straight lines Part I	I	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
2.	Draw two problems on projection of planes Part II	I	02
3.	Draw projections of Regular polyhedron. Part I	II	02*
4.	Draw projections of Regular polyhedron. Part II	II	02
5.	Draw projections of Regular prisms. Part III	II	02
6.	Draw projections of Regular pyramids Part. IV	II	02
7.	Draw projections of Regular solids of revolution. Part V	II	02
8.	Draw sectional views and true shape of the section for the solids mentioned in S. No.3-6. Part I	III	02*
9.	Draw sectional views and true shape of the section for the solids mentioned in S. No.3-6. Part II	III	02
10.	Draw sectional views and true shape of the section for the solids mentioned in S. No.3-6. Part III	III	02
11.	Draw sectional views and true shape of the section for the solids mentioned in S. No.3-6. Part IV	III	02
12.	Draw sectional views and true shape of the section for the solids mentioned in S. No.3-6. Part V	III	02
13.	Draw two problems on sectional orthographic views. Part I	IV	02*
14.	Draw two problems on sectional orthographic views. Part II	IV	02
15.	Draw two problems on sectional orthographic views. Part III	IV	02
16.	Draw two problems on sectional orthographic views. Part IV	IV	02
17.	Draw two problems on missing views. Part I	V	02*
18.	Draw two problems on missing views. Part II	V	02
19.	Draw two problems on missing views. Part III	V	02
20.	Draw two problems on missing views. Part IV	V	02
21.	Draw two problems on missing views. Part V	V	02
22.	Draw two problems on missing views. Part VI	V	02
23.	Draw auxiliary view from the given orthographic views - one problem. Part I	V	02
24.	Draw auxiliary view from the given orthographic views - one problem. Part II	V	02
25.	Draw auxiliary view from the given orthographic views - one problem. Part III	V	02
26.	Draw principal view from the given auxiliary view and other principal view - one problem. Part IV	V	02
27.	Draw principal view from the given auxiliary view and other principal view - one problem. Part V	V	02
28.	Draw principal view from the given auxiliary view and other principal view - one problem. Part VI	V	02
29.	Draw free hand sketches/conventional representation of: i. Rivet heads(1 sheet, at least 10 sketches/conventional	VI	02*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. Required
	representations). ii. Riveted joints: Lap Joint – Single and Double Riveted.		
30.	Draw free hand sketches/conventional representation of: i. Butt Joint – Single Strap, Double Strap. ii. Foundation bolts: Eye and Lewis.	VI	02
31.	Draw free hand sketches/conventional representation of: i. Couplings: Muff, Protected Flange and Flexible Flange. ii. Pulleys: Rope and V-Belt.	VI	02
32.	Draw free hand sketches/conventional representation of: i. Welding joints. ii. Common engineering materials used in practice and their conventional representation in section.	VI	02
	Total		**64**

'': compulsory practicals to be performed.*

Note

i. A suggestive list of practical PrOs is given in the above table, more such practical PrOs can be added to attain the COs and competency.

ii. The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:

S. No.	Performance Indicators	Weightage in %
1	Neatness, Cleanliness on drawing sheet	10
2	Uniformity in drawing and line work	10
3	Creating given drawing	40
4	Dimensioning the given drawing and writing text	20
5	Answer to sample questions	10
6	Submission of drawing in time	10
	Total	**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safe practices to operate drawing instruments.
b. Follow cleanliness and neatness.
c. Follow ethics and standards.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organising Level' in 2nd year
- 'Characterising Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by administrators.

S. No.	Equipment Name with Broad Specifications	Exp. No.
1	Drawing Table with Drawing Board of A1 or full imperial size	All
2	Drawing sheet of A2 or half imperial size	All
3	Models of various types of solids	2
4	Models of cut section of various solids	3
5	Models of cut sections of objects	4
6	Models of Mechanical Components	5
7	Models of objects with inclined surfaces	6
8	Specimen library of various rivet heads, foundation bolts, welding joints, valves and pipe fittings	7
9	Set of various industrial drawings being used by industries	All
10	Set of drawings sheets mentioned in section 6.0 could be developed by experienced teachers and made available on the MSBTE portal to be used as reference/standards	All
11	Drawing equipment's and instruments for class room teaching-large size: a. T-square or drafter (Drafting Machine) b. Set squares (45^0 and 30^0- 60^0) c. Protractor d. Drawing instrument box (containing set of compasses and dividers)	All
12	Interactive board with LCD overhead projector	All

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop LOs in cognitive domain for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit – I Projection of straight lines and planes	1a. Classify various positions of lines with respect to projection planes. 1b. Draw projection of lines in different positions based on given situation. 1c. Classify various types of planes according to orientations. 1d. Draw projection of planes with different orientations based on given situation.	1.1 Projection of straight lines with following positions: a) Parallel to both the planes. b) Perpendicular to one plane. c) Inclined to one plane and parallel to the other. d) Inclined to both the planes. 1.2 Traces of a Line. 1.3 Projection of Planes with following orientations: i. Plane parallel to one principal plane and perpendicular to the other. ii. Plane inclined to one principal plane and perpendicular to the other.
Unit– II Projection	2a. Classify various types of solids.	2.1 Types of Solids 2.2 Projection of the following solids:

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
of solids	2b. Explain orientation of axis with respect to projection planes. 2c. Draw projection of given standard regular solids like polyhedron, prisms, pyramids, solids of revolution.	a) Regular Polyhedron – Tetrahedron, Hexahedron (cube) b) Regular prisms and Pyramids – Triangular, Square, Pentagonal, Hexagonal c) Regular solids of Revolution – Cylinder, Cone, Sphere. **With Axis:** i. Perpendicular to one of the principal projection plane. ii. Inclined to one of the principal plane and parallel to the other. iii. Parallel to both principal planes
Unit– III Sections of solids	3a. Describe cutting planes and their orientation with respect to given solid and projection planes. 3b. Explain significance of sectional view and true shape. 3c. Draw sectional view of given solid. 3d. Draw true shape of the section of given solid with mentioned axis orientation.	3.1 Sectional Views and True shape of the section for the solids mentioned in Unit II with section plane in following positions: i parallel to one of the principal projection plane ii inclined to one and perpendicular to the other principal projection plane *Note: Position of solid is restricted to the following:* i. Axis parallel to both principal projection planes ii. Axis perpendicular to one and parallel to the other principal projection plane
Unit– IV Sectional orthograp hic views	4a. Classify various types of sectional views. 4b. Explain sectioning and hatching conventions. 4c. Convert pictorial views of given object into sectional orthographic views. 4d. Interpret the given drawing.	4.1 Cutting plane line 4.2 Types of sectional views: Full section, Half section, Partial or broken section, Revolved section, Removed section, offset section, Aligned section. 4.3 Sectioning conventions 4.4 Hatching or section lines 4.5 Conversion of pictorial views into sectional orthographic views
Unit– V Missing and Auxiliary views	5a. Interpret the given views. 5b. Draw the missing view from given situation. 5c. Interpret given Auxiliary view 5d. Draw Auxiliary view based on given situation.	5.1 Draw Missing lines and views from the given orthographic views 5.2 Auxiliary planes and views 5.3 Draw Auxiliary view from the given orthographic views 5.4 Complete the partial view from the given auxiliary and other principal view
Unit VI	6a. Identify various	6.1 Draw Free hand sketches/conventional

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Free Hand sketches/conventional representation	engineering components and their materials in the given sectional view. 6b. Draw Free hand sketches/conventional representation of given engineering components.	representation of: i Rivet heads ii Riveted joints: Lap Joint – Single and Double Riveted, Butt Joint – Single strap, Double Strap iii Foundation bolts: Eye and Lewis iv Couplings: Muff, Protected Flange and Flexible Flange v Pulleys: Rope and V-Belt vi Welding joints 6.2 Common engineering materials used in above components and their conventional representation in section.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' of Bloom's 'Cognitive Domain Taxonomy'.*

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Projection of straight Lines and Planes	10	-	02	08	10
II	Projection of solids	06	-	02	10	12
III	Section of solids	08	-	02	10	12
IV	Sectional orthographic views	08	-	02	10	12
V	Missing and Auxiliary views	12	02	04	12	18
VI	Free hand/conventional representation	04	04	02	-	06
Total		**48**	**06**	**14**	**50**	**70**

***Legends:** R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of LOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Student should maintain a separate A3 size sketch book which will be the part of term work and submit it along with drawing sheets. Following assignment should be drawn in the sketch book
   i. Minimum 5 problems each on Unit No I to VI.
   ii. Free hand sketches. All types of machine elements mentioned in Unit no-VI.
   iii. Note- Problems on sheet and in the sketch book should be different.
b. Students should collect Production drawings, Layouts from nearby workshops/industries and try visualize the part from the given views.

c. Each student should explain at least one problem for construction and method of drawing in sheet to all batch colleagues. Teacher will assign the problem of particular sheet/assignment to be explained to each student batch.
d. Each student will assess at least one sheet of other students (May be a group of 5-6 students identified by teacher can be taken) and will note down the mistakes committed by them. Student will also guide the students for correcting the mistakes, if any.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Show video/animation films to explain sectional orthographic and missing views and other topics.
g. Use charts and industrial drawing/drawing sheets developed by experienced faculty to teach standard symbols and current industrial/teaching practices.
h. Assign different types of micro projects.
i. Use wooden models to explain the problems.
j. Show the actual parts / models of machine elements mentioned in Unit VI.
k. Use Computer Aided Instructional software for teaching various concepts.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. **Wood/Thermocol Related Jobs:** Students should use the wooden/thermocol models and verify the correctness of views drawn in the problems solved in the sketch book.
b. **Production drawings:** Each student of the batch should collect at least one production drawings from local workshops or industry and list various types of sections used in the drawings.

c. **Production drawings:** Each student should be given 10 problems in which two views of the objects are given with missing lines. Student should identify the missing lines and complete the views.
d. **Thermocol Models:** The teacher will assign one set of orthographic views/auxiliary views and ask the student to develop 3D thermocol models of the same.
e. Students should collect samples / catalogues of the standard mechanical components available in the market.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1.	Engineering Drawing	Bhatt, N.D.	Charotar Publishing House Pvt. Anand, Gujarat Ltd.; ISBN No. 978-93-80358-55-0
3.	Machine Drawing	Bhatt, N.D.; Panchal, V. M	Charotar Publishing House Pvt. Ltd. Anand, Gujarat, ISBN No. 978-93-80358-69-7
4.	Engineering Drawing	Narayana, K.L. ; Kannaiah, P.	Scitech Publications India Pvt. Ltd. ISBN No. 978-81-8371-422-8
5.	Machine Drawing	Singh, Ajeet	Tata McGraw Hill Education, New Delhi ISBN No.: 0 -07-065992-3
6.	Engineering Drawing	Agrawal, Basant; Agrawal, C. M.	Tata McGraw Hill Education, New Delhi ISBN No. 10: 0 – 07 -066863 - 9

14. SOFTWARE/LEARNING WEBSITES

a. http://www.youtube.com/watch?v=o1YPja2wCYQ
b. http://www.youtube.com/watch?v=9AGD4tihjCg&feature=plcp
c. http://www.youtube.com/watch?v=n65NU32inOU
d. http://www.youtube.com/watch?v=tyRVsSsNiUQ
e. http://www.youtube.com/watch?v=_M5eYB6056M
f. http://www.youtube.com/watch?v=UyROI-bAMu4
g. http://www.youtube.com/watch?v=eix8xbqb93s
h. http://www.youtube.com/watch?v=kWOl6ttDTBc
i. http://www.youtube.com/watch?v=gJbrO2jtoa8&feature=related
j. http://www.youtube.com/watch?v=PXgkBadGHEE
k. Engineering Graphics & Drawing v 1.0 from Cognifront


MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION MUMBAI

Program Name: All Branches of Diploma in Engineering and Technology.

Program Code: CE/CR/CS/CH/PS/CM/CO/IF/CW/DE/EJ/EN/EQ/ET/EX/IE/MU/EE/ EP/EU/IS/IC/AE /FG/ME/PG/PT/DC/TX/TC/MK

Semester : Second

Course Title : Business Communication Using Computers

Course Code : 22009

1. RATIONALE

Communication is the key factor for smooth and efficient functioning of any industry or business activity. Effective business communication is the lifeblood of any organization and is required to maintain quality and progress. The efficacy of business communication skills are essential for engineering professionals for instructing, guiding and motivating subordinates to achieve desired goals at work place. It is very crucial for an entrepreneur to run organization successfully by communicating effectively and skillfully with employees, customers and investors. Thus this course has been designed to enhance the skills to '*Communicate effectively and skillfully at workplace.*'

2. COMPETENCY

The aim of this course is to help the students to attain the following industry identified competency through various teaching learning experiences

- **Communicate effectively and skillfully at workplace.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following ***industry oriented*** COs associated with the above-mentioned competency:

a. Communicate effectively by avoiding barriers in various formal and informal situations.
b. Communicate skillfully using non-verbal methods of communication.
c. Give presentations by using audio- visual aids.
d. Write reports using correct guidelines.
e. Compose e-mail and formal business letters.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme											
				Theory						Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
--	--	2	2	--	--	--	--	--	--	--	35@^	14	15~	06	50	20

(~[1]): For only practical courses, the PA (15 marks) has two components under practical marks i.e. the assessment of practical has a weightage of 60% (i.e.09 marks) and micro-project assessment has a weightage of 40% (i.e.06 marks). This is designed to facilitate attainment of COs holistically, as there is no theory ESE.

Legends: *L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P - Practical; C – Credit, ESE - End Semester Examination; PA - Progressive Assessment.*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

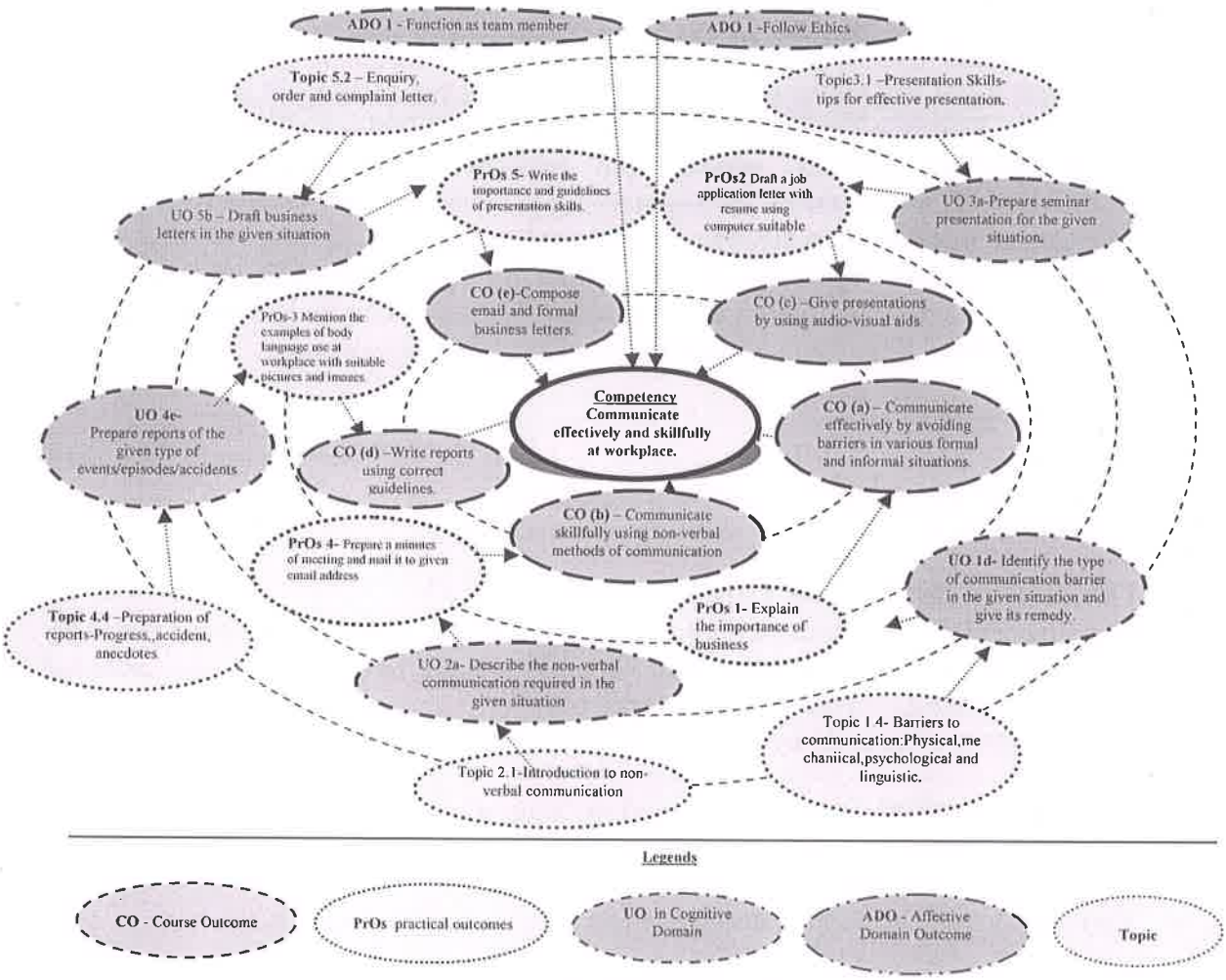

Figure 1 - Course Map

6. SUGGESTED PRACTICALS ACTIVITIES / EXERCISES (Integrate the theory in the laboratory when conducting practical)

The practical in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Explain the importance of business communication for an organization using case study	I	2*

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
2	Draft a job application letter with resume using computer.	V	2*
3	Mention the examples of body language use at workplace with suitable pictures and images.	II	2*
4	Prepare a minutes of meeting and mail it to given email address	VI	2
5	Write the importance and guidelines of presentation skills.	III	2*
6	Draft a detailed Progress Report.	IV	2*
7	Organize a debate on types of communication.	I & III	2
8	Summarize an industry report using techniques of summarizing.	IV	2
9	Draft a complaint letter on given topic.	V	2
10	Design PowerPoint presentation on any technical topic.	III	2*
11	Explain the eight principles of effective communication.	I	2*
12	Explain various non-verbal codes with examples.	II	2
13	Explain the importance of personal appearance stating tips of grooming for a professional.	II	2*
14	Draft a memo on given topic.	V	2
15	Present any Two barriers to communication using case study.	I	2*
16	Present a technical paper using IEEE format.	III	2*
			32

Note

i. *A suggestive list of practical LOs is given in the above table, more such practical LOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical LOs/tutorials need to be performed, out of which, the practicals marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry. The size of batch for the practical should not exceed more than 21 students strictly for the maximum attainment of COs and PrOs.*

ii. *Hence, the 'Process' and 'Product' related skills associated with each LO of the laboratory/workshop/field work are to be assessed according to a suggested sample given below:*

7. MAJOR EQUIPMENTS / INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of experiments, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	Exp. S.No.
1	LCD Projector	All
2	Smart Board with networking	All
3	Language lab with internet	All
4	Printer	Wherever Applicable

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs in cognitive domain for achieving the COs to attain the identified competency:

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	Speaking Skills	
Unit – I Introduction to Business Communication	1a. Describe the importance of the business communication in the given situation. 1b. Identify the missing element in the given communication process. 1c. Identify the type of communication in the given situation. 1d. Identify the type of communication barrier in the given situation and its remedy.	1e. Use different types of verbal and non–verbal communication for the given situation.	1.1 Introduction to Communication- Elements, Importance, Functions. 1.2 Types (meaning and importance) –Verbal (Oral-Written), Formal, Informal, Vertical, Horizontal and Diagonal communication. 1.3 Principles of effective communication. 1.4 Barriers to communication - Physical, mechanical, psychological and linguistic. 1.5 Business communication: Meaning, characteristics and importance.
Unit– II Non-Verbal Communication	2a. Describe the non-verbal communication required in the given situation. 2b. Describe personal appearance required in the given communication situation. 2c. Describe the given facial expressions.	2d. Use relevant facial expressions in the given situation. 2e. Answer questions after listening to presentations.	2.1 Introduction to Non-Verbal communication (Meaning and importance) 2.2 Body Language: Aspects of body language: gestures, eye contact, posture, facial expressions, personal appearance (dressing and grooming) vocalics. 2.3 Body language - positive and negative body language.
Unit– III Presentation skills	3a. Prepare seminar presentation for the given situation. 3b. Prepare debate points 'for' and 'against' the given topic. 3c. Prepare the points for computer presentation	3d. Make seminar presentation 3e. Participate in debate speaking 'for' or 'against' the given topic. 3f. Make effective	3.1 Presentation skills- tips for effective presentation. 3.2 Guidelines for developing power point presentation. 3.3 Presenting Technical papers.

Unit	Unit Outcomes (UOs) (in cognitive domain)		Topics and Sub-topics
	Writing Skills	**Speaking Skills**	
	for the given topic.	computer presentations	
Unit– IV Office Drafting	4a. Draft the given notice using the relevant format. 4b. Draft the given memorandum using the relevant format. 4c. Prepare agenda for the given type of meetings. 4d. Prepare minutes of the given type of meetings. 4e. Prepare reports of the given type of events/episodes/ accidents	4f. Read the agenda of the given meeting. 4g. Read the report of the given event. 4h. Initiate telephone calls for given situation. 4i. Answer official phone calls for given situation.	4.1. Office drafting: Formats and Guidelines. 4.2. Formulating notices and memoranda. 4.3. Preparation of agenda and writing minutes of meetings. 4.4. Preparation of reports- progress reports, Accident reports, case study. 4.5. Summarizing techniques.
Unit-V Business Correspondence	5a. Respond to given job advertisements by writing your CV/ Resume. 5b. Draft business letters in the given situations. 5c. Draft complaint letters for the given situations. 5d. Compose E- mails with relevant for the given situation.		5.1 Business correspondence. 5.2 Enquiry, order and complaint letters. 5.3 E-mails- netiquettes. 5.4 Difference –Curriculum Vitae, Bio-data and Resume. 5.5 Job application and resume writing

***Note**: To attain the COs and competency, above listed Learning Outcomes (UOs) need to be undertaken to achieve the 'Application Level' of Blooms's 'Cognitive Domain Taxonomy' Theory related topic should be covered during practical hours using multimedia.*

9. SUGGESTED SPECIFICATION TABLE FOR INTERNAL END SEMISTER EXAMINATION

Unit No.	Unit Title	Distribution of practical Marks			
		R Level	**U Level**	**A Level**	**Total Marks**
I	Introduction to Business Communication	02	02	01	05
II	Non-verbal Communication	02	01	02	05
III	Presentation Skills	02	01	02	05
IV	Office Drafting	02	04	04	10
V	Business Correspondence	02	04	04	10
	Total	**10**	**12**	**13**	**35**

***Legends**: R=Remember, U=Understand, A=Apply and above (Bloom's Revised taxonomy)*
***Note**: This specification table provides general guidelines to assist student for their learning and to teachers to teach and assess students with respect to attainment of PrOs and UOs. The actual distribution of marks at different taxonomy levels (of R, U and A) in the question paper may vary from above table.*

10. SUGGESTED GUIDELINES FOR ASSESSMENT TOOL TO CONDUCT INTERNAL END SEMETER EXAM (ESE) .

Weightage (20 Marks) **A**	**Weightage (15 Marks)** **B**	**Total**
Assessment based on PrOs, practicals conducted during semester Based on computer and written skill. (Minimum four questions each five marks) Sample questions: Eg. I Draft an email to The manager regarding the shortage of raw material at production department. Note-submit the printout of mail. (Computer based) **Eg. II Write job application with resume. (written)**	**Oral examination based on UOs Topics mentioned in syllabus. (Minimum five questions each two marks to be asked) Eg. I Explain the importance of communication in professional life. II. State any four guidelines of presentation skills.**	**(35 Marks) A+B** **Duration: 2 hours**

SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course:

a. Collect good articles from newspapers and magazines and read them with correct intonation.
b. Listen to Business news on TV and radio.
c. Watch videos of effective presentations on television and open learning sources for presentation skills and body language.
d. Undertake micro-projects.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.

b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
a. Arrange various communication activities using functional grammar.
b. Show video/animation films to develop listening skills and enhance vocabulary.
c. Use real life situations for explanation.
d. Prepare and give oral presentations.
e. Guide micro-projects in groups as well as individually.

12. SUGGESTED TITLES OF MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. S/he ought to submit it by the end of the semester to develop the industry oriented COs. Each micro-project should encompass two or more COs which are in fact, an integration of CrAs, UOs and ADOs. The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement*** hours during the course.

In the first four semesters, the micro-project could be group-based. However, in higher semesters, it should be individually undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. A suggestive list is given here. Similar micro-projects could be added by the concerned faculty:

a. Study the personal appearance and grooming of employees visiting sales store, shopping mall in the vicinity.
b. Comparative study of Bio-data, Resume and Curriculum vitae.
c. A detailed study of guidelines required for presentation skills.
d. Summarize technical content using English newspaper, magazines or online resources.
e. Prepare a booklet on aspects of body language in pictorial form.
f. A detailed study of the importance, of technical paper of technical paper presentation.
g. Case study on the importance of Business communication in an organization.
h. Report on various formal/business activities.
i. Study of oral presentation of famous business leader.
j. Detailed study of business etiquettes observed in organization.
k. Summarize the business article with the help of English newspapers/magazines and other sources.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	Effective Communication Skills	M Ashraf Rizvi	Tata McGraw Hill

S. No.	Title of Book	Author	Publication
2	Communication Skills	Sanjay Kumar and Pushp Lata	Oxford University Press
3	Personality Development and Soft Skills	Barun K. Mitra	Oxford University Press

14. SOFTWARE/LEARNING WEBSITES

a. https://www.britishcouncil.in/english/learn-online
b. http://learnenglish.britishcouncil.org/en/content
c. http://www.talkenglish.com/
d. languagelabsystem.com
e. www.wordsworthelt.com
f. www.notesdesk.com
g. http://www.tutorialspoint.com
h. www.studylecturenotes.com
i. totalcommunicator.com
j. www.speaking-tips.com

Program Name : **Diploma in Mechatronics**

Program Code : **MK**

Semester : **Second**

Course Title : **Mechatronics Workshop**

Course Code : **22069**

1. RATIONALE

Mechatronics diploma holders are expected to handle various mechanical, electrical and electronics tools in the workshop. The diploma engineer has to supervise soldering, sheet metal work, fitting of electronic components and circuits in the workshop. This course will develop skills in handling tools; equipment used in Mechatronics Workshop and performs soldering of components primarily.

2. COMPETENCY

The aim of this course is to help the student to attain the following industry identified competency through various teaching learning experiences:

- **Build the job of sheet metal & electronics circuit.**

3. COURSE OUTCOMES (COs)

The theory, practical experiences and relevant soft skills associated with this course are to be taught and implemented, so that the student demonstrates the following industry oriented COs associated with the above mentioned competency:

a. Use firefighting equipment and accessories.
b. Use fitting tools and machines for given application.
c. Use tools for sheet metal and soldering operations for manufacturing given job.
d. Identify active and passive electronic components.
e. Build basic electronic circuit.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme			Credit (L+T+P)	Examination Scheme												
				Theory							Practical					
L	T	P		Paper Hrs.	ESE		PA		Total		ESE		PA		Total	
					Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
1	-	4	5	--	--	--	--	--	--	--	50#	20	50~	20	100	40

(*): Under the theory PA, Out of 30 marks, 10 marks are for micro-project assessment to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during the semester for the assessment of the cognitive domain UOs required for the attainment of the COs.

***Legends:** **L**-Lecture; **T** – Tutorial/Teacher Guided Theory Practice; **P** -Practical; **C** – Credit, **ESE** -End Semester Examination; **PA** - Progressive Assessment*

5. COURSE MAP (with sample COs, PrOs, UOs, ADOs and topics)

This course map illustrates an overview of the flow and linkages of the topics at various levels of outcomes (details in subsequent sections) to be attained by the student by the end of the

course, in all domains of learning in terms of the industry/employer identified competency depicted at the centre of this map.

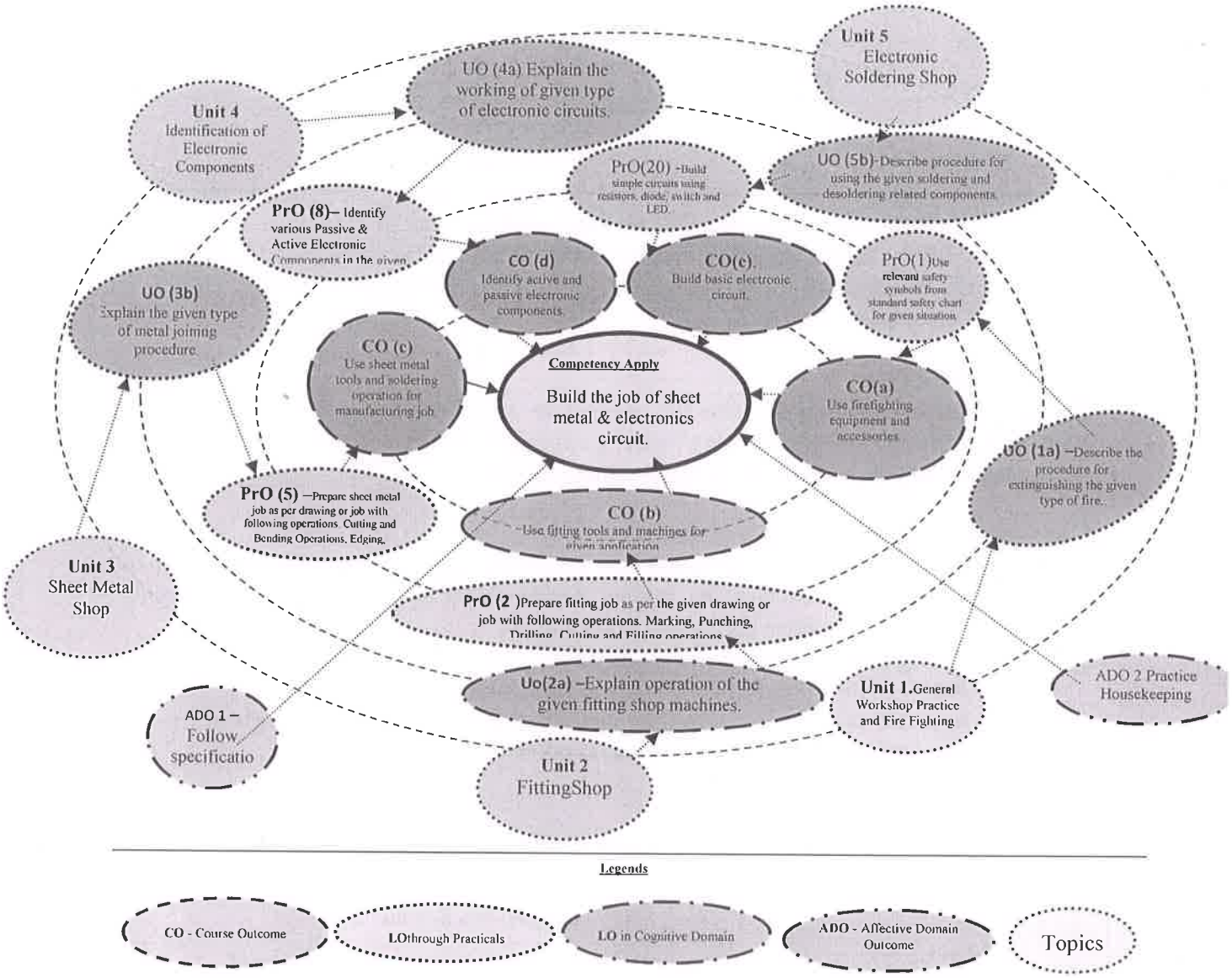

Figure 1 - Course Map

6. SUGGESTED PRACTICALS/ EXERCISES

The practicals in this section are PrOs (i.e. sub-components of the COs) to be developed and assessed in the student for the attainment of the competency:

S. No.	Practical Exercises (Learning Outcomes in Psychomotor Domain)	Unit No.	Approx. Hrs. required
1	Interpret safety symbols from standard safety.	I	02*
2	Use firefighting equipment.	I	02
3	Prepare fitting job as per the given drawing or job with following operations. Marking, Punching, Drilling, Cutting and Filling	II	02*

	operations. **Part-I**		
4	Prepare fitting job as per the given drawing or job with following operations. Marking, Punching, Drilling, Cutting and Filling operations. **Part - II**	II	02
5	Prepare fitting job as per the given drawing or job with following operations. Marking, Punching, Drilling, Cutting and Filling operations. **Part - III**	II	02
6	Prepare sheet metal job as per drawing or job with following operations. Cutting and Bending Operations, Edging, End curling, Lancing, Soldering and Spot welding. **Part - I**	II	02*
7	Prepare sheet metal job as per drawing or job with following operations. Cutting and Bending Operations, Edging, End curling, Lancing, Soldering and Spot welding. **Part - II**	III	02
8	Prepare sheet metal job as per drawing or job with following operations. Cutting and Bending Operations, Edging, End curling, Lancing, Soldering and Spot welding. **Part - III**	III	02
9	Identify various a) Passive Electronic Components in the given circuit.	IV	02*
10	Identify various b) Active Electronic Components in the given circuit.	IV	02*
11	Identify various controls available on the front panel of CRO.	IV	02*
12	Determine colour code of a given resistor using digital multimeter.	IV	02*
13	Test the semiconductor diodes using digital multimeter.	IV	02*
14	Test the LEDs display using multimeter.	IV	02*
15	Test 7 segment display using multimeter.	IV	02
16	Identify 3 terminals of a transistor using digital multimeter.	IV	02*
17	Connect resistors in series and parallel combination on breadboard for measuring its value using digital multimeter.	IV	02
18	Connect capacitors in series and parallel combination on breadboard for measuring its value using digital multimeter.	IV	02*
19	Identify primary and secondary winding of step down transformer using multimeter.	IV	02
20	Identify relay terminals.(coil, common normally open and close)	IV	02
21	Desolder the components using desoldering tools.	IV	02
22	Build simple circuits using resistors, diode, switch and LED.	IV,V	02
23	Build simple circuit using relay and other electronics components.	IV,V	02*
24	Test the circuit developed in the experiment number 22 using various testing equipment.	IV,V	02*
25	Solder more than two components on PCB for continuity.	V	02*
26	Identify the features of electronics circuit drawing software like express SCH.	V	02*
27	Draw circuit diagram of simple dual regulated power supply.	V	02
28	Draw circuit diagram of single stage BJT amplifier using express SCH. **Part-I**	V	02
29	Draw circuit diagram of single stage BJT amplifier using express SCH. **Part-II**	V	02
30	Identify the feature of electronics PCB LAYOUT drawing software like express PCB.	V	02*

31	Prepare PCB layout for simple dual regulated power supply using express PCB software. **Part-I**	V	02
32	Prepare PCB layout for simple dual regulated power supply using express PCB software. **Part-II**	V	02
	Total		64

Note

i. *A suggestive list of PrOs is given in the above table. More such PrOs can be added to attain the COs and competency. A judicial mix of minimum 12 or more practical needs to be performed, out of which, the practical's marked as '*' are compulsory, so that the student reaches the 'Precision Level' of Dave's 'Psychomotor Domain Taxonomy' as generally required by the industry.*

ii. *The 'Process' and 'Product' related skills associated with each PrO is to be assessed according to a suggested sample given below:*

S.No.	Performance Indicators	Weightage in %
a.	Setting of experimental setup	20
b.	Operate equipment skillfully	30
c.	Follow safety measures	10
d.	Work in team	10
e.	Record observations	10
f.	Interpret results to conclude	10
g.	Answer to sample questions.	5
h.	Submit report in time	5
Total		**100**

The above PrOs also comprise of the following social skills/attitudes which are Affective Domain Outcomes (ADOs) that are best developed through the laboratory/field based experiences:

a. Follow safety practices.
b. Practice good housekeeping.
c. Practice energy conservation.
d. Demonstrate working as a leader/a team member.
e. Maintain tools and equipment.
f. Follow ethical Practices.

The ADOs are not specific to any one PrO, but are embedded in many PrOs. Hence, the acquisition of the ADOs takes place gradually in the student when s/he undertakes a series of practical experiences over a period of time. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- 'Valuing Level' in 1st year
- 'Organizing Level' in 2nd year
- 'Characterizing Level' in 3rd year.

7. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

The major equipment with broad specification mentioned here will usher in uniformity in conduct of practicals, as well as aid to procure equipment by authorities concerned.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	Mechanical foam type fire extinguisher with ISI mark. (9 Liter B and C Type Fire)	01
2	A,B,C portable type fire extinguishers.	01
3	Bench Drilling Machine (up to 13 mm drilling capacity) with half HP motor, 1000mm height.	02
4	Work Benches 1800 mm X 1900mm X 750mm.	02
5	Power Saw Machine 350mm mechanical with 1HP Motor and all accessories.	02
6	Bench Grinder 200mm, grinding disc diameter 200mm with 25mm bore with ½ HP/ 1 HP motor.	02
7	Vernier height gauge 450mm.	02
8	Surface plate 600mm X 900mm grade 1.	02
9	Angle plate 450mm X 450mm.	02
10	Bench vice 100mm.	02
11	Work Benches 1800 mm X 1900mm X 750mm.	03
12	Sheet Cutting Machine.	03
13	Sheet Bending Machine.	03
14	Sheet Metal soldering and brazing equipment.	03
15	Bench vice 100mm.	03
16	Sheet metal hand tools- snip, shear, sheet gauge, straight edge, right angle , scriber, divider, trammel, punches, pliers, stakes, groovers and limit sets.	03
17	Light Duty Spot Welding machine- portable type spot welder rating 2.5 KVA, for welding up to 2mm + 2mm M.S. Sheet, maximum throat depth 20cm.	03
18	CRO: 50Mhz, Dual trace, Dual Beam, Inbuilt +- 5 V Supply, Component Tester, Function Generator.	04
19	Soldering Gun: 40 Watt, Holding Stand, Temperature Control, Power Cord.	04,05
20	De-soldering Gun: 80 Watts, Output voltage 24V.	04,05
21	Multimeter 3 and ½ digit with component tester.	04,05
22	Wire Cutter.	04,05
23	Wire stripper.	04,05
24	Consumable components: Resistors, Capacitors, Diodes, Transistors, ICs, IC Sockets, General Purpose PCBs, LEDs, Relays, Switches, Connectors, Connecting Wires, Soldering meal, soldering Flux, desoldering mesh.	01,04,05
25	Express PCB SCH, Express PCB LAYOUT Software.	05

8. UNDERPINNING THEORY COMPONENTS

The following topics/subtopics should be taught and assessed in order to develop UOs for achieving the COs to attain the identified competency.

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
Unit– I General Workshop Practice and Fire Fighting	1a. Describe the procedure for extinguishing the given type of fire. 1b. Describe the procedure to use the given firefighting equipment 1c. Locate the specified equipment in workshop describe the ways of maintaining good housekeeping at workplace.	1.1 Safety Practices, Causes of accidents, General Safety rules, Safety signs and symbols. 1.2 First Aid. 1.3 Fire, Causes of Fire, Basic ways of extinguishing the fire Classification of fire, Class A, B, C, D, Firefighting equipment, fire extinguishers and their types. 1.4 Workshop Layout 1.5 Issue and Return system of tools, equipment and consumables.
Unit– II Fitting Shop	2a. List different fitting hand tools. 2b. Explain the uses of Fitting tool. 2c. Write the specifications of Fitting machinery. 2d. Explain different processes for fitting operation.	2.1 Fitting hand tools and their specifications- Bench Vice, Hammers, Chisels, Files, Hacksaw, Surface plate, Punch, V-Block, Angle plate, Try square, marking block, steel rule, twist drills. Machineries and their specifications in fitting shop- Drilling Machine, Power saw, Grinder. 2.2 Basic process chipping, filling, scraping, grinding, marking, sawing, drilling etc
Unit-III Sheet Metal Shop	3a. List different sheet metal working tools. 3b. Explain sheet metal joining procedure. 3c. Explain processes for Sheet Metal operation.	3.1 Sheet metal hand tools and their specifications.- Snip, Shears, Sheet gauge, Straight edge, Try square, Scriber, Divider, Trammel, Punches, Pliers, Stakes, Groovers, Limit set. 3.2 Machinery and their specifications in sheet metal shop- Sheet cutting and bending machine 3.3 Basic process- Marking, Bending, Folding, Edging, Seaming, Staking, Soldering, Spot welding.
Unit –IV Identification of Electronic Components	4a. List different energy sources for electronic circuit. 4b. Identify active and passive components of a given circuit. 4c. Select electronic component using data sheet and catalog. 4d. Use Multimeter for measuring different parameters of electronic component. 4e. Collect information of tools for Mechatronics workshop using catalog.	4.1 Sources: AC and DC Batteries 4.2 Electronic components: Passive components like resistors, capacitor and inductor, Active Component like diode, transistor, IC. 4.3 Switches, Relays, LEDs, 7-Segment connectors and cables used in electronics circuits. 4.4 Data Sheet and the catalog of electronics components, multimeter. 4.5 Tools required for Mechatronics workshop: Specification, Cost and other important characteristics

Unit	Unit Outcomes (UOs) (in cognitive domain)	Topics and Sub-topics
		(Catalog of Multimeter, Power Supply and soldering machine to collect the latest information of tools).
Unit-V Electronic Soldering Shop	5a. Select the soldering and desoldering tools for the given job. 5b. Describe procedure for using the given soldering and desoldering related components. 5c. Describe the procedure for building simple electronic circuit on breadboard. 5d. Explain the procedure for assembling given simple electronic circuit on general purpose PCB. 5e. Use PCB, SCH and PCB Layout software.	5.1 Soldering and desoldering tools like normal soldering gun, temperature controlled soldering gun, soldering metals, soldering flux, soldering pot, De-soldering gun, De-soldering pump, De-soldering mesh. 5.2 Soldering techniques like hand soldering, wave soldering and dip soldering 5.3 Dry soldering, problems of dry and loose soldering. 5.4 Soldering of simple electronics components like resistors, capacitors, diode, switches, LED on general purpose PCB and de-soldering of the components from the PCB 5.5 Use of electronics software for circuit and PCB art work drawing.

***Note**: To attain the COs and competency, above listed UOs need to be undertaken to achieve the 'Application Level' and above of Bloom's 'Cognitive Domain Taxonomy'*

9. SUGGESTED SPECIFICATION TABLE FORQUESTION PAPER DESIGN

-Not Applicable

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested student-related ***co-curricular*** activities which can be undertaken to accelerate the attainment of the various outcomes in this course prepare chart displaying various electronics components and instruments

a. Prepare broad specifications of tools and equipment used in the mechatronics workshop with help of hand book and product catalogs available on internet.
b. List Specifications of various electronics components.
c. Download the catalog of multimeter, CRO, Soldering Gun, Relays and Connectors of various reputed manufacturer from websites to update the latest developments.
d. Undertake a market survey of local dealers for procurements of workshop tools, equipment, machineries and raw material.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

a. Massive open online courses (***MOOCs***) may be used to teach various topics/sub topics.
b. ***'L' in item No. 4*** does not mean only the traditional lecture method, but different types of teaching methods and media that are to be employed to develop the outcomes.
c. About ***15-20% of the topics/sub-topics*** which is relatively simpler or descriptive in nature is to be given to the students for ***self-directed learning*** and assess the development of the COs through classroom presentations (see implementation guideline for details).
d. With respect to item No.10, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
e. Guide student(s) in undertaking micro-projects.
f. Show video/animation films to explain functions of fire extinguisher and fire fighting procedure.
g. Arrange visit to nearby electronics manufacturer or testing industry.
h. Show video / animation films to explain functioning of electronics components and their applications.
i. Assign micro projects to students on simple electronics circuits.

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be ***individually*** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should ***not exceed three.***

The micro-project could be industry application based, internet-based, workshop-based, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than ***16 (sixteen) student engagement hours*** during the course. The student ought to submit micro-project by the end of the semester to develop the industry oriented COs.

A suggestive list of micro-projects is given here. Similar micro-projects could be added by the concerned faculty:

a. Prepare chart showing comparison of various types of resistors used in the electronics industry.
b. Build Heat sink for the given specifications
c. Build a cabinet for the given circuit/ equipment/ instrument.
d. Solder components on PCB and Check the continuity
e. Test the active and passive components connected in the given electronics equipment.
f. Prepare small report on market survey on diodes used in small electronics industry.
g. Prepare the specifications of the active and passive components and their manufacturer and their addresses.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication
1	A Course in Workshop	Raghuwanshi B.S.	Dhanpat Rai Sons, New Delhi,2011/ Latest edition ISBN:0000017108

S. No.	Title of Book	Author	Publication
	Technology		
2	Workshop practice	Bawa H.S.	McGraw Hill Education, Noida ISBN: 13:978-007067195
3	Electronics Components Handbook	Jones, Thomas H	Reston Publishing Reston Virginia US Latest Edition ISBN 9780879092221
4	Principles of Electronics	Mehta V.K., Mehta Rohit	S. Chand & Company Ramnagar, New Delhi-110055,2014 ISBN-9788121924504
5	Troubleshooting of electronic Equipments	R.S. Khandpur	Tata McGraw Hill, 2006 ISBN13 9780071477314

14. SOFTWARE/LEARNING WEBSITES

a. http://fireextinguishertraining.com
b. www.nptel.iitm.ac.in
c. http://eleccircuit.com
d. http://electroschematics.com
e. http://www.expresspcb.com/ExpressPCBHtm/Download
f. http://www.electronics-lab.com/downloads/pcb/index.html