

**Maharashtra State Board Of Technical Education, Mumbai****Learning and Assessment Scheme for Post S.S.C Diploma Courses**

<b>Programme Name</b>	<b>: Diploma In Automobile Engineering. / Mechanical Engineering / Mechatronics / Production Engineering</b>		
<b>Programme Code</b>	<b>: AE / ME / MK / PG</b>	<b>With Effect From Academic Year</b>	<b>: 2023-24</b>
<b>Duration Of Programme</b>	<b>: 6 Semester</b>	<b>Duration</b>	<b>: 16 WEEKS</b>
<b>Semester</b>	<b>: Second</b>	<b>NCrF Entry Level : 3.0</b>	<b>Scheme : K</b>

Sr No	Course Title	Abbreviation	Course Type	Course Code	Total IKS Hrs for Sem.	Learning Scheme					Credits	Paper Duration (hrs.)	Assessment Scheme										Total Marks
						Actual Contact Hrs./Week			Self Learning (Activity/ Assignment /Micro Project)	Notional Learning Hrs /Week			Theory			Based on LL & TL				Based on Self Learning			
						CL	TL	LL					FA-TH	SA-TH	Total		Practical		SLA				
															Max	Min	Max	Min	Max	Min	Max	Min	

**(All Compulsory)**

1	APPLIED MATHEMATICS	AMS	AEC	312301	2	3	1	-	-	4	2	3	30	70	100	40	-	-	-	-	-	-	100	
2	APPLIED SCIENCE	APPLIED PHYSICS	ASC	DSC	312308	4	2	-	2	0	8	4	1.5	30	70*#	100	40	25	10	25@	10	-	-	200
		2					-	2	0	25								10	25@	10				
3	ENGINEERING DRAWING	EDG	SEC	312311	4	2	-	4	2	8	4	4	30	70	100	40	25	10	25@	10	25	10	175	
4	ENGINEERING MECHANICS	EGM	DSC	312312	2	3	1	2	2	8	4	3	30	70	100	40	25	10	-	-	25	10	150	
5	MANUFACTURING TECHNOLOGY	MPR	DSC	312313	1	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175	
6	PROFESSIONAL COMMUNICATION	PCO	SEC	312002	-	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50	
7	SOCIAL AND LIFE SKILLS	SFS	VEC	312003	-	-	-	-	2	2	1	-	-	-	-	-	-	-	-	-	50	20	50	
<b>Total</b>					<b>13</b>	<b>15</b>	<b>2</b>	<b>16</b>	<b>7</b>		<b>20</b>		<b>150</b>	<b>350</b>	<b>500</b>		<b>150</b>	<b>125</b>		<b>125</b>		<b>900</b>		

**Abbreviations :** CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, FA - Formative Assessment, SA -Summative Assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

**Legends :** @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

**Note :**

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**Course Category :** Discipline Specific Course Core (DSC) : 3, Discipline Specific Elective (DSE) : 0, Value Education Course (VEC) : 1, Intern./Apprenti./Project./Community (INP) : 0, Ability Enhancement Course (AEC) : 1, Skill Enhancement Course (SEC) : 2, Generic Elective (GE) : 0

♦ **For the course Applied Science - candidate will have to appear for pre-examination of both physics & chemistry. If absent in any one section (physics / chemistry) student will be declared as absent & fail for the course and marks will not be processed or carried forward.**

<b>Programme Name/s</b>	<b>: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/          Agricultural Engineering/          Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/          Cloud Computing and Big Data/          Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer          Engineering/          Civil &amp; Rural Engineering/ Construction Technology/ Computer Science &amp; Engineering/          Fashion &amp; Clothing Technology/          Dress Designing &amp; Garment Manufacturing/ Digital Electronics/ Data Sciences/          Electrical Engineering/          Electronics &amp; Tele-communication Engg./ Electrical Power System/ Electronics &amp;          Communication Engg./ Electronics Engineering/          Food Technology/ Computer Hardware &amp; Maintenance/ Instrumentation &amp; Control/          Industrial Electronics/          Information Technology/ Computer Science &amp; Information Technology/          Instrumentation/ Interior Design &amp; Decoration/          Interior Design/ Civil &amp; Environmental Engineering/ Mechanical Engineering/          Mechatronics/          Medical Laboratory Technology/ Medical Electronics/ Production Engineering/ Printing          Technology/          Polymer Technology/ Surface Coating Technology/ Textile Technology/ Electronics &amp;          Computer Engg./          Travel and Tourism/ Textile Manufactures</b>
<b>Programme Code</b>	<b>: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/ DE/          DS/ EE/ EJ/ EP/ ET/ EX/ FC/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/          ML/ MU/ PG/ PN/ PO/ SC/ TC/ TE/ TR/ TX</b>
<b>Semester</b>	<b>: Second</b>
<b>Course Title</b>	<b>: PROFESSIONAL COMMUNICATION</b>
<b>Course Code</b>	<b>: 312002</b>

### I. RATIONALE

Communication is key to smooth and efficient functioning of any industry or business . Professional communication is the need of every organization to maintain ethics, quality and standards. The efficacy of business communication skills are essential for engineering professionals to instruct, guide and motivate peers/ subordinates to achieve desired goals at work place. Strong Communication skills are highly valued in the professional world and contribute to career growth and opportunities. Thus, this course has been designed to enhance the professional communication skills for effective presentation both in written and oral forms at workplace.

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

1. Communicate effectively at workplace. 2. Issues can be identified and resolved by brainstorming solutions 3. Effective communication ensures strong decision making

### III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Communicate effectively (oral / spoken and Written) in various formal and informal situations minimizing the barriers.
- CO2 - Develop listening skills through active listening and note taking.
- CO3 - Write circulars, notices and minutes of the meeting.
- CO4 - Draft inquiry letter, complaint letter , Job application with resume / CV, Compose effective E - mails .

- CO5 - Write Industrial reports.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL						
				CL	TL	LL			Total			FA-TH	SA-TH	Practical		FA-PR		SA-PR		SLA		
							Max	Min						Max	Min	Max	Min	Max	Min	Max	Min	
312002	PROFESSIONAL COMMUNICATION	PCO	SEC	-	-	2	-	2	1	-	-	-	-	-	25	10	25@	10	-	-	50	

**Total IKS Hrs for Sem. : 0 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination  
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Describe the importance of professional communication in given situations</p> <p>TLO 1.2 Identify the types of communication barriers in given situations and suggestive remedies</p> <p>TLO 1.3 Use different types of verbal and non-verbal communication for the given situation</p>	<p><b>Unit - I Professional Communication : An Overview</b></p> <p>1.1 Definition of professional communication- Importance, relevance, Elements and process of communication</p> <p>1.2 7 C's of Professional Communication (Clarity, Conciseness, correctness, Coherent, concrete, courteous and Complete)</p> <p>1.3 Types –Verbal (Oral-Written),Formal, Informal (Grapevine), Vertical</p> <p>1.4 Barriers to communication,Types of barriers (Linguistic, Psychological, Technological )</p>	<p>Language lab</p> <p>Role plays</p> <p>Chalk board</p> <p>Reference books</p> <p>Case studies</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	TLO 2.1 Identify the difference between listening and hearing TLO 2.2 Differentiate the types of listening in various situations TLO 2.3 Take notes during lectures, seminars . Make use of types of note taking and note making for different subjects / topics	<b>Unit - II Listening &amp; Note Taking</b> 2.1 Difference between listening & Hearing 2.2 Types of listening a)Active listening b)Passive listening c)Selective listening 2.3 Techniques of Note taking , Types of note taking (Outline notes, Mind Mapping, Flowcharts )	Language Lab Classroom learning NPTEL Role Play
3	TLO 3.1 Prepare notices / agenda for the given type of meeting / information TLO 3.2 Prepare minutes of meeting/s TLO 3.3 Draft a circular for a particular information/ event	<b>Unit - III Office Drafting</b> 3.1 Format of Notice and Circular 3.2 Drafting Agenda 3.3 Preparing Minutes of meeting	white board Language Lab Reference books Classroom learning
4	TLO 4.1 Compose cover letter and CV / Resume for jobs TLO 4.2 Apply E- mail Etiquette for professional purposes TLO 4.3 Compose E- mails for different official purposes	<b>Unit - IV Writing Skills for Professional Communication</b> 4.1 Job Application with Resume / CV 4.2 E-Mail Etiquettes 4.3 Writing official E- Mails to communicate intended purposes 4.4 Drafting Enquiry letter and Complaint letter	Language lab Classroom learning NPTEL Reference books
5	TLO 5.1 Compose technical reports TLO 5.2 Draft accident / Investigation/ Daily reports	<b>Unit - V Report Writing</b> 5.1 Introduction to report writing 5.2 Accident Report 5.3 Investigation Report 5.4 Daily Report	Chalk and talk Language Lab Collaborative learning Classroom learning

#### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Draw communication cycle using real life examples and explain process of communication.	1	*Communication Process and Cycle	2	CO1
LLO 2.1 Undertake the Role play / Group discussion to illustrate types / barriers to communication	2	Role plays and Group Discussion	2	CO1
LLO 3.1 Listen to audios in the language lab and make notes of it.	3	*Active Listening	2	CO2
LLO 4.1 Give a presentation / Seminar using 7 C's of Communication.	4	*Presentations / Seminars	2	CO1
LLO 5.1 Explain the types of note taking with examples and make notes on any one topic related to your curriculum.	5	*Note taking and Note Making	2	CO2
LLO 6.1 Prepare agenda for meeting and draft minutes of the meeting.	6	*Agenda and Minutes of the meeting	2	CO3
LLO 7.1 Draft circulars for the given situation .	7	*Office Drafting	2	CO3

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 8.1 Respond to job advertisements referring newspapers, LinkedIn. Write cover letter with resume /CV.	8	*Type Job Application with Resume / CV	2	CO4
LLO 9.1 Type Four ( formal) E-mails using ethics and etiquette.	9	* E- Mail writing	2	CO4
LLO 10.1 Write a detailed report on Accident/ Investigation .	10	*Technical Report writing	2	CO5
LLO 11.1 Prepare a case study related to linguistic barriers : language ,pronunciation, punctuation, technical jargon and suggest remedies for the same.	11	*Barriers to Communication	2	CO1
LLO 12.1 Draft complaint / enquiry letter for various situations	12	Complaint and Enquiry letter	2	CO4
LLO 13.1 List psychological barriers to communication LLO 13.2 Prepare case studies on any two psychological barriers and suggest remedies to overcome the barriers	13	Psychological barriers to Communication	2	CO1
LLO 14.1 Draw flow chart and mind mapping for any topic related to the curriculum.	14	*Listening Skills	2	CO2
LLO 15.1 Face mock interview arranged by your teacher.	15	* Typed Job Application , Resume / CV/ formal dressing and Interview	2	CO4

**Note : Out of above suggestive LLOs -**

- '\* Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)****Micro project**

- Conduct an interview of any person and follow the procedure ( interview questions, photo with the interviewee etc.)
- Listening and Speaking are life long learnings . Explain with appropriate examples and real life case studies.
- Collect (four to five) emails with technical jargons, barriers, make required corrections and keep a record of both the mails (original and Corrected one)
- Complete any one certification course of (Two Weeks duration) from (MOOC/ NPTEL/ Coursera/ any other source)related to Communication Skills / Personality Development.
- Prepare a report on aspects of body language
- Prepare a case study on Technological /Psychological barriers to communication

**Reading for vocabulary and sentence structure**

- Read any motivational book and present a review of the book

**Note :**

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. 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 15 (fifteen) 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.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Language Lab with software and internet facility	All
2	LCD Projector	All
3	Smart Board with networking	All
4	Printer	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table) : NOT APPLICABLE****X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Term Work, Micro Project

**Summative Assessment (Assessment of Learning)**

- Practical Exam of 25 marks using language lab

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	1	1		1	3	1			
CO2	1	1				3	1			
CO3	1					3	1			
CO4		1				3	1			
CO5		1	1			3	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	M Ashraf Rizvi	Effective Communication Skills	Tata McGraw-Hill Publication-ISBN 0070599521, 9780070599529
2	Sanjay Kumar and Pushp Lata	Communication Skills	Oxford University Press ISBN 9780199457069
3	MSBTE Textbook	Communication Skills	MSBTE
4	Robert King	Effective communication Skills	Audio Book -ISBN 978181667009742
5	N P Sudharshana , C Savitha	English for Technical Communication	Cambridge-ISBN 978-13-16640-08-1
6	C. Murlikrishna , Sunita Mishra	Communication Skills for Engineers	Pearson - ISBN 978-81-317-3384-4
7	Meenakshi Raman, Sangeeta Sharma	Technical Communication, Principles and Practice	Oxford University Press -ISBN 978-13-16640-08-1
8	K. K. Sinha	Business Communication	Galgotiya Publishing company, New Delhi - ISBN 9789356227064
9	Rajendra Pal, J.S. Korlahalli	Essentials of Business Communication	Sultan Chand & Sons, New Delhi ISBN 9788180547294

## XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.britishcouncil.in">https://www.britishcouncil.in</a>	conversations
2	<a href="https://www.coursera.org">https://www.coursera.org</a>	certification courses
3	<a href="https://www.udemy.com">https://www.udemy.com</a>	Communication skills training courses
4	<a href="http://www.makeuseof.com">http://www.makeuseof.com</a>	Dale Carnegie's free resources

<b>Programme Name/s</b>	<b>: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/  Agricultural Engineering/  Artificial Intelligence and Machine Learning/ Automation and Robotics/  Architecture/ Cloud Computing and Big Data/  Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer  Engineering/  Civil &amp; Rural Engineering/ Construction Technology/ Computer Science &amp;  Engineering/ Fashion &amp; Clothing Technology/  Dress Designing &amp; Garment Manufacturing/ Digital Electronics/ Data Sciences/  Electrical Engineering/  Electronics &amp; Tele-communication Engg./ Electrical Power System/ Electronics  &amp; Communication Engg./ Electronics Engineering/  Food Technology/ Computer Hardware &amp; Maintenance/ Hotel Management &amp;  Catering Technology/ Instrumentation &amp; Control/  Industrial Electronics/ Information Technology/ Computer Science &amp;  Information Technology/ Instrumentation/  Interior Design &amp; Decoration/ Interior Design/ Civil &amp; Environmental  Engineering/ Mechanical Engineering/  Mechatronics/ Medical Laboratory Technology/ Medical Electronics/ Production  Engineering/  Printing Technology/ Polymer Technology/ Surface Coating Technology/ Textile  Technology/  Electronics &amp; Computer Engg./ Travel and Tourism/ Textile Manufactures</b>
<b>Programme Code</b>	<b>: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DC/ DD/  DE/  DS/ EE/ EJ/ EP/ ET/ EX/ FC/ HA/ HM/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/  MK/ ML/ MU/ PG/ PN/ PO/ SC/ TC/ TE/ TR/ TX</b>
<b>Semester</b>	<b>: Second</b>
<b>Course Title</b>	<b>: SOCIAL AND LIFE SKILLS</b>
<b>Course Code</b>	<b>: 312003</b>

## I. RATIONALE

Rationale : Life skills can be defined as abilities that enable humans to deal effectively with the demands and challenges of life. Social skills are a subset of life skills that are needed for successful, healthy relationships to easily adapt when moving from one social situation to the next. They help regulate our emotions effectively and develop enduring, supportive relationships, we're happier and healthier. This is why developing life skills and eventually social skills is key not only to being successful in life, it's key for our health and well-being. Thus, Teaching of Social and life skills provide students with essentials of knowing , understanding attitudes, values, morals ,social skills and better equip them to handle stress and build their self efficacy, self esteem and self confidence.

Note : The course offers five different alternatives(modules) for achieving above outcomes . Students must complete any one module from the following given options.

- a. MODULE-I : Unnat Maharashtra Abhiyan (UMA)
- b. MODULE-II : National Service Scheme (NSS)

- c. MODULE-III : Unniversal Human Values
- d. MODULE-IV: Value Education (Unnati Foundation)
- e. MODULE-V : Financial Literacy (NABARD)

The institute can choose to offer any one MODULE to the groups of the students by taking into consideration the resources required and resources available in the institute . Different group of students maybe offered different MODULE based on their choices .

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Exhibit psychosocial competencies, workplace ethics, resilience, positive attitude , integrity and self-confidence

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Develop ability to adapt to new challenges.
- CO2 - Manage emotions effectively.
- CO3 - Follow workplace ethics and practices
- CO4 - Manage time Effectively.
- CO5 - Increased self confidence to handle stress.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Assessment Scheme											
				Actual Contact Hrs./Week			SL	H	NL		H	Paper Duration	Theory			Based on LL & TL				Based on SL		Total Marks
				CL	TL	LL							Practical			FA-PR		SA-PR		SLA		
													Max	Min	Max	Min	Max	Min	Max	Min		
312003	SOCIAL AND LIFE SKILLS	SFS	VEC	-	-	-	2	2	1	-	-	-	-	-	-	-	-	50	20	50		

**Total IKS Hrs for Sem. : Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
-------	--	---	--------------------------------

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Explain developmental needs and connection of various stakeholders</p> <p>TLO 1.2 Enlist the local problems</p> <p>TLO 1.3 Design a methodology for fieldwork</p> <p>TLO 1.4 Select the attributes of engineering and social system for measurement, quantification, and documentation</p> <p>TLO 1.5 Measure &amp; quantify the quantities / systems parameters</p> <p>TLO 1.6 Write a report using information collected tStudy the data collected from fieldwork and conclude the observations</p>	<p><b>Unit - I MODULE I : Activities Under Unnat Maharashtra Abhiyan (UMA)</b></p> <p>1.1 Introduction to Societal Needs and respective stakeholders :</p> <p>Regional societal issues that need engineering intervention</p> <p>1.2 Multidisciplinary approach-linkages of academia, society and technology</p> <p>1.3 Stakeholders' involvement</p> <p>1.4 Introduction to Important secondary data sets available such as census, district economic surveys, cropping pattern, rainfall data, road network data etc</p> <p>1.5 Problem Outline and stakeholders :</p> <p>Importance of activity and connection with Mapping of system components and stakeholders (engineering / societal)</p> <p>1.6 Key attributes of measurement</p> <p>1.7 Various instruments used for data collection - survey templates, simple measuring equipments</p> <p>1.8 Format for measurement of identified attributes/ survey form and piloting of the same</p> <p>1.9 Fieldwork :</p> <p>Measurement and quantifications of local systems such as agriculture produce, rainfall, Road network, production in local industries, Produce /service which moves from A to B</p> <p>1.10 Analysis and Report writing</p> <p>Report writing containing-</p> <ol style="list-style-type: none"> <li>1. Introduction of the topic</li> <li>2. Data collected in various formats such as table, pie chart, bar graph etc</li> <li>3. Observations of field visits and data collected.</li> </ol>	<p>i) Field visit</p> <p>ii) Field work</p> <p>iii) Expert lectures</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Adoption of Village or Slum</p> <p>TLO 2.2 Survey and Problem Identification</p> <p>TLO 2.3 Conduct Project / Programs in the selected village / slum</p> <p>TLO 2.4 Undertake Special Camping Programme</p>	<p><b>Unit - II MODULE II : National Service Scheme (NSS)</b></p> <p>2.1 Contacting Village/Area Leaders</p> <p>2.2 Primary socio economic survey of few villages in the vicinity of the institute.</p> <p>2.3 Selection of the village for adoption - conduct of activities</p> <p>2.4 Comprehensive Socio Economic Survey of the Village/Area</p> <p>2.5 Identification of Problem(s)</p> <p>2.6 Dissemination of information about the latest developments in agriculture, watershed management, wastelands development, non-conventional energy, low cost housing, sanitation, nutrition and personal hygiene, schemes for skill development, income generation, government schemes, legal aid, consumer protection and allied fields.</p> <p>2.7 A liaison between government and other development agencies for the implementation of various development schemes in the selected village / slum.</p>	<p>(i) Field visit</p> <p>(ii) Field work</p> <p>(iii) Expert lectures</p>
3	<p>TLO 3.1 Love and Compassion (Prem and Karuna)</p> <p>TLO 3.2 Truth (Satya)</p> <p>TLO 3.3 Non-Violence (Ahimsa)</p> <p>TLO 3.4 Righteousness (Dharma)</p> <p>TLO 3.5 Peace (Shanti)</p> <p>TLO 3.6 Service (Seva)</p> <p>TLO 3.7 Renunciation (Sacrifice) Tyaga</p> <p>TLO 3.8 Gender Equality and Sensitivity</p>	<p><b>Unit - III MODULE-III : Universal Human Values</b></p> <p>3.1 Love and Compassion (Prem and Karuna): Introduction, Practicing Love and Compassion (Prem and Karuna)</p> <p>3.2 Truth (Satya) : Introduction, Practicing Truth (Satya)</p> <p>3.3 Non-Violence (Ahimsa) : Introduction, Practicing Non-Violence (Ahimsa)</p> <p>3.4 Righteousness (Dharma) : Introduction, Practicing Righteousness (Dharma)</p> <p>3.5 Peace (Shanti) : Introduction, Practicing Peace (Shanti)</p> <p>3.6 Service (Seva) : Introduction, Practicing Service (Seva)</p> <p>3.7 Renunciation (Sacrifice) Tyaga : Introduction, Practicing Renunciation (Sacrifice) Tyaga</p> <p>3.8 Gender Equality and Sensitivity: Introduction, Practicing Gender Equality and Sensitivity</p>	<p>i) Lectures</p> <p>ii) Demonstration</p> <p>iii) Case Study</p> <p>iv) Role Play</p> <p>v) Observations</p> <p>vi) Portfolio Writing</p> <p>vii) Simulation</p> <p>viii) Motivational talks by Practitioners</p> <p>ix) Site/Industry Visit</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	<p>TLO 4.1 Punctuality</p> <p>TLO 4.2 Cleanliness, Hygiene and Orderliness</p> <p>TLO 4.3 Responsibility</p> <p>TLO 4.4 Gratitude and Appreciations</p> <p>TLO 4.5 Determination &amp; Persistence</p> <p>TLO 4.6 Respect</p> <p>TLO 4.7 Team Spirit</p> <p>TLO 4.8 Caring &amp; Sharing</p> <p>TLO 4.9 Honesty</p> <p>TLO 4.10 Forgive and Forget</p>	<p><b>Unit - IV MODULE-IV: Value Education (Unnati Foundation)</b></p> <p>4.1 Punctuality, Icebreaker and Simple Greeting, Understanding &amp; Managing Emotions, Introducing Self, The power of a Positive Attitude, Talking about one's Family, Talking about one's Family, Making a Positive Impression, Give word list for a Word based</p> <p>4.2 Cleanliness , Hygiene and Orderliness , Likes and Dislikes, Developing Confidence in Self and Others, Strengths and Weaknesses, Listening Skills , Greeting gestures, Gender Equality and Sensitivity</p> <p>4.3 Responsibility, OCSEM- Visual Comprehension and Word Based Learning, Goal Setting – Make it happen, Follow, Like &amp; Share Unnati Social Media - Facebook / Instagram/ Twitter Introducing Others, Time Management, Talking about the daily routine, Money Management</p> <p>4.4 Gratitude and Appreciation , Asking Simple Questions &amp; Asking for the price , Stress Management, Student Referral process ,Comprehending &amp; Paraphrasing Information, A Plate of Rice and Dignity of Labour, Topics for Public Speaking, Placement Process , OCSEM-E-Newspaper, Critical Thinking to overcome challenges</p> <p>4.5 Determination and Persistence, Guiding and Giving Directions, Language Etiquette &amp; Mannerism, . Unnati Philosophy , b. Unnati Branding - Follow, Like &amp; Share Unnati Social Media - Facebook / Instagram/ Twitter, Simple instructions to follow procedures, Assertiveness, Give topics for Debate, Describing a person/Objects, Refusal Skills, Word List for Word based Learning</p> <p>4.6 Respect, Comparing , OCSEM - Public Speaking, Student referral process, Attending a phone call, Being a Good Team Player , Placement Process, At a Restaurant, Workplace ethics</p> <p>4.7 Team Spirit, Inviting someone, OCSEM - Picture Reading &amp; Word, a. Unnati Philosophy &amp; b. Unnati Branding - Follow, Like &amp; Share Unnati Social Media - Facebook / Instagram/ Twitter, Apologizing, Apologizing, Dealing effectively with Criticism, Introduce Importance of Self Learning</p>	<p>i) Video Demonstrations</p> <p>ii) Flipped Classroom</p> <p>iii) Case Study</p> <p>iv) Role Play</p> <p>v) Collaborative learning</p> <p>vi) Cooperative Learning</p> <p>vii) Chalk-Board</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
		and upskilling 4.8 Caring and Sharing , Handling Customer queries, Flexibility & Adaptability, Student referral process, Writing a Resume, OCSEM-Public Speaking, Placement Process, Meditation/ Affirmation & OCSEM-Debate, Introduce Certif-ID, how to create Certif-ID Project , 4.9 Honesty, Email etiquette & Official Email communication, Alcohol & Substance use & abuse, Describing a known place , Leadership Skills, Describing an event, OSCEM-Picture Reading & Visual Comprehension 4.10 Forgive and Forget, Facing and Interview, OSCEM-Public Speaking , Attending a telephonic/Video interview & Mock Interview , Affirmation , Pat-a-Back & Closure (Valediction , Unnati Branding, Student Testimonials), Meditation/ Affirmation & Sponsor connect (Speak to UNXT HO)	
5	TLO 5.1 Literacy About Savings and Investments TLO 5.2 Literacy About Financial Planning TLO 5.3 Literacy About Transactions TLO 5.4 Literacy About Income, expenditure and budgeting TLO 5.5 Literacy About Inflation TLO 5.6 Literacy About Loans TLO 5.7 Literacy About the Importance of Insurance TLO 5.8 Literacy About the Dos and Dons in finances	<b>Unit - V MODULE-V : Financial Literacy</b> 5.1 Introduction - Life Goals and financial goals 5.2 Savings and Investments - Three pillars of investments, Popular asset classes, Government schemes, Mutual Funds, Securities markets (Shares and bonds), Gold, Real Estate, Do's and Don'ts of investments 5.3 Retirement planning 5.4 Cashless transactions 5.5 Income, expenditure and budgeting – Concepts and Importance 5.6 Inflation- Concept, effect on financial planning of an individual 5.7 Loans – Types, Management of loans, Tax benefits 5.8 Insurance – Types, Advantages, selection 5.9 Dos and Dons in Financial planning and Transactions	i) Online/Offline Mode of Instructions ii) Video Demonstrations iii) Presentations iv) Case Study v) Chalk-Board vi) Collaborative learning

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES : NOT APPLICABLE.**

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)**

**Suggestive list of activities during Regular as well as Special Camping (NSS Activities)**

• Following list is only an illustrative list of the type of activities that can be undertaken. Under the programme it would be open to each NSS Unit to undertake one of these programmes or any other activity which may seem desirable to them according to local needs. The NSS Unit should aim at the integrated development of the area selected for its operation which could be a village or a slum. It has also to be ensured that at least a part of the programme does involve manual work.

**(a) Environment Enrichment and Conservation:**

The activities under this sub-theme would inter-alia, include:

- (i) plantation of trees, their preservation and upkeep
- (ii) Construction & maintenance of village streets, drains
- (iii) Cleaning of village ponds and wells;
- (iv) Popularization and construction of Gobar Gas Plants, use of non-conventional energy;
- (v) Disposal of garbage & composting;
- (vi) Prevention of soil erosion and work for soil conservation,
- (vii) Watershed management and wasteland development
- (viii) Preservation and upkeep of monuments, and creation of consciousness about the preservation of cultural heritage among the community.

**(b) Health, Family Welfare and Nutrition Programme:**

- (i) Programme of mass immunization;
- (ii) Working with people in nutrition programmes with the help of Home Science and medical college students;
- (iii) Provision of safe and clean drinking water;
- (iv) Integrated child development programmes;
- (v) Health education, AIDS Awareness and preliminary health care.
- (vi) Population education and family welfare programme;
- (vii) Lifestyle education centres and counselling centres.

- © Programmes aimed at creating an awareness for improvement of the status of women: (i) programmes of educating people and making them aware of women's rights both constitutional and legal;
- (ii) creating consciousness among women that they too contributed to economic and social well-being of the community;
  - (iii) creating awareness among women that there is no occupation or vocation which is not open to them provided they acquire the requisite skills; and
  - (iv) imparting training to women in sewing, embroidery, knitting and other skills wherever possible.

**(d) Social Service Programmes:**

- (i) work in hospitals, for example, serving as ward visitors to cheer the patients, help the patients, arranging occupational or hobby activities for long term patients; guidance service for out-door-patients including guiding visitors about hospital's procedures, letter writing and reading for the patients admitted in the hospital; follow up of patients discharged from the hospital by making home visits and places of work, assistance in running dispensaries etc.
- (ii) work with the organisations of child welfare;
- (iii) work in institutions meant for physically and mentally handicapped;
- (iv) organising blood donation, eye pledge programmes;

- (v) work in Cheshire homes, orphanages, homes for the aged etc.;
  - (vi) work in welfare organisations of women;
  - (vii) prevention of slums through social education and community action;
- (e) Production Oriented Programmes:
- (i) working with people and explaining and teaching improved agricultural practices;
  - (ii) rodent control land pest control practices;
  - (iii) weed control;
  - (iv) soil-testing, soil health care and soil conservation;
  - (v) assistance in repair of agriculture machinery;
  - (vi) work for the promotion and strengthening of cooperative societies in villages;
  - (vii) assistance and guidance in poultry farming, animal husbandry, care of animal health etc.;
  - (viii) popularisation of small savings and assistance in procuring bank loans
- (f) Relief & Rehabilitation work during Natural Calamities:
- (i) assisting the authorities in distribution of rations, medicine, clothes etc.;
  - (ii) assisting the health authorities in inoculation and immunisation, supply of medicine etc.;
  - (iii) working with the local people in reconstruction of their huts, cleaning of wells, building roads etc.;
  - (iv) assisting and working with local authorities in relief and rescue operation;
  - (v) collection of clothes and other materials, and sending the same to the affected areas;
- (g) Education and Recreations: Activities in this field could include:
- (i) adult education (short-duration programmes);
  - (ii) pre-school education programmes;
  - (iii) programmes of continuing education of school drop outs, remedial coaching of students from weaker sections;
  - (iv) work in crèches;
  - (v) participatory cultural and recreation programmes for the community including the use of mass media for instruction and recreation, programmes of community singing, dancing etc.;
  - (vi) organisation of youth clubs, rural land indigenous sports in collaboration with Nehru Yuva Kendras;
  - (vii) programmes including discussions on eradications of social evils like communalism, castism, regionalism, untouchability, drug abuse etc.;
  - (viii) non- formal education for rural youth and
  - (ix) legal literacy, consumer awareness.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Simple engineering measurement devices GPS data collection tools GIS open source softwares- Google Earth and QGIS MS office suite	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE**

(Specification Table) : NOT APPLICABLE

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Formative assessment (Assessment for Learning) Report and presentation of fieldwork activities, Self-Learning (Assignment)

**Summative Assessment (Assessment of Learning)****XI. SUGGESTED COS - POS MATRIX FORM : NOT APPLICABLE****XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	IRAP, Hyderabad, CTARA, IIT Bombay and UNICEF, Mumbai	Compendium of Training Materials for the Capacity Building of the Faculty and Students of Engineering Colleges on 'IMPROVING THE PERFORMANCE OF RURAL WATER SUPPLY AND SANITATION SECTOR IN MAHARASHTRA' Districts Economic survey reports	UNICEF
2	Central Public Health and Environmental Engineering Organisation	Manual on Water Supply and Treatment	Ministry of Urban Development, New Delhi
3	Specifications And Standards Committee	Indian Standards (IS) Codes and Indian Roads Congress (IRC) Codes	Bureau of Indian Standards and The Indian Road Congress
4	Prepared by each district administration	Districts Economic survey reports	Govt. of Maharashtra
5	Local college students, UMA staffs	Sample Case Studies on UMA website	IITB-UMA team

**XIII . LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
1	<a href="https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201601131501523808.pdf">https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201601131501523808.pdf</a>	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan
2	<a href="https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201606151454073708.pdf">https://gr.maharashtra.gov.in/Site/Upload/Government%20Resolutions/English/201606151454073708.pdf</a>	Government Resolution of Government of Maharashtra regarding Unnat Maharashtra Abhiyan Guidelines

Sr.No	Link / Portal	Description
3	<a href="https://censusindia.gov.in/census.website/">https://censusindia.gov.in/census.website/</a>	A Website of Census of India
4	<a href="https://gsda.maharashtra.gov.in/english/">https://gsda.maharashtra.gov.in/english/</a>	A Website of Groundwater Survey and Development Agency, GoM
5	<a href="https://mrsac.gov.in/MRSAC/map/map">https://mrsac.gov.in/MRSAC/map/map</a>	A Website where district-wise maps showcasing different attributes developed by Maharashtra Remote Sensing Applications Centre.
6	<a href="https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx">https://ejalshakti.gov.in/jjmreport/JJMIndia.aspx</a>	A Website of Jal Jivan Mission, Government of India
7	<a href="https://cpcb.nic.in/">https://cpcb.nic.in/</a>	A Website of Central Pollution Control Board, Government of India
8	<a href="http://www.mahapwd.com/#">http://www.mahapwd.com/#</a>	A Website of Public Works Department, GoM
9	<a href="http://tutorial.communitygis.net/">http://tutorial.communitygis.net/</a>	A Website for GIS data sets developed by Unnat Maharashtra Abhiyan
10	<a href="https://youtu.be/G71maumVZ1A?si=TzDTxKUpLYaRos7U">https://youtu.be/G71maumVZ1A?si=TzDTxKUpLYaRos7U</a>	A video record of lecture by Prof. Milind Sohoni, IIT Bombay, on Engineering, Development and Society
11	<a href="https://youtu.be/TUcPNwtdKyE?si=wnSWrhGc9dJTC-ac">https://youtu.be/TUcPNwtdKyE?si=wnSWrhGc9dJTC-ac</a>	A keynote talk by Prof. Milind Sohoni, IIT Bombay, on Interdisciplinary Engineering: The Road Ahead
12	<a href="https://youtu.be/mKJj6j_1gWg?si=ajE8s4lfB2OM63Ng">https://youtu.be/mKJj6j_1gWg?si=ajE8s4lfB2OM63Ng</a>	A TED talk by Prof. Milind Sohoni, IIT Bombay, on Vernacular Science: The Science of Delivery
13	<a href="https://www.ugc.gov.in/pdfnews/4371304_LifeSKill_JeevanKaushal_2023.pdf">https://www.ugc.gov.in/pdfnews/4371304_LifeSKill_JeevanKaushal_2023.pdf</a>	UHV: UGC Course on life skills. Unit 4 i.e. Course 4 is to be referred
14	<a href="https://nss.gov.in/">https://nss.gov.in/</a>	NSS : Know about the NSS Scheme and details

<b>Programme Name/s</b>	: Architecture Assistantship/ Automobile Engineering./ Artificial Intelligence/ Agricultural Engineering/ Artificial Intelligence and Machine Learning/ Automation and Robotics/ Architecture/ Cloud Computing and Big Data/ Civil Engineering/ Chemical Engineering/ Computer Technology/ Computer Engineering/ Civil & Rural Engineering/ Construction Technology/ Computer Science & Engineering/ Digital Electronics/ Data Sciences/ Electrical Engineering/ Electronics & Tele-communication Engg./ Electrical Power System/ Electronics & Communication Engg./ Electronics Engineering/ Computer Hardware & Maintenance/ Instrumentation & Control/ Industrial Electronics/ Information Technology/ Computer Science & Information Technology/ Instrumentation/ Interior Design & Decoration/ Interior Design/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Medical Electronics/ Production Engineering/ Electronics & Computer Engg./
<b>Programme Code</b>	: AA/ AE/ AI/ AL/ AN/ AO/ AT/ BD/ CE/ CH/ CM/ CO/ CR/ CS/ CW/ DE/ DS/ EE/ EJ/ EP/ ET/ EX/ HA/ IC/ IE/ IF/ IH/ IS/ IX/ IZ/ LE/ ME/ MK/ MU/ PG/ TE/
<b>Semester</b>	: Second
<b>Course Title</b>	: APPLIED MATHEMATICS
<b>Course Code</b>	: 312301

**I. RATIONALE**

An Applied Mathematics course, covering integration, definite integration, differential equations, numerical methods, and probability distribution, equips engineering students with essential problem-solving tools. It enables them to model and analyze complex systems, make informed decisions and address real-world engineering challenges effectively.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Engineers applying Mathematics should proficiently solve complex real-world problems, enhancing decision-making, design and innovation with precision and efficiency.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Solve the broad-based engineering problems of integration using suitable methods.
- CO2 - Use definite integration to solve given engineering related problems.
- CO3 - Apply the concept of differential equation to find the solutions of given engineering problems.
- CO4 - Employ numerical methods to solve programme specific problems.
- CO5 - Use probability distributions to solve elementary engineering problems.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme					Credits	Assessment Scheme										Total Marks	
				Actual Contact Hrs./Week			SLH	NLH		Paper Duration	Theory			Based on LL & TL				Based on SL			
				CL	TL	LL					FA-TH	SA-TH	Total	Practical		SLA					
														FA-PR	SA-PR	Max	Min	Max	Min		
312301	APPLIED MATHEMATICS	AMS	AEC	3	1	-	-	4	2	3	30	70	100	40	-	-	-	-	-	-	100

**Total IKS Hrs for Sem. : 2 Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Solve the given simple problem(s) based on rules of integration. TLO 1.2 Evaluate the given simple integral(s) using substitution method. TLO 1.3 Integrate given simple functions using the integration by parts. TLO 1.4 Solve the given simple integral by partial fractions.	<b>Unit - I Indefinite Integration</b> 1.1 Simple Integration: Rules of integration and integration of standard functions 1.2 Integration by substitution. 1.3 Integration by parts. 1.4 Integration by partial fractions (only linear non repeated factors at denominator of proper fraction).	Improved Lecture Demonstration Chalk-Board Presentations Video Demonstrations
2	TLO 2.1 Solve given examples based on Definite Integration. TLO 2.2 Use properties of definite integration to solve given problems.	<b>Unit - II Definite Integration</b> 2.1 Definite Integration: Definition, rules of definite integration with simple examples. 2.2 Properties of definite integral (without proof) and simple examples.	Video Simulation Chalk-Board Improved Lecture Presentations

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Find the order and degree of given differential equations. TLO 3.2 Form simple differential equation for given elementary engineering problems. TLO 3.3 Solve given differential equations using the methods of Variable separable and Exact Differential Equation(Introduce the concept of partial differential equation). TLO 3.4 Solve given Linear Differential Equation.	<b>Unit - III Differential Equation</b> 3.1 Concept of Differential Equation. 3.2 Order, degree and formation of Differential equations 3.3 Methods of solving differential equations: Variable separable form, Exact Differential Equation, Linear Differential Equation.	Video Demonstrations Presentations Chalk-Board Improved Lecture Flipped Classroom
4	TLO 4.1 Find roots of algebraic equations by using appropriate methods. TLO 4.2 Solve the system of equations in three unknowns by iterative methods. TLO 4.3 Solve problems using Bakhshali iterative method for finding approximate square root. (IKS)	<b>Unit - IV Numerical Methods</b> 4.1 Solution of algebraic equations: Bisection method, Regula falsi method and Newton –Raphson method. 4.2 Solution of simultaneous equations containing three Unknowns by iterative methods: Gauss Seidal and Jacobi's method. 4.3 Bakhshali iterative method for finding approximate square root. (IKS)	Video SCILAB Spreadsheet Chalk-Board Flipped Classroom Presentations
5	TLO 5.1 Solve given problems based on repeated trials using Binomial distribution. TLO 5.2 Solve given problems when number of trials are large and probability is very small. TLO 5.3 Utilize the concept of normal distribution to solve related engineering problems.	<b>Unit - V Probability Distribution</b> 5.1 Binomial distribution. 5.2 Poisson's distribution. 5.3 Normal distribution.	Video ORANGE Chalk-Board Improved Lecture Presentations

#### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Solve simple problems of Integration by substitution	1	*Integration by substitution	1	CO1
LLO 2.1 Solve integration using by parts	2	*Integration by parts	1	CO1
LLO 3.1 Solve integration by partial fractions(only linear non repeated factors at denominator of proper fraction).	3	Integration by partial fractions.	1	CO1
LLO 4.1 Solve examples on Definite Integral based on given methods.	4	Definite Integral based on given methods.	1	CO2
LLO 5.1 Solve problems on properties of definite integral.	5	*Properties of definite integral	1	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 6.1 Solve given problems for finding the area under the curve and volume of revolution.	6	* #Area under the curve and volume of revolution.(Only for Civil and Mechanical Engineering Group)	1	CO2
LLO 7.1 Solve examples on mean value and root mean square value.	7	* #Mean value and root mean square value. (Only for Computer, Electrical and Electronics Engineering Group)	1	CO2
LLO 8.1 Solve examples on order, degree and formation of differential equation.	8	Order, degree and formation of differential equation.	1	CO3
LLO 9.1 Solve first order first degree differential equation using variable separable method.	9	Variable separable method.	1	CO3
LLO 10.1 Solve first order first degree differential equation using exact differential equation and linear differential equation.	10	*Exact differential equation and linear differential equation.	1	CO3
LLO 11.1 Solve engineering application problems using differential equation.	11	*Applications of differential equations.(Take programme specific problems)	1	CO3
LLO 12.1 Solve problems on Bisection method and Regula falsi method.	12	*Bisection method and Regula falsi method.	1	CO4
LLO 13.1 Solve problems on Newton-Raphson method.	13	Newton- Raphson method.	1	CO4
LLO 14.1 Solve problems on Jacobi's method and Gauss Seidal Method.	14	Jacobi's method and Gauss Seidal Method.	1	CO4
LLO 15.1 Use Bakhshali iterative methods for finding approximate value of square root. (IKS)	15	*Bakhshali iterative methods for finding approximate value of square root. (IKS)	1	CO4
LLO 16.1 Solve engineering problems using Binomial distribution.	16	*Binomial Distribution	1	CO5
LLO 17.1 Solve engineering problems using Poisson distribution.	17	*Poisson Distribution	1	CO5
LLO 18.1 Solve engineering problems using Normal distribution.	18	Normal Distribution	1	CO5
LLO 19.1 Solve problems on Laplace transform and properties of Laplace transform.	19	* # Laplace transform and properties of Laplace transform.(Only for Electrical and Electronics Engineering Group)	1	CO2
LLO 20.1 Solve problems on Inverse Laplace transform and properties of Inverse Laplace transform.	20	* # Inverse Laplace transform and properties of Inverse Laplace transform.(Only for Electrical and Electronics Engineering Group)	1	CO2

**Note : Out of above suggestive LLOs -**

- '\*' Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING /**

**SKILLS DEVELOPMENT (SELF LEARNING)****Micro project**

- NA

**Assignment**

- NA

**Note :**

NA

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Open-source software like wolfram alpha, SageMaths, MATHS3D, GeoGebra, Graph, DPLOT, and Graphing Calculator (Graph Eq2.13), ORANGE can be used for Algebra, Calculus, Trigonometry and Statistics respectively.	All

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Indefinite Integration	CO1	15	2	6	12	20
2	II	Definite Integration	CO2	8	2	4	6	12
3	III	Differential Equation	CO3	8	2	4	6	12
4	IV	Numerical Methods	CO4	6	2	4	8	14
5	V	Probability Distribution	CO5	8	2	4	6	12
<b>Grand Total</b>				<b>45</b>	<b>10</b>	<b>22</b>	<b>38</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS****Formative assessment (Assessment for Learning)**

- Tests

**Summative Assessment (Assessment of Learning)**

- End Term Exam

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	-	-	1	-	1			
CO2	3	1	-	-	1	-	1			
CO3	3	2	1	1	1	1	1			
CO4	2	3	2	2	1	1	1			
CO5	2	2	1	1	2	1	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Grewal B. S.	Higher Engineering Mathematics	Khanna publication New Delhi, 2013 ISBN: 8174091955
2	Dutta. D	A text book of Engineering Mathematics	New age publication New Delhi, 2006 ISBN: 978- 81-224-1689-3
3	Kreyszig, Ervin	Advance Engineering Mathematics	Wiley publication New Delhi 2016 ISBN: 978-81- 265-5423-2
4	Das H.K.	Advance Engineering Mathematics	S Chand publication New Delhi 2008 ISBN: 9788121903455
5	S. S. Sastry	Introductory Methods of Numerical Analysis	PHI Learning Private Limited, New Delhi. ISBN-978-81-203-4592-8
6	C. S. Seshadri	Studies in the History of Indian Mathematics	Hindustan Book Agency (India) P 19 Green Park Extension New Delhi. ISBN 978-93-80250-06-9
7	Marvin L. Bittinger David J. Ellenbogen Scott A. Sargent	Calculus and Its Applications	Addison-Wesley 10th Edition ISBN-13: 978-0-321-69433-1
8	Gareth James, Daniela Witten, Trevor Hastie Robert Tibshirani	An Introduction to Statistical Learning with Applications in R	Springer New York Heidelberg Dordrecht London ISBN 978-1-4614-7137-0 ISBN 978-1-4614-7138-7 (eBook)

## XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="http://nptel.ac.in/courses/106102064/1">http://nptel.ac.in/courses/106102064/1</a>	Online Learning Initiatives by IITs and IISc
2	<a href="https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig">https://www.khanacademy.org/math?gclid=CNqHuabCys4CFdOJaddHoPig</a>	Concept of Mathematics through video lectures and notes
3	<a href="https://www.wolframalpha.com/">https://www.wolframalpha.com/</a>	Solving mathematical problems, performing calculations, and visualizing mathematical concepts.

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
4	<a href="http://www.sosmath.com/">http://www.sosmath.com/</a>	Free resources and tutorials
5	<a href="http://mathworld.wolfram.com/">http://mathworld.wolfram.com/</a>	Extensive math encyclopedia with detailed explanations of mathematical concepts
6	<a href="https://www.mathsisfun.com/">https://www.mathsisfun.com/</a>	Explanations and interactive lessons covering various math topics, from basic arithmetic to advanced
7	<a href="http://tutorial.math.lamar.edu/">http://tutorial.math.lamar.edu/</a>	Comprehensive set of notes and tutorials covering a wide range of mathematics topics.
8	<a href="https://www.purplemath.com/">https://www.purplemath.com/</a>	Purplemath is a great resource for students seeking help with algebra and other foundational mathematics to improve learning.
9	<a href="https://www.brilliant.org/">https://www.brilliant.org/</a>	Interactive learning in Mathematics
10	<a href="https://www.edx.org/">https://www.edx.org/</a>	Offers a variety of courses
11	<a href="https://www.coursera.org/">https://www.coursera.org/</a>	Coursera offers online courses in applied mathematics from universities and institutions around the globe.
12	<a href="https://ocw.mit.edu/index.htm">https://ocw.mit.edu/index.htm</a>	The Massachusetts Institute of Technology (MIT) offers free access to course materials for a wide range of mathematical courses.

<b>Programme Name/s</b>	: Automobile Engineering./ Agricultural Engineering/ Automation and Robotics/ Civil Engineering/ Civil & Rural Engineering/ Construction Technology/ Electrical Engineering/ Electrical Power System/ Instrumentation & Control/ Instrumentation/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Production Engineering
<b>Programme Code</b>	: AE/ AL/ AO/ CE/ CR/ CS/ EE/ EP/ IC/ IS/ LE/ ME/ MK/ PG
<b>Semester</b>	: Second
<b>Course Title</b>	: APPLIED SCIENCE
<b>Course Code</b>	: 312308

### I. RATIONALE

Diploma engineers have to deal with various processes, materials and machines. The comprehension of concepts and principles of Science like Elasticity, motion, Oscillation, Photoelectricity, X rays ,LASER, Nanomaterials, metals, alloys, water treatment ,fuel and combustion, cells and batteries will help the students to use relevant materials ,processes and methods for various engineering applications .

### II. INDUSTRY / EMPLOYER EXPECTED OUTCOME

The aim of this course is to attain following industry/ employer expected outcome through various teaching learning experiences. Apply the principles of physics and chemistry to solve broad-based engineering problems.

### III. COURSE LEVEL LEARNING OUTCOMES (COS)

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select relevant material in industries by analyzing its physical properties .
- CO2 - Apply the concept of simple harmonic motion , resonance and ultrasonic sound for various engineering applications.
- CO3 - Apply the concept of modern Physics ( X-rays, LASER, Photosensors and Nanotechnology ) for various engineering applications.
- CO4 - Use the relevant metallurgical processes in different engineering applications.
- CO5 - Use relevant water treatment processes to solve industrial problems.
- CO6 - Use appropriate fuel and electrolyte for engineering applications.

### IV. TEACHING-LEARNING & ASSESSMENT SCHEME

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL						
				CL	TL	LL			Practical			FA-PR		SA-PR		SLA						
				Max	Max	Max	Max	Min	Max			Min	Max	Min	Max	Min	Max	Min				
312308	APPLIED SCIENCE	ASC	DSC	4	-	4	-	8	4	1.5	30	70*#	100	40	50	20	50@	20	-	-	200	

**Total IKS Hrs for Sem. : 4 Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

#### V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Apply the concept of elasticity and plasticity to select the material for engineering applications.</p> <p>TLO 1.2 Establish relation between given types of moduli of elasticity.</p> <p>TLO 1.3 Predict the behavior of the given metallic wire.</p> <p>TLO 1.4 Explain the relevant Newton's laws of motion for the given moving object.</p> <p>TLO 1.5 Calculate the work, power, energy for the given situation.</p>	<p><b>Unit - I Properties of matter and kinematics</b></p> <p>1.1 Deforming Force and Restoring Force, Elasticity, Plasticity, Rigidity.</p> <p>1.2 Stress and Strain and their types, elastic limit and Hooke's law, types of moduli of elasticity.</p> <p>1.3 Stress -Strain diagram, Poisson's ratio, factors affecting elasticity</p> <p>1.4 Newton's laws of motion, and their applications.</p> <p>1.5 Angular displacement, angular velocity, angular acceleration, three equations of angular motion, projectile motion, trajectory, range of projectile angle of projection ,time of flight</p> <p>1.6 Work, power and energy: potential energy, kinetic energy, work –energy principle.</p>	<p>Improved lecture</p> <p>Video</p> <p>Demonstrations</p> <p>Model</p> <p>Demonstration</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Find the parameters required to analyze the given wave motion and simple harmonic motion.</p> <p>TLO 2.2 Explain the concept of resonance and its applications.</p> <p>TLO 2.3 Describe the properties of given ultrasonic waves.</p> <p>TLO 2.4 Explain the given method of production of ultrasonic waves .</p>	<p><b>Unit - II Waves and Oscillations</b></p> <p>2.1 Sound waves, amplitude, frequency, time - period, wave-length and velocity of wave, relation between velocity, frequency and time - period of wave.</p> <p>2.2 Simple Harmonic Motion , Uniform Circular Motion as Simple Harmonic Motion, Equation of simple harmonic motion , Phase of Simple Harmonic Motion.</p> <p>2.3 Resonance , Application of resonance.</p> <p>2.4 Resonance concept in prehistoric times, concept of different frequencies ( Mantras) used to ignite different chakras in body ( IKS).</p> <p>2.5 Ultrasonic waves, properties of ultrasonic waves.</p> <p>2.6 Piezoelectric and Magnetostriction method to produce ultrasonic waves .</p> <p>2.7 Applications of ultrasonic waves.</p>	<p>Improved lecture Demonstration Video Demonstrations</p>
3	<p>TLO 3.1 Explain properties of photon on basis Planck's hypothesis.</p> <p>TLO 3.2 Explain the construction and working of given photoelectric device.</p> <p>TLO 3.3 Explain the method to produce X-Rays with its properties and engineering applications.</p> <p>TLO 3.4 Differentiate between LASER and ordinary light.</p> <p>TLO 3.5 Explain the given terms related to LASER.</p> <p>TLO 3.6 Describe the properties of nanomaterials and its various applications.</p>	<p><b>Unit - III Modern Physics (Photoelectricity , X rays, LASER and nanotechnology)</b></p> <p>3.1 Planck's hypothesis, properties of photons.</p> <p>3.2 Photo electric effect: threshold frequency, threshold wavelength, stopping potential, Work function, characteristics of photoelectric effect, Einstein's photoelectric equation</p> <p>3.3 Photoelectric cell and LDR : principle ,Working and applications</p> <p>3.4 Production of X-rays by modern Coolidge tube, properties and engineering applications.</p> <p>3.5 Laser: properties, absorption, spontaneous and stimulated emission,</p> <p>3.6 Population inversion, active medium, optical pumping, three energy level system, He-Ne Laser.</p> <p>3.7 Engineering applications of Laser.</p> <p>3.8 Nanotechnology : Properties of nanomaterials ( optical, magnetic and dielectric properties) , applications of nanomaterials, Metallic Bhasma (Ancient Ayurveda, IKS).</p>	<p>Improved lecture Presentations Demonstration Video Demonstrations</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	<p>TLO 4.1 Describe the extraction process of the ore.</p> <p>TLO 4.2 Explain Mechanical properties of metals.</p> <p>TLO 4.3 State purposes of making alloys.</p> <p>TLO 4.4 Describe methods of preparation of alloys.</p> <p>TLO 4.5 State Composition ,properties and applications of ferrous and nonferrous alloys.</p>	<p><b>Unit - IV Metals and Alloys</b></p> <p>4.1 Ancient Indian Metallurgy (IKS)</p> <p>4.2 Metals: Occurrence of metals in free and combined state. Basic concepts : Mineral, ore, gangue, flux and slag, metallurgy.</p> <p>4.3 Metallurgy:Extraction processes of metal from ore Concentration : Gravity separation, electromagnetic separation, froth floatation, calcination and roasting, Reduction : Smelting, aluminothermic process, Refining, poling , electrorefining.</p> <p>4.4 Mechanical properties of metals :Hardness, ductility, malleability, tensile strength, toughness, machinability, weldability, forging, soldering, brazing, castability.</p> <p>4.5 Alloys: Purposes of making alloys with examples.</p> <p>4.6 Preparation methods of alloys : Fusion, compression.</p> <p>4.7 Classification of alloys :Ferrous and non-ferrous alloys Ferrous alloys: Composition ,properties and applications of low carbon, medium carbon, high carbon steels. Non-ferrous alloy:Composition ,properties and applications of Brass, Bronze, Duralumin, Tinman Solder, Woods metal.</p>	<p>Chalk-Board Demonstration Case Study Video Demonstrations</p>
5	<p>TLO 5.1 Explain types of hardness of water.</p> <p>TLO 5.2 List salts causing temporary and permanent hardness to water.</p> <p>TLO 5.3 Describe boiler corrosion and caustic embrittlement.</p> <p>TLO 5.4 Explain the given type of water softening process.</p> <p>TLO 5.5 Describe the Wastewater treatment and potable water treatment.</p> <p>TLO 5.6 Solve numerical based on pH and pOH.</p>	<p><b>Unit - V Water Treatment</b></p> <p>5.1 Hard and soft water, causes of hardness, types of hardness</p> <p>5.2 Hard water in boilers and prevention: Boiler corrosion, caustic embrittlement, priming and foaming, scales and sludges, and methods of prevention of boiler corrosion.</p> <p>5.3 Methods of water softening: lime soda process (hot lime soda and cold lime soda process), zeolite process, ion exchange process.</p> <p>5.4 Potable water treatment: Sedimentation, coagulation, filtration and sterilization .</p> <p>5.5 Wastewater treatment: Sewage treatment, BOD and COD of sewage water.</p> <p>5.6 pH and pOH: Concept of pH, pOH, pH Scale, Numerical.</p>	<p>Chalk-Board Demonstration Case Study Video Demonstrations</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
6	<p>TLO 6.1 Describe the properties of the given type of fuel.</p> <p>TLO 6.2 Describe Proximate analysis and Ultimate analysis of coal samples.</p> <p>TLO 6.3 Calculate the calorific value of the given solid fuel using Bomb calorimeter.</p> <p>TLO 6.4 Describe fractional distillation of crude petroleum.</p> <p>TLO 6.5 Explain properties of liquid fuels.</p> <p>TLO 6.6 Describe composition, properties of given gaseous fuel with their applications.</p> <p>TLO 6.7 Describe production of green hydrogen by electrolysis.</p> <p>TLO 6.8 Describe construction and working of given cells and batteries.</p>	<p><b>Unit - VI Fuels and Combustion</b></p> <p>6.1 Fuel: Calorific value and ignition temperature, classification.</p> <p>6.2 Solid fuels: Coal, Classification and composition , Proximate analysis, Ultimate analysis, Calorific value of coal by Bomb calorimeter.</p> <p>6.3 Liquid fuels: Fractional distillation of crude petroleum, boiling range, composition, propertie Knocking, cracking, octane number and cetane number.</p> <p>6.4 Gaseous fuels: Biogas, LPG, and CNG. Combustion equation of gaseous fuels, mass and volume of air required for complete combustion.</p> <p>6.5 Green hydrogen: Producing green hydrogen by electrolysis from renewable sources , Advantages and disadvantages of green hydrogen.</p> <p>6.6 Electrical conductance in metals and electrolytes, specific conductance, equivalent conductance, cell constant</p> <p>6.7 Cells and batteries :Construction ,working and applications of dry cell, lead acid storage cell H<sub>2</sub> - O<sub>2</sub> fuel cell, Ni-Cd battery and Lithium ion battery</p>	<p>Chalk-Board</p> <p>Demonstration</p> <p>Case Study</p> <p>Video</p> <p>Demonstrations</p>

#### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Use Searle's method to determine the Young's modulus of given wire	1	* Determination of Young's modulus of given wire.	2	CO1
LLO 2.1 Compare young's moduli of different materials of wires .	2	Comparison of Young's moduli of given materials of wires.	2	CO1
LLO 3.1 Use of inclined plane to find the downward force.	3	* Determination of relationship between angle of inclination and downward force using inclined plane.	2	CO1
LLO 4.1 Use projectile motion to find the range from initial launch speed and angle	4	*Determination of range of projectile	2	CO1
LLO 5.1 Use helical spring to find force constant .	5	* Determination of force constant using helical spring .	2	CO2
LLO 6.1 Use resonance tube method to determine velocity of sound	6	* Determination of velocity of sound using resonance tube method.	2	CO2
LLO 7.1 Use Simple pendulum to find acceleration due to gravity .	7	* Determination of acceleration due to gravity by using simple pendulum .	2	CO2
LLO 8.1 Use ultrasonic distance – meter to measure distance of object .	8	Determination of distance of object using ultrasonometer.	2	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 9.1 Use ultrasonic interferometer to determine velocity of sound	9	Determination of velocity of ultrasonic sound waves in different liquids using ultrasonic interferometer .	2	CO2
LLO 10.1 Use photo electric cell to find dependence of the stopping potential on the frequency of given light source.	10	Determination of the dependence of the stopping potential on the frequency of given light source .(Virtual Lab)	2	CO3
LLO 11.1 Determine I-V characteristics of the given photo electric cell.	11	* Determination of I-V characteristics of photoelectric cell.	2	CO3
LLO 12.1 Determine I-V characteristics of given light dependent resistor.	12	* Determination of I-V characteristics of LDR.	2	CO3
LLO 13.1 Find divergence of given laser .	13	Determination of the divergence of laser beam.	2	CO3
LLO 14.1 Use LASER beam to find the refractive index of glass plate	14	Determination of refractive index of glass plate using laser beam. (Virtual Lab)	2	CO3
LLO 15.1 Find the wavelength of given laser.	15	Determination of wavelength of helium neon laser (Virtual Lab)	2	CO3
LLO 16.1 Prepare KMnO <sub>4</sub> solution. LLO 16.2 Prepare standard oxalic acid. LLO 16.3 Standardize KMnO <sub>4</sub> solution.	16	Standardization of KMnO <sub>4</sub> solution using standard oxalic acid and preparation of Fe alloy sample.	2	CO4
LLO 17.1 Set up titration Assembly. LLO 17.2 Record the observations. LLO 17.3 Calculate percentage of iron in haematite ore by titration method .	17	* Determination of the percentage of iron present in given Haematite ore by KMnO <sub>4</sub> solution.	2	CO4
LLO 18.1 Prepare Cu ore sample. LLO 18.2 Calculate percentage of Cu .	18	* Determination of percentage of copper in given copper ore .	2	CO4
LLO 19.1 Prepare EDTA solution of known concentration. LLO 19.2 Determine total hardness of water by titration.	19	*Calculation of total hardness, temporary hardness and permanent hardness of water sample by EDTA method.	2	CO5
LLO 20.1 Prepare acid solution of known concentration. LLO 20.2 Determine alkalinity of water sample.	20	* Determination of the alkalinity of a given water sample.	2	CO5
LLO 21.1 Determine turbidity by using a Nephelometer or simulation.	21	Determination of turbidity of a given water sample by Nephelometric method by using Nephelometer or simulation.	2	CO5
LLO 22.1 Set up titration Apparatus LLO 22.2 Record the observations. LLO 22.3 Calculate dissolved oxygen.	22	Determination of dissolved oxygen in the given water sample.	2	CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 23.1 Prepare AgNO <sub>3</sub> Solution of known concentration. LLO 23.2 Calculate chloride content in water sample.	23	Determination of chloride content in the given water sample by Mohr's method.	2	CO5
LLO 24.1 Use universal indicator for PH values. LLO 24.2 Calculate PH value by using PH meter.	24	* Determination of pH value of given solution using pH meter and universal indicator.	2	CO5
LLO 25.1 Use of oven for appropriate temperature settings. LLO 25.2 Calculate moisture and ash content in coal samples.	25	* Determination of the moisture and ash content in a given coal sample using proximate analysis.	2	CO6
LLO 26.1 Set up a Bomb Calorimeter. LLO 26.2 Calculate calorific value.	26	* Determination of calorific value of given solid fuel using Bomb calorimeter.	2	CO6
LLO 27.1 Use gravimetric analysis method LLO 27.2 calculate the percentage of Sulphur.	27	Calculate the percentage of Sulphur in a given coal sample by ultimate analysis. (Gravimetric analysis)	2	CO6
LLO 28.1 Standardize conductivity meter. LLO 28.2 Measure the conductance of given solutions.	28	Determination of conductance of given electrolyte by using a conductivity meter.	2	CO6
LLO 29.1 Set up conductometric titration assembly. LLO 29.2 Record conductance. LLO 29.3 Determine specific conductance and equivalence conductance.	29	* Determination of specific conductance and equivalence conductance of given salt sample solution.	2	CO6
LLO 30.1 Set up conductometric titration assembly. LLO 30.2 Record conductance. LLO 30.3 Determine equivalence point.	30	Determination of equivalence point of acetic acid and ammonium hydroxide using conductivity meter.	2	CO6

**Note : Out of above suggestive LLOs -**

- '\* Marked Practicals (LLOs) Are mandatory.
- Minimum 80% of above list of lab experiment are to be performed.
- Judicial mix of LLOs are to be performed to achieve desired outcomes.

**VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING) : NOT APPLICABLE****VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Searle's apparatus( with slotted mass of 0.5 kg each)	1,2
2	An inclined plane , a trolley or a roller , pan , weight box , spring balance spirit level, strong thread , meter scale .	3
3	Retort stand, helical spring , 6 slotted weight of 50 grams ., scale , stop watch.	4
4	Resonance tube , Tuning forks of different frequencies	5

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
5	Metallic bob , strong thread , stopwatch .	6
6	Ultrasonometer	7
7	ultrasonic interferometer	8
8	Experimental setup for characteristics of photoelectric cell	9,10
9	Experimental setup for characteristics of LDR, optical bench .Source of light ,LDR .	11
10	Laser Source ( He Ne, diode laser), optical bench , graph paper, glass plate	12,13,14
11	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
12	Nephelometer ; Auto-ranging from 20-200 NTU,+/- 2% of reading plus 0.1 NTU, power 220 Volts +/- 10% AC 50 Hz	21
13	pH meter reading up to pH14; ambient temp. -40 to 700 C.; pH/mV resolution:13 bit	24
14	Electric oven inner size 18’’x18’’x18’’; temperature range 100 to 2500 C with the capacity of 40 lt.	25
15	Bomb calorimeter Temperature Resolution:0.001°C Oxygen Filling Automatic /Manual	26
16	Conductivity meter; conductivity range – 0.01 uS /cm to 200 mS/cm, Cell constant – digital 0.1 to 2.00; Temp. range – 0 to 100°C	28,29,30

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Properties of matter and kinematics	CO1	9	3	4	4	11
2	II	Waves and Oscillations	CO2	10	3	5	4	12
3	III	Modern Physics (Photoelectricity , X rays, LASER and nanotechnology)	CO3	11	3	5	4	12
4	IV	Metals and Alloys	CO4	10	2	3	5	10
5	V	Water Treatment	CO5	8	3	4	4	11
6	VI	Fuels and Combustion	CO6	12	3	5	6	14
<b>Grand Total</b>				<b>60</b>	<b>17</b>	<b>26</b>	<b>27</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS**

**Formative assessment (Assessment for Learning)**

- Two unit tests of 30 marks (Physics 15 marks,Chemistry-15 marks) and average of two unit tests.
- For laboratory learning 50 marks (Physics 25 marks,Chemistry-25 marks).

**Summative Assessment (Assessment of Learning)**

- End semester assessment of 50 marks for laboratory learning (Physics 25 marks,Chemistry-25 marks).
- End semester assessment of 70 marks through online MCQ examination.

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	1	1	1	1	1	2			
CO2	3	1	1	1	1	1	2			
CO3	3	2	1	1	1	1	2			
CO4	3	1	-	1	2	2	1			
CO5	3	2	1	2	2	2	1			
CO6	3	1	-	1	2	2	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Aryabhatta	The Surya Siddhanta	Baptist mission press, Calcutta
2	Haliday, David; Resnik, Robert and Walker, Jearl	Fundamentals of Physics	John Wiley & sons, Hoboken, USA, 2014 ISBN : 812650823X.
3	Hussain Jeevakhan	Applied Physics II	Publisher: Khanna Book Publishing ISBN: 9789391505578.
4	Narlikar, J.V.;Joshi , A. W.; Ghatak A.K. et al	Physics Textbook Part I - Class XII	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314
5	Narlikar, J.V.;Joshi , A. W.; Ghatak A.K. et al	Physics Textbook Part II - Class XII	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506713
6	Jain and Jain	Engineering Chemistry	National Council of Education Research and Training, New Delhi, 2010, ISBN : 8174505083
7	Dara, S. S.	Engineering Chemistry	National Council of Education Research and Training, New Delhi, 2015, ISBN : 8174505660
8	Bagotsky V.S.	Fundamental of electrochemistry	National Council of Education Research and Training, New Delhi, 2013, ISBN : 8174506314.
9	Agnihotri Rajesh	Chemistry for Engineers	Wiley India Pvt. Ltd. New Delhi, 2014, ISBN: 9788126550784.
10	Anju Rawlley, Devdatta V. Saraf	Applied Chemistry with Lab Manual	Khanna Book Publishing Co. (P) Ltd. New Delhi, 2021, ISBN- 978-93-91505-44-8
11	Vairam S.	Engineering Chemistry	Wiley India Pvt. Ltd. New Delhi, 2013, ISBN: 9788126543342

## XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.iberdrola.com/sustainability/green-hydrogen">https://www.iberdrola.com/sustainability/green-hydrogen</a>	Green hydrogen

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
2	<a href="https://vedicheritage.gov.in/vedic-heritage-in-present-context/metallurgy">https://vedicheritage.gov.in/vedic-heritage-in-present-context/metallurgy</a>	Ancient indian metallurgy (IKS)
3	<a href="https://vlab.amrita.edu/?sub=2&amp;brch=193&amp;sim=575&amp;cnt=4">https://vlab.amrita.edu/?sub=2&amp;brch=193&amp;sim=575&amp;cnt=4</a>	Determine turbidity by using a simulation
4	<a href="https://www.britannica.com/science/metallurgy">https://www.britannica.com/science/metallurgy</a>	Metals and alloy
5	<a href="https://phet.colorado.edu/en/simulations/ph-scale">https://phet.colorado.edu/en/simulations/ph-scale</a>	PH and POH
6	<a href="https://archive.nptel.ac.in/courses/103/105/103105110/">https://archive.nptel.ac.in/courses/103/105/103105110/</a>	Solid fuel
7	<a href="http://www.physicsclassroom.com">www.physicsclassroom.com</a>	Concepts of Physics
8	<a href="http://www.fearofphysics.com">www.fearofphysics.com</a>	Fundamental terms in Physics
9	<a href="https://iksindia.org">https://iksindia.org</a>	IKS

**Programme Name/s** : Automobile Engineering./ Mechanical Engineering/ Mechatronics/ Production Engineering/  
**Programme Code** : AE/ ME/ MK/ PG  
**Semester** : Second  
**Course Title** : ENGINEERING DRAWING  
**Course Code** : 312311

**I. RATIONALE**

Engineering drawing lays the foundation for visualizing the situation and delivering the essential instructions, required to carry out engineering jobs. This course aims at developing the ability to read and draw projection of lines, planes, solids. It also aims at reading and drawing the sections of the orthographic views. Engineering drawing also intends to develop the ability to visualize and draw curves of intersection and develop lateral surfaces of various solids

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Use different drawing instruments for solving broad based engineering problems.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Apply principles of sectional orthographic projections for drawing given pictorial views.
- CO2 - Draw projection of lines and planes.
- CO3 - Draw projections of given solids for various orientations.
- CO4 - Interpret curves of intersection for given solids.
- CO5 - Draw development of lateral surfaces of various solids.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Paper Duration		Theory			Based on LL & TL		Based on SL					
				CL	TL	LL					FA-TH	SA-TH	Total	Practical		SLA					
														FA-PR	SA-PR	Max	Min	Max	Min		
312311	ENGINEERING DRAWING	EDG	SEC	2	-	4	2	8	4	4	30	70	100	40	25	10	25@	10	25	10	175

**Total IKS Hrs for Sem. : 4 Hrs**

Abbreviations: CL- Classroom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

#### V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 Draw different types of sectional views. TLO 1.2 Draw sectioning and hatching conventions. TLO 1.3 Develop sectional orthographic views from the pictorial views of given object. TLO 1.4 Interpret the given drawing.	<b>Unit - I Sectional Orthographic Views</b> 1.1 Cutting plane line. 1.2 Types of sectional views: Full Section, half section, Partial or Broken section, Revolved section, removed section, offset section, aligned section. 1.3 Sectioning conventions. 1.4 Hatching or section lines. 1.5 Conversion of pictorial views into sectional orthographic views (complete object involving slots, threads, ribs, etc).	Model Demonstration Video Demonstrations
2	TLO 2.1 Draw different position of lines with respect to projection planes. TLO 2.2 Draw projection of lines in various positions according to the given condition. TLO 2.3 Draw various types of planes based on their orientation. TLO 2.4 Draw projection of planes in various orientations according to the given condition.	<b>Unit - II Projection of Lines and Planes</b> 2.1 Projection of straight lines involving following positions- i. Parallel to both the planes. ii. Perpendicular to one plane. iii. Inclined to one plane and parallel to the other plane. iv. Inclined to both the planes. 2.2 Traces of line. 2.3 Projection of planes involving following orientations- i. Plane parallel to one principal plane and perpendicular to the other plane. ii. Plane inclined to one principal plane and perpendicular to the other plane.	Model Demonstration Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
3	TLO 3.1 Draw projection of given regular solids. TLO 3.2 Draw projection of regular solids according to their orientation with planes. TLO 3.3 Interpret orientation of axis with respect to projection of planes of solids.	<b>Unit - III Projection of Solids</b> 3.1 Types of solids. 3.2 Projection of following solids- i. Regular polyhedron – Tetrahedron, Hexahedron (Cube) ii. Regular Prisms and Pyramids- Triangular, Square. iii. Regular solids of revolution- Cylinder, Cone. 3.3 Projection of given solids With Axis a. Perpendicular to one of the principal projection plane. b. Inclined to one of the principal plane and parallel to the other. c. Parallel to both principal planes.	Model Demonstration Video Demonstrations
4	TLO 4.1 Interpret intersection for the given solids. TLO 4.2 Draw curves of intersection of the given solid combination.	<b>Unit - IV Intersection of Solids</b> 4.1 Curves of intersection of surfaces - Prism with Prism (Triangular, Square), Cylinder with cylinder. 4.2 Curves of intersection of surfaces - Square Prism with Cylinder when – i. Axes are at 90° and bisecting. ii. Axes are at 90° and offset. 4.3 Curves of intersection of surfaces - Cylinder with Cone: when the axis of cylinder is parallel to both the reference planes and cone resting on base on HP with axis intersecting and offset from axis of cylinder.	Model Demonstration Video Demonstrations Hands-on of the intersecting solids
5	TLO 5.1 Draw development of lateral surfaces of the given solid. TLO 5.2 Identify parts where concept of development of the given surfaces is required. TLO 5.3 Draw development of given sheet metal.	<b>Unit - V Development of Surfaces</b> 5.1 Developments of lateral surfaces of cube, prisms (Triangular, Square), cylinder, pyramids (Triangular, Square), cone. 5.2 Applications of development of surfaces such as tray, funnel.	Model Demonstration Video Demonstrations Hands-on to develop lateral surface from the existing solids

#### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 1.1 Apply method of projection for drawing simple sectional orthographic views.	1	*Draw two problems on sectional orthographic projections (simple object) using first angle method of projection.	4	CO1
LLO 2.1 Apply method of projection for drawing simple sectional orthographic views.	2	*Draw two problems on sectional orthographic projections (object consisting of slot/rib/thread) using first angle method of projection.	4	CO1
LLO 3.1 Draw the projection of lines for the given positions of lines.	3	*Draw two problems on projection of lines showing the traces of line.	4	CO2

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 4.1 Draw the projection of planes for the given orientation of plane.	4	Draw two problems on projection of planes when plane is parallel to one principal plane and perpendicular to the other plane.	4	CO2
LLO 5.1 Draw the projection of planes for the given orientation of plane.	5	*Draw two problems on projection of planes when plane is inclined to one principal plane and perpendicular to the other plane.	4	CO2
LLO 6.1 Draw the projection of solids for the given position of plane.	6	*Draw any two problems on projection of solids with axis perpendicular to one of the principal projection planes.	4	CO3
LLO 7.1 Draw the projection of solids for the given position of plane.	7	*Draw any two problems on projection of solids with axis inclined to one of the principal plane and parallel to the other.	4	CO3
LLO 8.1 Draw the projection of solids for the given position of plane.	8	*Draw any two problems on projection of solids with axis parallel to both principal planes.	4	CO3
LLO 9.1 Draw the intersection of solids as per given situation.	9	Draw problems on intersection of solids when intersecting solids are -Prism with Prism, Cylinder with cylinder.	4	CO4
LLO 10.1 Draw the intersection of solids as per given situation.	10	*Draw problems on intersection of solids when intersecting solid is - Square Prism with Cylinder when . 1. Axes are at 90° and bisecting. 2. Axes are at 90° and offset.	4	CO4
LLO 11.1 Draw the intersection of solids as per given situation.	11	*Draw problems on intersection of solids when intersecting solids are Cylinder with Cone and the axis of cylinder is parallel to both the reference planes and cone resting on base on HP with axis intersecting and offset from axis of cylinder.	4	CO4
LLO 12.1 Draw the developments of lateral surfaces of given object.	12	Draw problems on developments of lateral surfaces of cube, prisms.	4	CO5
LLO 13.1 Draw the developments of lateral surfaces of given object.	13	*Draw problems on developments of lateral surfaces of cylinder, pyramids.	4	CO5
LLO 14.1 Draw the developments of lateral surfaces of given object.	14	*Draw problems on developments of lateral surfaces of tray, funnel.	4	CO5
LLO 15.1 Collect information of an ancient Indian culture related to engineering drawing.	15	*Prepare a report on the use of various solid geometrical shapes employed in ancient Indian constructions (IKS).	4	CO1 CO2 CO3 CO4 CO5

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
<b>Note : Out of above suggestive LLOs -</b> <ul style="list-style-type: none"> <li>*' Marked Practicals (LLOs) Are mandatory.</li> <li>Minimum 80% of above list of lab experiment are to be performed.</li> <li>Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

## VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

### Assignment

- Sectional Orthographic projections. Minimum 5 problems
- Projection of Lines. Minimum 5 problems
- Projection of planes. Minimum 5 problems
- Projection of solids. One problem for each type of solids.
- Intersection of solids surfaces. One problem for each type of solids.
- Development of lateral surfaces of solids. One problem for each type of solids.

### Micro project

- Student should collect fabricated job/component nearby workshop/industries/ and try to show curves of intersections for different solid surfaces.
- Each student will assess at least one sheet of other students (May be a group of 4 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.
- Students should collect component, job/sample from nearby workshops/industries and try to show the development of lateral surfaces of that.
- Each student should explain at least one problem for construction and method of drawing in sheet. Teacher will assign the problem of particular sheet to be explained to each student.

<b>Note :</b> Assignments are aimed at enhancing the imagination and drawing skills of students. Separate books are recommended for assignments.
---

## VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Drawing Table with Drawing Board of Full Imperial/ A1 size.	All
2	Models of objects for sectional orthographic.	1,2
3	Models/ Charts/ animated video of objects mentioned in unit no.2.	3,4,5
4	Models/charts/ animated video of projections of different solids.	6,7,8
5	Models/charts/ animated video of intersections of various solids.	9,10,11
6	Models/charts/ animated video of development of lateral surfaces of various solids.	12,13,14
7	Set of various industrial drawings being used by industries.	All

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
8	Drawing equipment and instruments for class room teaching-large size: T-square or drafter (Drafting Machine). Set squares (45°and 30°-60°) Protractor. Drawing instrument box (containing set of compasses and dividers). Drawing sheets, Drawing pencils, Eraser, Drawing pins / clips.	All

### IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Sectional Orthographic Views	CO1	4	0	0	14	14
2	II	Projection of Lines and Planes	CO2	6	0	0	12	12
3	III	Projection of Solids	CO3	6	0	0	14	14
4	IV	Intersection of Solids	CO4	7	0	0	14	14
5	V	Development of Surfaces	CO5	7	0	0	16	16
<b>Grand Total</b>				<b>30</b>	<b>0</b>	<b>0</b>	<b>70</b>	<b>70</b>

### X. ASSESSMENT METHODOLOGIES/TOOLS

#### Formative assessment (Assessment for Learning)

- Continous assessment based on process and product related performance indicators.Each practical will be assessed considering- -60% weightage to process -40% weightage to product
- Tests

#### Summative Assessment (Assessment of Learning)

- End term exam- Theory
- End term exam- Practical (Lab Performance)

### XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	3	-	2	-	2	2			
CO2	3	3	-	2	-	2	2			
CO3	3	3	-	2	-	2	2			
CO4	3	3	2	2	-	2	2			
CO5	3	3	2	2	-	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -

\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	Bureau of Indian Standards.	Engineering Drawing Practice for Schools and Colleges IS: SP-46	Third Reprint, October 1998 ISBN No. 81-7061-091-2
2	Bhatt, N.D.	Engineering Drawing	Charotar Publishing House, 2010 ISBN No. 978-93-80358-17-8
3	Bhatt, N.D.; Panchal, V. M	Machine Drawing	Charotar Publishing House, 2010 ISBN No. 978-93-80358-11-6
4	Jolhe, D.A.	Engineering Drawing	Tata McGraw Hill Edu. New Delhi, 2010, ISBN No. 978-0-07-064837-1
5	Dhawan, R. K.	Engineering Drawing	S. Chand and Company New Delhi, ISBN No. 81-219-1431-0
6	Agrawal Basant , Agrawal C.M.	Engineering drawing	McGraw Hill Education ,New Delhi, ISBN No. 978-1259062889
7	Narayana, K.L., Kannaiah. P.	Engineering Drawing	Scitech PublicationsIndia, Chennai ISBN No-978-8183714433
8	Singhania Nitin	Indian Art And Culture	McGraw Hill, ISBN No-978-9354601804

## XIII . LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://youtu.be/3VWnhRCF_0M">https://youtu.be/3VWnhRCF_0M</a>	Sectional Orthographics
2	<a href="https://youtu.be/3WXPanCq9LI">https://youtu.be/3WXPanCq9LI</a>	Projection of lines
3	<a href="https://youtu.be/44glqyyw7OM">https://youtu.be/44glqyyw7OM</a>	Projection of Plane
4	<a href="https://youtu.be/RE_ZG_SSsV8">https://youtu.be/RE_ZG_SSsV8</a>	Projection of solids
5	<a href="https://youtu.be/gIRsXiTKfDo">https://youtu.be/gIRsXiTKfDo</a>	Projection of solids
6	<a href="https://youtu.be/q4uZYDtO05s">https://youtu.be/q4uZYDtO05s</a>	Projection of solids
7	<a href="https://youtu.be/rerGFp3V6W8">https://youtu.be/rerGFp3V6W8</a>	Intersection of solids
8	<a href="https://youtu.be/40pvNA0_sNM">https://youtu.be/40pvNA0_sNM</a>	Intersection of solids
9	<a href="https://youtu.be/P5oPrynRsTI">https://youtu.be/P5oPrynRsTI</a>	Development of lateral surfaces
10	<a href="https://youtu.be/vqk7SnpDQvg">https://youtu.be/vqk7SnpDQvg</a>	Development of lateral surfaces

<b>Programme Name/s</b>	: Automobile Engineering./ Agricultural Engineering/ Civil Engineering/ Chemical Engineering/ Civil & Rural Engineering/ Construction Technology/ Civil & Environmental Engineering/ Mechanical Engineering/ Mechatronics/ Production Engineering
<b>Programme Code</b>	: AE/ AL/ CE/ CH/ CR/ CS/ LE/ ME/ MK/ PG
<b>Semester</b>	: Second
<b>Course Title</b>	: ENGINEERING MECHANICS
<b>Course Code</b>	: 312312

**I. RATIONALE**

The analysis of forces acting on various structural and machine elements using principles of mechanics gives useful data for detailing and design of structure and machine. The analysis of forces helps to prevent arises of defects, errors and subsequent failures in such elements under action of forces. This course is designed for diploma aspirants to acquire and apply the basic and discipline knowledge to solve practical problems regarding design and automation components in the field of various engineering disciplines such as civil, mechanical, agricultural etc. their allied disciplines.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Apply the principles of engineering mechanics to analyze, design and automation the prototypes and equipment's of various industries.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Select the suitable machine under given loading condition.
- CO2 - Analyze the given force system to calculate resultant force.
- CO3 - Determine unknown force(s) of given load combinations in the given situation.
- CO4 - Apply the laws of friction in the given situation.
- CO5 - Determine the centroid/centre of gravity of the given structural elements of having specific shape and size.

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SLH	NLH	Theory			Based on LL & TL				Based on SL						
				CL	TL	LL			FA-TH			SA-TH	Total	Practical		SLA						
				Max	Max	Max	Min	Max	Min			Max	Min	Max	Min	Max	Min					
312312	ENGINEERING MECHANICS	EGM	DSC	3	1	2	2	8	4	3	30	70	100	40	25	10	-	-	25	10	150	

**Total IKS Hrs for Sem. : 2 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination

Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

#### V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	<p>TLO 1.1 Identify the type of machine based on efficiency of machine.</p> <p>TLO 1.2 Calculate effort required and load lifted by the given simple lifting machine.</p> <p>TLO 1.3 Verify law machine for given loading.</p> <p>TLO 1.4 Determine effort required along with efficiency for given machine with varying velocity ratio.</p>	<p><b>Unit - I Simple Lifting Machine</b></p> <p>1.1 Concept of simple lifting machine, load, effort, mechanical advantage, velocity ratio, efficiency of machines, reversible and non-reversible/self locking machines. (IKS*: Hand axe as wedge, Lever in battle, Inclined Plane for loading, Pulleys to lift water in irrigation)</p> <p>1.2 Concept of ideal machine and its conditions, machine friction, ideal effort, ideal load, effort lost in friction and load lost in friction, maximum mechanical advantage and maximum efficiency.</p> <p>1.3 Nature of graphs: Load vs. effort, load vs. ideal effort, load vs. MA, load vs. efficiency, Law of machine and its uses.</p> <p>1.4 Velocity ratios of inclined plane, 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, two sheave pulley block, three sheave pulley block.</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Demonstration</p> <p>Hands-on</p> <p>Case Study</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Describe the characteristics of force.</p> <p>TLO 2.2 Calculate the moment of given forces in a force system.</p> <p>TLO 2.3 Suggest the suitable law for the analysis of given force system.</p> <p>TLO 2.4 Determine the components of given force.</p> <p>TLO 2.5 Calculate the resultant force of given force system analytically.</p> <p>TLO 2.6 Calculate the resultant force of given force system graphically.</p>	<p><b>Unit - II Analysis of Forces</b></p> <p>2.1 Introduction of Mechanics: Engineering Mechanics, Statics, Dynamics, Kinetics, Kinematics, concept of rigid body, Force: definition, unit, graphical representation, Bow's notation, characteristics, Types of force system</p> <p>2.2 Moment of force: Definition, unit, sign conventions, couple and its properties.</p> <p>2.3 Law related to forces: Law of transmissibility of force, Law of polygon of forces, Varignon's theorem of moments, Law of moment, Law of parallelogram of forces. (IKS*: Weighing scale in Mohenjodaro, Harappa)</p> <p>2.4 Resolution of coplanar forces: orthogonal and non orthogonal components of a force.</p> <p>2.5 Composition of coplanar forces using analytical method. Resultant of collinear, concurrent and non-concurrent force system.</p> <p>2.6 Composition of coplanar forces using graphical method. Resultant of concurrent force system and parallel force system consisting of maximum four forces only.</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Collaborative learning</p> <p>Presentations</p> <p>Hands-on</p> <p>Case Study</p>
3	<p>TLO 3.1 Draw the Free Body Diagram for given loading in given situation.</p> <p>TLO 3.2 Determine the equilibrant of the given concurrent force system.</p> <p>TLO 3.3 Use Lami's theorem to determine the unknown forces causing equilibrium for given practical situation.</p> <p>TLO 3.4 Identify the type of beam in a given structure.</p> <p>TLO 3.5 Determine reactions in the given type of beam analytically.</p>	<p><b>Unit - III Equilibrium of Forces</b></p> <p>3.1 Equilibrium and its conditions.</p> <p>3.2 Equilibrant and relation with resultant, Equilibrant of concurrent force system.</p> <p>3.3 Lami's Theorem and its applications, Concept of Free body diagram, (Problems unknown not more than two.)</p> <p>3.4 Types of supports: fixed, simple, hinged, roller and fixed, Types of beams: cantilever, simply supported, overhanging, continuous and fixed. Types of loads: vertical and inclined point load, uniformly distributed load.</p> <p>3.5 Determination of Beam reactions using analytical method for cantilever simply supported and overhanging beam subjected to vertical load, inclined load and uniformly distributed load (combination of any two types).</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Site/Industry Visit</p> <p>Hands-on</p> <p>Case Study</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
4	<p>TLO 4.1 Determine friction force along with coefficient of friction for the given condition.</p> <p>TLO 4.2 Describe the conditions for friction for the give situation.</p> <p>TLO 4.3 Determine friction force in the given situation.</p> <p>TLO 4.4 Draw free body diagram for showing forces acting on a ladder under given condition.</p>	<p><b>Unit - IV Friction of Forces</b></p> <p>4.1 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, and their relationship.</p> <p>4.2 Equilibrium of bodies on level surface subjected to force parallel to plane and inclined to plane.</p> <p>4.3 Equilibrium of bodies on inclined plane subjected to force parallel to the plane only.</p> <p>4.4 Forces acting on ladder (only free body diagram, no numerical).</p>	<p>Chalk-Board</p> <p>Video</p> <p>Demonstrations</p> <p>Presentations</p> <p>Demonstration</p> <p>Case Study</p> <p>Hands-on</p>
5	<p>TLO 5.1 Determine the centroid of given plane figure.</p> <p>TLO 5.2 Determine the centroid of given composite figure.</p> <p>TLO 5.3 Determine center of gravity of given solid.</p> <p>TLO 5.4 Determine Centre of gravity of the given composite solid.</p>	<p><b>Unit - V Centroid and Centre of Gravity</b></p> <p>5.1 Centroid of geometrical plane figures: square, rectangle, triangle, circle, semi-circle, quarter circle (IKS*: Archery arrowheads in Ramayana, Arch in archeological structures such as Mahal, Gol Gumbaz).</p> <p>5.2 Centroid of composite figures such as I, L, C, T, Z sections (not more than three simple figures).</p> <p>5.3 Centre of Gravity of simple solids: cube, cuboid, cylinder, cone, sphere and hemisphere (no hollow solids).</p> <p>5.4 Centre of Gravity of composite solids composed of not more than two simple solids.</p>	<p>Chalk-Board</p> <p>Demonstration</p> <p>Video</p> <p>Demonstrations</p> <p>Model</p> <p>Demonstration</p> <p>Hands-on</p> <p>Case Study</p>

#### VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
<p>LLO 1.1 Verify law of machine under the given condition.</p> <p>LLO 1.2 Verify law of moment of forces.</p> <p>LLO 1.3 Understand the centroid of structural component.</p>	1	Collect the photographic information of Indian Knowledge System (IKS) given in various units.	2	CO1 CO2 CO5
LLO 2.1 Verify law of machine under the given condition.	2	*Determine mechanical advantage and velocity ratio of differential axle and wheel for different load and efforts.	2	CO1
LLO 3.1 Verify law of machine under the given condition.	3	Determine mechanical advantage and velocity ratio of worm and worm wheel for different load and efforts.	2	CO1
LLO 4.1 Verify law of machine under the given condition.	4	Determine mechanical advantage and velocity ratio of single purchase crab winch for different load and efforts.	2	CO1

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 5.1 Verify law of machine under the given condition.	5	Determine mechanical advantage and velocity ratio of double purchase crab winch for different load and efforts.	2	CO1
LLO 6.1 Verify law of machine under the given condition.	6	*Determine mechanical advantage and velocity ratio of simple screw jack for different load and efforts.	2	CO1
LLO 7.1 Verify law of machine under the given condition.	7	Determine mechanical advantage and velocity ratio of Weston's differential pulley block for different load and efforts.	2	CO1
LLO 8.1 Verify law of machine under the given condition.	8	Determine mechanical advantage and velocity ratio of geared pulley block for different load and efforts.	2	CO1
LLO 9.1 Verify law of machine under the given condition.	9	Determine mechanical advantage and velocity ratio of two sheave pulley block for different load and efforts.	2	CO1
LLO 10.1 Verify law of machine under the given condition.	10	Determine mechanical advantage and velocity ratio of three sheave pulley block for different load and efforts.	2	CO1
LLO 11.1 Analyse the resultant force of given force system.	11	*Verify law of polygon of forces using Universal force table for given forces.	2	CO2
LLO 12.1 Analyse the resultant force of given force system.	12	*Verify law of moment of forces using law of moment apparatus for given forces.	2	CO2
LLO 13.1 Analyse the resultant force of given force system.	13	Verify Varignon's theorem of moments of forces using law of moment apparatus for given forces.	2	CO2
LLO 14.1 Analyse the resultant force of given force system.	14	Determine graphically the resultant force of given concurrent force system.	2	CO2
LLO 15.1 Analyse the given force system acting on structural element.	15	Determine graphically the resultant force of given parallel force system.	2	CO2
LLO 16.1 Verify laws of friction related to forces.	16	*Verify the Lamis theorem using Universal force table apparatus for given forces.	2	CO3
LLO 17.1 Verify laws of friction related to forces.	17	*Determine support reactions of simply supported beam using parallel force or beam reaction apparatus for given vertical forces.	2	CO3
LLO 18.1 Apply the concept of centroid for given objects.	18	*Determine coefficient of friction using friction apparatus for given block on horizontal plane.	2	CO4
LLO 19.1 Verify laws of friction related to forces.	19	Determine coefficient of friction using friction apparatus for given block on inclined plane.	2	CO4
LLO 20.1 Apply the concept of centroid for given objects.	20	*Verify centroid of plane figure of given dimensions by making simple paper model.	2	CO5
<p><b>Note : Out of above suggestive LLOs -</b></p> <ul style="list-style-type: none"> <li>*' Marked Practicals (LLOs) Are mandatory.</li> <li>Minimum 80% of above list of lab experiment are to be performed.</li> <li>Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

#### VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

**Assignment**

- Solve the examples on calculation of values of MA, VR,  $\eta$ ,  $P_i$ ,  $P_f$ ,  $W_i$ ,  $W_f$  etc. for given type of machine.
- Solve the examples on calculation of centroid of simple/composite plane figures from given problem statement or figure.
- Solve the examples on calculation of centroid of simple/composite plane figures from given problem statement or figure.
- Solve the examples on calculation of centroid of simple/composite solid bodies from given problem statement or figure.
- Solve the examples on calculation of coefficient of friction, normal reaction, force required to pull the block for given case of frictional bodies (horizontal or inclined plane).
- Solve the examples on calculation of unknown forces using Lamis theorem from given problem statement or figure.
- Solve the examples on calculation of support reactions of given beam from given problem statement or figure.
- Solve the examples on calculation of orthogonal or non orthogonal components of a force.
- Solve the examples on calculation of resultant of a force for given force system from given problem statement or figure.
- Solve the examples on calculation of moments of a force from given problem statement or figure.

**Micro project**

- Prepare a chart showing comparison of centroid and center of gravity for square-cube, rectangle-cylinder, triangle-cone, circle-sphere, semicircle-hemisphere.
- Prepare chart of types of forces showing real-life examples.
- Prepare chart or flex of laws related to engineering mechanics like law of moment, law of machine, law of parallelogram of forces, Varignon's theorem of moments etc..
- 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"
- Prepare chart showing all types of beams having types of support (roller, hinged, fixed) with sketches and corresponding photographs of real life examples.
- Prepare models of types of beam subjected to all loads (point load, udl, uvl, moment, couple) with sketches and corresponding photographs of real life examples.
- Prepare photographic chart showing real life examples of uses of friction on horizontal (walking, writing, etc.) and inclined plane (slider in gardens, loading of heavy material in trucks etc.).

**Note :**

Note: Student should maintain a separate full size book to solve the assignment given by course teacher. Course teacher can assign following type of assignments to students. Assignments should be solved by individual students and corrective actions should be given by course teacher. These are the just suggestive microproject topics. Faculty must design microproject/activities/assignments based on course outcome requirements. Student should prepare 10-15 pages microproject on any topic in a group of 4 students only. Course teacher can allot following topics to microproject group. Microproject report should be prepared with new information other than classroom teaching. The necessary guidance for the microproject work should be provided by course teacher.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Simple 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 .	1
2	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

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
3	Worm and worm wheel (wall mounted unit with threaded spindle, load drum, effort wheel; with necessary slotted weights, hanger and thread)	3
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.	4
5	Double Purchase Crab winch (Having assembly same as above but with double set of gearing arrangement.)	5
6	Simple screw Jack (Table mounted metallic body , screw with a pitch of 5 mm carrying a double flanged turn table of 20 cm diameter.	6
7	Weston's Differential pulley block (consisting of two pulleys; one bigger and other smaller.	7
8	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)	8
9	Universal Force Table (Consists of a circular 40 cm dia. Aluminum disc, graduated into 360 degrees.) with all accessories.	9,14
10	Law of moment's apparatus consisting of a stainless steel graduated beam 12.5 mm square in section, 1m long, pivoted at centre.	10,11
11	Beam Reaction apparatus (The apparatus is with two circular dial type 10 kg.)	15
12	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)	16,17
13	Models of geometrical figures.	18

#### IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Simple Lifting Machine	CO1	9	2	8	4	14
2	II	Analysis of Forces	CO2	13	2	4	12	18
3	III	Equilibrium of Forces	CO3	9	2	8	4	14
4	IV	Friction of Forces	CO4	7	2	4	6	12
5	V	Centroid and Centre of Gravity	CO5	7	2	4	6	12
<b>Grand Total</b>				<b>45</b>	<b>10</b>	<b>28</b>	<b>32</b>	<b>70</b>

#### X. ASSESSMENT METHODOLOGIES/TOOLS

##### Formative assessment (Assessment for Learning)

- Term work (Lab Manual), Self-Learning (Assignment) Question and Answers in class room, quiz and group discussion. Note: Each practical will be assessed considering-60% weightage to process related and 40 % weightage to product related.

##### Summative Assessment (Assessment of Learning)

- Practical Examination, Oral Examination, Pen and Paper Test.

#### XI. SUGGESTED COS - POS MATRIX FORM

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	1	1	1	2	1	-	1			
CO2	2	2	1	2	1	-	1			
CO3	2	2	1	2	1	-	1			
CO4	2	2	2	2	1	-	1			
CO5	2	2	1	2	1	-	1			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
\*PSOs are to be formulated at institute level

## XII. SUGGESTED LEARNING MATERIALS / BOOKS

Sr.No	Author	Title	Publisher with ISBN Number
1	S. Ramamrutham	Engineering Mechanics	Dhanpat Rai Publishing Co. 2016 ISBN-13: 978-9352164271
2	R. S. Khurmi, N.Khurmi	Engineering Mechanics	S.Chand & Co. New Delhi 2018 ISBN: 978-9352833962
3	S. S. Bhavikatti	Engineering Mechanics	New Age International Private Limited ISBN: 978-9388818698
4	D. S. Bedi, M. P. Poonia	Engineering Mechanics	Khanna Publishing ISBN-13:978-9386173263
5	Dr. R. K. Bansal	Engineering Mechanics	Laxmi Publications ISBN 13: 9788131804094

## XIII. LEARNING WEBSITES & PORTALS

Sr.No	Link / Portal	Description
1	<a href="https://www.engineersrail.com/simple-lifting-machine/">https://www.engineersrail.com/simple-lifting-machine/</a>	Introduction of simple lifting machine
2	<a href="https://www.youtube.com/watch?v=kNypk8GReqM">https://www.youtube.com/watch?v=kNypk8GReqM</a>	Law of machine and types of machines useful in industry.
3	<a href="http://nitttrc.edu.in/nptel/courses/video/112106286/L01.html">http://nitttrc.edu.in/nptel/courses/video/112106286/L01.html</a>	Introduction to engineering mechanics
4	<a href="https://www.youtube.com/watch?v=6u_rjLjv-MY&amp;list=PLOSWwFV98r-fkXq2KBphJz95rao7q8PpwT&amp;index=3">https://www.youtube.com/watch?v=6u_rjLjv-MY&amp;list=PLOSWwFV98r-fkXq2KBphJz95rao7q8PpwT&amp;index=3</a>	Introduction of force system with examples
5	<a href="https://www.youtube.com/watch?v=Fudcc0JoXdo&amp;list=PLOSWwFV98r-fkXq2KBphJz95rao7q8PpwT&amp;index=4">https://www.youtube.com/watch?v=Fudcc0JoXdo&amp;list=PLOSWwFV98r-fkXq2KBphJz95rao7q8PpwT&amp;index=4</a>	Resolution and composition of forces
6	<a href="https://www.youtube.com/watch?v=RrVuSbCZH8c">https://www.youtube.com/watch?v=RrVuSbCZH8c</a>	Verification of Lamis theorem in laboratory
7	<a href="https://www.youtube.com/watch?v=tM5hsUiNpGA">https://www.youtube.com/watch?v=tM5hsUiNpGA</a>	Calculation of beam reactions for various types of beams

<b>Sr.No</b>	<b>Link / Portal</b>	<b>Description</b>
8	<a href="https://www.youtube.com/watch?v=RGT1g_lu440">https://www.youtube.com/watch?v=RGT1g_lu440</a>	Calculation of coefficient of friction for horizontal and inclined plane
9	<a href="https://www.youtube.com/watch?v=wflNSfPXAI">https://www.youtube.com/watch?v=wflNSfPXAI</a>	Centroid of plane/composite figures, C.G. of plane/composite solids
10	<a href="https://www.youtube.com/watch?v=v6VTMwxx4oA">https://www.youtube.com/watch?v=v6VTMwxx4oA</a>	Centroid of composite figures.

**Programme Name/s** : Automobile Engineering./ Mechanical Engineering/ Mechatronics/ Production Engineering/  
**Programme Code** : AE/ ME/ MK/ PG  
**Semester** : Second  
**Course Title** : MANUFACTURING TECHNOLOGY  
**Course Code** : 312313

**I. RATIONALE**

Diploma graduates frequently encounter diverse manufacturing processes. This core manufacturing technology course aims to enhance student's comprehension of manufacturing methods, like turning, drilling, milling, casting, forming, and joining, etc.

**II. INDUSTRY / EMPLOYER EXPECTED OUTCOME**

Produce a given component using various manufacturing processes.

**III. COURSE LEVEL LEARNING OUTCOMES (COS)**

Students will be able to achieve & demonstrate the following COs on completion of course based learning

- CO1 - Produce a part using a lathe and drilling machine as per given drawing.
- CO2 - Produce a part using a milling machine as per given drawing.
- CO3 - Produce a part using casting processes as per given drawing.
- CO4 - Produce a part using forming processes as per given drawing.
- CO5 - Produce a part using joining processes as per given drawing..

**IV. TEACHING-LEARNING & ASSESSMENT SCHEME**

Course Code	Course Title	Abbr	Course Category/s	Learning Scheme						Credits	Paper Duration	Assessment Scheme										Total Marks
				Actual Contact Hrs./Week			SL	LH	NLH			Theory			Based on LL & TL				Based on SL			
				CL	TL	LL						FA-TH	SA-TH	Total	FA-PR		SA-PR		SLA			
				Max	Max	Max	Min	Max	Min						Max	Min	Max	Min	Max	Min		
312313	MANUFACTURING TECHNOLOGY	MPR	DSC	3	-	4	1	8	4	3	30	70	100	40	25	10	25@	10	25	10	175	

**Total IKS Hrs for Sem. : 1 Hrs**

Abbreviations: CL- ClassRoom Learning , TL- Tutorial Learning, LL-Laboratory Learning, SLH-Self Learning Hours, NLH-Notional Learning Hours, FA - Formative Assessment, SA -Summative assessment, IKS - Indian Knowledge System, SLA - Self Learning Assessment

Legends: @ Internal Assessment, # External Assessment, \*# On Line Examination , @\$ Internal Online Examination  
Note :

1. FA-TH represents average of two class tests of 30 marks each conducted during the semester.
2. If candidate is not securing minimum passing marks in FA-PR of any course then the candidate shall be declared as "Detained" in that semester.
3. If candidate is not securing minimum passing marks in SLA of any course then the candidate shall be declared as fail and will have to repeat and resubmit SLA work.
4. Notional Learning hours for the semester are (CL+LL+TL+SL)hrs.\* 15 Weeks
5. 1 credit is equivalent to 30 Notional hrs.
6. \* Self learning hours shall not be reflected in the Time Table.
7. \* Self learning includes micro project / assignment / other activities.

**V. THEORY LEARNING OUTCOMES AND ALIGNED COURSE CONTENT**

Sr.No	Theory Learning Outcomes (TLO's)aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
1	TLO 1.1 List various angles of single point cutting tool. TLO 1.2 List accessories of lathe machine and their function. TLO 1.3 Calculate machining parameters for given component. TLO 1.4 Describe construction and specification of a drilling machine. TLO 1.5 List various drilling operations	<b>Unit - I Fundamentals of Lathe and drilling machines</b> 1.1 Basics of Machining: Single point cutting Tool and its nomenclature, Mechanics of Chip formation, Types of Chips. 1.2 Lathe machine: Classification, specification of centre lathe; Basic parts and accessories like chucks (three jaw, four jaw, and magnetic chuck), mandrels, rests, faceplate, centres and angle plate of centre lathe and their functions. 1.3 Lathe operations: facing, plain turning, taper turning, thread cutting, chamfering, grooving, knurling and cutting parameters like speed, feed, depth of cut and machining time. 1.4 Drill machine: Classification, specification of drilling machine Basic parts of radial drilling machine, Sensitive drilling and their function. 1.5 Drilling machine operations: Drilling, reaming, boring, counter sinking, counter boring, spot facing and Cutting parameters- speed, feed, depth of cut and machining time.	Model Demonstration Video Demonstrations

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
2	<p>TLO 2.1 Demonstrate working of milling machines.</p> <p>TLO 2.2 Select appropriate milling cutter for given component.</p> <p>TLO 2.3 Describe milling operations for given component.</p> <p>TLO 2.4 Illustrate procedure of indexing methods.</p>	<p><b>Unit - II Milling Machines</b></p> <p>2.1 Milling Machine: Working principle, types of milling machines.</p> <p>2.2 Milling cutter: Different types of cutters, face milling cutters end milling cutters, staggered tooth milling cutter, side and face milling cutter, form milling cutters and metal slitting saw.</p> <p>2.3 Milling Process: Plain milling, face milling, side milling, end milling, straddle milling, gang milling, up and down milling.</p> <p>2.4 Dividing head; Types, function of dividing head, method of indexing.</p>	<p>Model Demonstration Video Demonstrations</p>
3	<p>TLO 3.1 Describe significance of pattern allowances.</p> <p>TLO 3.2 Describe moulding methods.</p> <p>TLO 3.3 Classify casting processes.</p> <p>TLO 3.4 Enumerate safety guidelines and precautions for a foundry workshop.</p>	<p><b>Unit - III Casting processes</b></p> <p>3.1 Pattern making: Basic steps in making pattern, types, materials and allowances, Color coding of pattern.</p> <p>3.2 Moulding: Types and properties of moulding sands, moulding methods, cores and core prints, gating and risering system.</p> <p>3.3 Casting: Casting in Indus valley civilization (IKS), Centrifugal casting, investment casting, shell moulding and applications, Casting defects-causes and remedies.</p> <p>3.4 Safety practices/ precautions in foundry shop.</p>	<p>Chalk-Board Model Demonstration Video Demonstrations</p>
4	<p>TLO 4.1 Select the relevant forming process for given component.</p> <p>TLO 4.2 Differentiate rolling and forging process.</p> <p>TLO 4.3 List various press tool operations for given component.</p> <p>TLO 4.4 Enumerate safety guidelines and precautions for a forging/press shop</p>	<p><b>Unit - IV Forming processes</b></p> <p>4.1 Drop forging: Introduction to forging, upset forging, Press forging, open die and closed die forging operations.</p> <p>4.2 Rolling: Principle of rolling, hot and cold rolling and applications, rolling mill.</p> <p>4.3 Press tool: Various operations performed on press, press tool, simple, progressive and forming dies and applications.</p> <p>4.4 Safety practices/ precautions in forging and press shop.</p>	<p>Chalk-Board Model Demonstration</p>

Sr.No	Theory Learning Outcomes (TLO's) aligned to CO's.	Learning content mapped with Theory Learning Outcomes (TLO's) and CO's.	Suggested Learning Pedagogies.
5	<p>TLO 5.1 Select suitable welding process for given component.</p> <p>TLO 5.2 Describe gas welding process.</p> <p>TLO 5.3 Differentiate various arc welding processes.</p> <p>TLO 5.4 Compare soldering and brazing process.</p> <p>TLO 5.5 List causes of welding defects and suggest remedies.</p> <p>TLO 5.6 Enumerate safety guidelines and precautions for a welding shop.</p>	<p><b>Unit - V Metal joining processes</b></p> <p>5.1 Welding Processes: welding and weldability, types and classification of welding processes.</p> <p>5.2 Gas welding: gas welding equipments, oxy-acetylene welding, types of flame.</p> <p>5.3 Arc welding: arc welding equipment equipments, flux shielded metal arc welding, TIG and MIG welding.</p> <p>5.4 Soldering and brazing process, Comparison, fillers, merits, demerits and applications.</p> <p>5.5 Defects in welding joints: causes and remedies.</p> <p>5.6 Safety practices/ precautions in welding shop.</p>	Chalk-Board Demonstration

**VI. LABORATORY LEARNING OUTCOME AND ALIGNED PRACTICAL / TUTORIAL EXPERIENCES.**

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
<p>LLO 1.1 Setup a lathe machine for given job as per operations.</p> <p>LLO 1.2 Select suitable cutting parameters for operations as per given job.</p> <p>LLO 1.3 Prepare a turning job as per given drawing.</p>	1	*Produce a job on a lathe machine that comprises facing, plain turning and step turning operations as per the given drawing.	4	CO1
<p>LLO 2.1 Setup a lathe machine for taper turning operations.</p> <p>LLO 2.2 Calculate taper angle for taper turning operations as per given job.</p> <p>LLO 2.3 Prepare a taper turning job as per given drawing.</p>	2	*Produce a job on a lathe machine that comprises taper turning and grooving operations as per the given drawing.	4	CO1
<p>LLO 3.1 Setup a lathe machine for chamfering and knurling operations.</p> <p>LLO 3.2 Select suitable cutting parameters for chamfering and knurling operations.</p> <p>LLO 3.3 Prepare a chamfering and knurling job as per given drawing.</p>	3	*Produce a job on a lathe machine that comprises knurling and chamfering operations as per the given drawing.	4	CO1
<p>LLO 4.1 Setup a drill machine for given job as per operations.</p> <p>LLO 4.2 Prepare a drilling job as per given drawing.</p>	4	*Produce a job on a drilling machine comprising drilling and reaming operations as per the given drawing.	4	CO1

<b>Practical / Tutorial / Laboratory Learning Outcome (LLO)</b>	<b>Sr No</b>	<b>Laboratory Experiment / Practical Titles / Tutorial Titles</b>	<b>Number of hrs.</b>	<b>Relevant COs</b>
LLO 5.1 Setup a drill machine and tool for given job as per operations. LLO 5.2 Prepare a tapping job as per given drawing.	5	*Produce a job on drilling machine comprising tapping operation as per the given drawing.	4	CO1
LLO 6.1 Setup a drill machine and tool for given job as per operations. LLO 6.2 Prepare a counter-boring job as per given drawing.	6	Produce a job on a drilling machine comprising counter-boring operation as per the given drawing.	4	CO1
LLO 7.1 Setup a milling machine and cutter for given job. LLO 7.2 Prepare a job on milling machine as per the given drawing.	7	Produce a job on a milling machine that comprises of plain milling operation as per the given drawing.	4	CO2
LLO 8.1 Setup a milling machine and side milling cutter for given job. LLO 8.2 Prepare a job on milling machine as per the given drawing.	8	Produce a job on a milling machine that comprises of side milling operation as per given drawing.	4	CO2
LLO 9.1 Setup a milling machine and cutter for given job. LLO 9.2 Use dividing head for indexing. LLO 9.3 Prepare a spur gear on milling machine as per the given drawing.	9	*Produce a spline shaft with 3 slots using indexing mechanism as per the given drawing.	4	CO2
LLO 10.1 Select material and tool for preparing pattern. LLO 10.2 Prepare wooden pattern as per given drawing.	10	*Produce a simple wooden pattern for the given component.	4	CO3
LLO 11.1 Choose appropriate sand and tools for moulding a given pattern. LLO 11.2 Prepare a mould for given pattern.	11	*Produce a sand mould for the given pattern.	4	CO3
LLO 12.1 Select suitable material and melt it for required casting. LLO 12.2 Prepare casting as per given drawing.	12	*Produce a casting from the given mould.	4	CO3
LLO 13.1 Identify various components of forging machine. LLO 13.2 Enlist various forging operations. LLO 13.3 Identify need of safety while working in forging shop.	13	Demonstrate components of a forging machine and its safety considerations.	4	CO4
LLO 14.1 Select tool for producing given job. LLO 14.2 Prepare a bolt head/a cold chisel/hook as per given drawing.	14	*Produce a bolt head/cold chisel/hook using forging.	4	CO4

Practical / Tutorial / Laboratory Learning Outcome (LLO)	Sr No	Laboratory Experiment / Practical Titles / Tutorial Titles	Number of hrs.	Relevant COs
LLO 15.1 Identify various components of rolling mill/machine. LLO 15.2 Enlist rolling methods used in industries. LLO 15.3 Identify need of safety while working rolling shop.	15	Demonstrate the various parts of rolling mill/machine and various safety aspects of it.	4	CO4
LLO 16.1 Identify various components of Press tool. LLO 16.2 Identify type of die used for production of washer. LLO 16.3 Identify need of safety while working in press shop.	16	Demonstrate production process of washer.	2	CO4
LLO 17.1 Prepare material for fabricating structure. LLO 17.2 Select suitable equipment and tool for welding. LLO 17.3 Fabricate structure as per given drawing.	17	*Fabricate structure using arc welding machine as per given drawing.	4	CO5
LLO 18.1 Prepare joint for soldering/brazing by applying flux. LLO 18.2 Perform soldering/brazing operations on the given components.	18	*Perform soldering/brazing operations on the given components.	2	CO5
LLO 19.1 Enlist various welding defects and their causes. LLO 19.2 Identify casting defects in the given welded joints.	19	Identify various welding defects from given castings.	2	CO5
<b>Note : Out of above suggestive LLOs -</b> <ul style="list-style-type: none"> <li>*' Marked Practicals (LLOs) Are mandatory.</li> <li>Minimum 80% of above list of lab experiment are to be performed.</li> <li>Judicial mix of LLOs are to be performed to achieve desired outcomes.</li> </ul>				

## VII. SUGGESTED MICRO PROJECT / ASSIGNMENT/ ACTIVITIES FOR SPECIFIC LEARNING / SKILLS DEVELOPMENT (SELF LEARNING)

### Assignment

- Justify why lathe machine is called mother of all machines.
- Collect information regarding car bonnet manufacturing in automobile industry.
- Collect information of material used for preparation of pattern.
- Justify necessity of safety precaution in industries.
- Prepare a list of machine tools seen in the industry during industrial visit.

### Micro project

- Collect specifications of machine tools available in the industry you have visited.
- Prepare a list of similar operations that can be performed on different machine tools along with their specifications.
- Collect different welding equipments required for a welding shop.

- Collect a information about operations required for key manufacturing.
- Prepare a list of machine tools available in the workshop of the institute with their specifications.

**VIII. LABORATORY EQUIPMENT / INSTRUMENTS / TOOLS / SOFTWARE REQUIRED**

Sr.No	Equipment Name with Broad Specifications	Relevant LLO Number
1	Centre lathe machine. (Length between canters 1000 mm, swing 500 mm)	1,2,3
2	Drilling Machine (drill diameter up to 40 mm)	4,5,6
3	Column and knee type milling machine along with dividing head (length X width of working table 1000 mm X 500)	7,8,9
4	Pattern making, moulding and casting shop with necessary equipment.	10,11,12
5	Mini forging press (Capacity upto 1 ton)	13,14
6	Rolling mill (Laboratory type)	15
7	Mini press tool (Capacity upto 1 ton)	16
8	TIG/MIG welding equipmet (upto 160 A, 240 Volts)	17,18,19

**IX. SUGGESTED WEIGHTAGE TO LEARNING EFFORTS & ASSESSMENT PURPOSE (Specification Table)**

Sr.No	Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
1	I	Fundamentals of Lathe and drilling machines	CO1	10	4	6	6	16
2	II	Milling Machines	CO2	9	4	6	6	16
3	III	Casting processes	CO3	9	2	6	4	12
4	IV	Forming processes	CO4	8	2	4	4	10
5	V	Metal joining processes	CO5	9	4	8	4	16
<b>Grand Total</b>				<b>45</b>	<b>16</b>	<b>30</b>	<b>24</b>	<b>70</b>

**X. ASSESSMENT METHODOLOGIES/TOOLS**

**Formative assessment (Assessment for Learning)**

- Tests
- Seminar/Presentation
- Term Work

**Summative Assessment (Assessment of Learning)**

- Practical
- Theory

**XI. SUGGESTED COS - POS MATRIX FORM**

Course Outcomes (COs)	Programme Outcomes (POs)							Programme Specific Outcomes* (PSOs)		
	PO-1 Basic and Discipline Specific Knowledge	PO-2 Problem Analysis	PO-3 Design/ Development of Solutions	PO-4 Engineering Tools	PO-5 Engineering Practices for Society, Sustainability and Environment	PO-6 Project Management	PO-7 Life Long Learning	PSO-1	PSO-2	PSO-3
CO1	3	2	2	2	-	2	2			
CO2	3	2	2	2	-	2	2			
CO3	3	2	2	2	-	2	2			
CO4	3	2	2	2	-	2	2			
CO5	3	2	2	2	-	2	2			

Legends :- High:03, Medium:02,Low:01, No Mapping: -  
 \*PSOs are to be formulated at institute level

**XII. SUGGESTED LEARNING MATERIALS / BOOKS**

Sr.No	Author	Title	Publisher with ISBN Number
1	P N RAO	Manufacturing Technology Vol-1	McGraw Hill, New Delhi. ISBN-1259062570, 9781259062575
2	P N RAO	Manufacturing Technology Vol-2	McGraw Hill, New Delhi, ISBN: 9789353160524
3	S K Hajra Choudhury, A K Hajra Choudhury, Nirjhar Roy	Elements Of Workshop Technology Vol-1	Media Propoters & Publisher PVT. LMT. ISBN-13 5551234102415
4	S K Hajra Choudhury, A K Hajra Choudhury, Nirjhar Roy	Elements Of Workshop Technology Vol-2	Media Propoters & Publisher PVT. LMT., ISBN: 978-8-185-09915-6.
5	D.P. Agrawal	Ancient Metal Technology and Archaeology of South Asia: a Pan-Asian perspective	Aditya Prakashan, New Delhi. ISBN: 9788173051777

**XIII. LEARNING WEBSITES & PORTALS**

Sr.No	Link / Portal	Description
1	<a href="https://www.youtube.com/watch?v=Wc2gpWcmGK4">https://www.youtube.com/watch?v=Wc2gpWcmGK4</a>	Lathe Machine Operations
2	<a href="https://www.youtube.com/watch?v=DGsV6RhBnbM">https://www.youtube.com/watch?v=DGsV6RhBnbM</a>	Radial drilling machine
3	<a href="https://www.youtube.com/watch?v=zzXddrV2so">https://www.youtube.com/watch?v=zzXddrV2so</a>	Simple Job on milling machine
4	<a href="https://www.youtube.com/watch?v=2CIcvB72dmk">https://www.youtube.com/watch?v=2CIcvB72dmk</a>	Basics of Metal Casting
5	<a href="https://www.youtube.com/watch?v=-w7E88zox6w">https://www.youtube.com/watch?v=-w7E88zox6w</a>	Closed die forging
6	<a href="https://www.youtube.com/watch?v=RyLvVMg84xs">https://www.youtube.com/watch?v=RyLvVMg84xs</a>	Basics of welding process