Mechanical Engineering

Preamble: The curriculum of B. Tech. (Mechanical Engineering) program offered by the Department of Mechanical Engineering under Academic Regulation 2020 is prepared in accordance with the curriculum framework of AICTE, UGC and Andhra Pradesh State Council of Higher Education (APSCHE). Further this Outcome Based Curriculum (OBC) is designed with Choice Based Credit and Semester System (CBCSS) enabling the learners to gain professional competency with multi-disciplinary approach catering the minimum requirement (Program Specific Criteria) of Lead Societies like American Society of Mechanical Engineers (ASME) and other Professional Bodies as per the Engineering Accreditation Commission (EAC) of ABET and NBA. In addition, the curriculum and syllabi are designed in a structured approach by deploying Feedback Mechanism on Curriculum from various stakeholders viz. Industry, Potential Employers, Alumni, Academia, Professional Bodies, Research Organizations and Parents to capture their voice of the respective stakeholders.

The Curriculum design, delivery, and assessment, the three major pillars of academic system are completely aligned in line with Outcome Based Education (OBE) to assess and evaluate the learning outcomes facilitating the learners to achieve their Professional and Career Accomplishments.

The Vision

To train the students to be professional and competent Mechanical Engineers to take up the challenges in the society and strive continuously for excellence in education and research

The Mission

- To provide quality education for successful career and higher studies in Mechanical Engineering
- To emphasize academic and technical excellence in the profession
- To take up consultancy and research in solving the problems related to Mechanical Engineering

Program Educational Objectives (PEOs)

The PEOs are the educational goals that reflect Professional and Career Accomplishments that a graduate should attain after 4 – 5 years of his/her graduation.

The graduates of Mechanical Engineering of NSRIT will

1. Continue to excel in professional mechanical related careers or chosen career path that apply 21st century skills following ethical standards and practices contributing towards sustainable development by providing feasible and viable technical solutions catering the real-time engineering problems
2. Engage in experiential learning through their professional practices and adapt to changing skills sets in the pursuit of lifelong learning

Program Outcomes (POs)

The POs are the transactional statements of graduate attributes (GAs) that each graduating engineer should possess in terms of knowledge, skill and behavior with a minimum target performance level at the time of graduation as fixed by the program of study seeking continuous improvement year on year.

The graduates of Mechanical Engineering of NSRIT will be able to demonstrate the following outcomes in terms knowledge, skill, and behavioral competencies at the time of graduation with the expected target performance level

1. Apply the knowledge of basic sciences and fundamental engineering concepts in solving engineering problems (Engineering Knowledge)
2. Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences (Problem Analysis)
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations (Design/Development of Solutions)
4. Perform investigations, design and conduct experiments, analyse and interpret the results to provide valid conclusions (Investigation of Complex Problems)
5. Select/develop and apply appropriate techniques and IT tools for the design & analysis of the systems (Modern Tool Usage)
6. Give reasoning and assess societal, health, legal and cultural issues with competency in professional engineering practices (The Engineer and Society)
7. Demonstrate professional skills and contextual reasoning to assess environmental/societal issues for sustainable development (The Environment and Sustainability)
8. Demonstrate Knowledge of professional and ethical practices (Ethics)
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multi-disciplinary situations (Individual and Team Work)
10. Communicate effectively among engineering community, being able to comprehend and writeeffectively reports, presentation and give / receive clears instructions (Communication)
11. Demonstrate and apply engineering & management principles in their own / team projects in multidisciplinary environment (Project Finance and Management)
12. Recognize the need for, and have the ability to engage in independent and lifelong learning (Life Long Learning)

Program Specific Outcomes (PSOs)

1. Demonstrate adequate core competency in designing and fabricating mechanical systems, thermal and hydraulic machines, materials and similar others, and thereby providing sustainable computer aided solutions maintaining professional standards and value system
2. Demonstrate adequate knowledge in the allied specialization of Mechanical Engineering that adds value addition for professional practices

Category-wise Credit Distribution of Courses

	Category	AICTE	APSCHE	NSRIT (A)
HS	Humanities and Social Science	12.0	10.5	10.5
BS	Basic Science	25.0	18.0	18.0
ES	Engineering Science	24.0	22.5	24.0
PC	Professional Core	48.0	55.5	54.0
PE	Professional Elective	18.0	15.0	15.0
OE	Open Elective	18.0	12.0	12.0
IN	Internship (s), Project & Seminars	15.0	16.5	16.5
SC	Skill Oriented Courses	-	10.0	10.0
MC	Mandatory Courses	-	-	-
AC	Audit Course	-	-	-
	Total no. of credits	160	160	160

Mechanical Engineering

Credit requirement for the award of the degree under academic Regulation 2020 – 2021 for the candidates admitted from the academic year 2021 onwards	Four Years	Three Years
B. Tech. (Regular Degree)	160	121
B. Tech. (Honors Degree)	180	141
B. Tech. (With Minor specialization other than Chosen Branch of Engg. & Tech.)	180	141

Semester I

No.	Code	Course	Pos	L	T*	P	C	
01	20HSX01	Communicative English	10	3	0	0	3.0	HS
02	20BSX11	Linear Algebra and Differential Equations	1, 12[1]	3	1	0	3.0	BS
03	20BSX21	Engineering Chemistry	1	3	0	0	3.0	BS
04	20ESX01	Engineering Drawing	1, 5, 10	1	0	4	3.0	ES
05	20ESX02	Programming for Problem Solving Using 'C'	1	3	0	0	3.0	ES
06	20HSX02	Communicative English Lab	10	0	0	3	1.5	HS
07	20BSX22	Engineering Chemistry Lab	1, 4	0	0	3	1.5	BS
08	20ESX07	Programming for Problem Solving Using 'C' Lab	1	0	0	3	1.5	ES
			Sub-total	13	01	13	**19.5**	

Semester II

No.	Code	Course	Pos	L	T*	P	C	
01	20BSX12	Partial Differential Equations and Vector Calculus	1	3	1	0	3.0	BS
02	20BSX31	Engineering Physics	1	3	0	0	3.0	BS
03	20ESX05	Basic Electrical and Electronics Engineering	1	3	1	0	3.0	ES
04	20ESX04	Engineering Mechanics	1, 2, 4	3	1	0	3.0	ES
05	20ME201	Computer Aided Engineering Drawing	1, 5, 10	1	0	4	3.0	ES
06	20BSX32	Engineering Physics Lab	1, 4	0	0	3	1.5	BS
07	20ESX08	Basic Electrical and Electronics Engineering Lab	1, 4	0	0	3	1.5	ES
08	20ESX06	Engineering Workshop	4	0	0	3	1.5	ES
09	20MCX01	Environmental Science	-	2	0	0	-	MC
			Sub-total	15	03	13	**19.5**	

Semester III

No.	Code	Course	Pos	L	T*	P	C	
01	20BSX13	Numerical Methods and Transforms	1	3	1	0	3.0	BS
02	20ME302	Thermodynamics	1, 2, 4, PSO 1	3	1	0	3.0	PC
03	20ME303	Material Science and Metallurgy	1, 7, 12	3	0	0	3.0	PC
04	20ME304	Mechanics of Solids	2, 3, 12, PSO 1	3	1	0	3.0	PC
05	20ME305	Manufacturing Processes	1, 6, 12	3	0	0	3.0	PC
06	20ME306	Material Science and Metallurgy Lab	1, 4	0	0	3	1.5	PC
07	20ME307	Mechanics of Solids Lab	1, 4	0	0	3	1.5	PC
08	20ME308	Manufacturing Processes Lab	1, 4	0	0	3	1.5	PC
09	20MES01	Computer Aided Modelling	5, 10, PSO 1	1	0	2	2.0	SC
10	20MCX02	Constitution of India	-	2	0	0	-	MC
			Sub-total	18	03	11	**21.5**	

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* Suggested hours for tutorial
[1] By default all courses are mapped to PO 12 as they are weakly contributing

Semester IV

No.	Code	Course	Pos	L	T	P	C	
01	20HSX03	Managerial Economics and Financial Analysis	11	3	0	0	3.0	HS
02	20CS403	Python Programming	1	3	1	0	3.0	ES
03	20ME403	Kinematics of Machinery	2, 3, PSO 1	3	1	0	3.0	PC
04	20ME404	Fluid Mechanics and Hydraulic Machines	2, 3, PSO 1	3	1	0	3.0	PC
05	20ME405	Internal Combustion Engines and Gas Turbines	2, 3, PSO 2	3	1	0	3.0	PC
06	20ME406	Fluid Mechanics and Hydraulic Machines Lab	1, 4	0	0	3	1.5	PC
07	20ME407	Thermal Engineering Lab	1, 4	0	0	3	1.5	PC
08	20CS407	Python Programming Lab	1	0	0	3	1.5	ES
09	20MES02	Computer Numerical Control Programming	1, 2, 4, 5, 10	1	0	2	2.0	SC
			Sub-total	16	04	11	**21.5**	

Semester V

No.	Code	Course	Pos	L	T	P	C	
01	20ME501	Dynamics of Machinery	2, 3, 4,12, PSO 1	3	1	0	3.0	PC
02	20ME502	Design of Machine Elements I	2, 3, 4,12, PSO 1	2	1	0	3.0	PC
03	20ME503	Metal Cutting and Machine Tools	1, 6, 12	3	0	0	3.0	PC
04	-	Professional Elective I	-	3	0	0	3.0	PE
05	-	Open Elective I	-	3	0	0	3.0	OE
06	20ME506	Dynamics of Machinery Lab	1, 4	0	0	3	1.5	PC
07	20ME507	Metal Cutting and Machine Tools Lab	1, 3, 4	0	0	3	1.5	PC
08	-	MOOCs	12	0	0	0	2.0	SC
09	20MCX03	Intellectual Property Rights and Patents	-	2	0	0	-	MC
10	-	Summer Internship #1[2]	5, 8, 9, 10, PSO 1	0	0	0	1.5	IN
11	-	Technical Paper Writing	-	0	0	2	-	AC
			Sub-total	15	02	14	**21.5**	

Semester VI

No.	Code	Course	Pos	L	T	P	C	
01	20ME601	Mechanical Measurements and Metrology	1, 6, 12	3	0	0	3.0	PC
02	20ME602	Design of Machine Elements II	2, 3, 4, PSO 1	3	1	0	3.0	PC
03	20ME603	Heat Transfer	1, 2, 3, 4, PSO 2	3	1	0	3.0	PC
04	-	Professional Elective II	-	3	0	0	3.0	PE
05	-	Open Elective II	-	3	0	0	3.0	OE
06	20ME606	Computer Aided Machine Drawing	1, 5, 10, PSO 1	0	0	3	1.5	PC
07	20ME607	Mechanical Measurements and Metrology Lab	1, 4	0	0	3	1.5	PC
08	20ME608	Heat Transfer Lab	1, 3, 4, PSO 2	0	0	3	1.5	PC
09	20MES04	Computer Aided Analysis	1, 4, 5	0	0	4	2.0	SC
10	20MCX04	Indian Traditional Knowledge	-	2	0	0	-	MC
			Sub-total	16	02	15	**21.5**	

Semester VII

No.	Code	Course	Pos	L	T	P	C	
01	-	Professional Elective III	-	3	0	0	3.0	PE
02	-	Professional Elective IV	-	3	0	0	3.0	PE
03	-	Professional Elective V	12	3	0	0	3.0	PE
04	-	Open Elective III	-	3	0	0	3.0	OE
05	-	Open Elective IV	12	3	0	0	3.0	OE
06	20HSX04	Professional Ethics	8	3	0	0	3.0	HS
07	20MES05	Applications of Mechatronics	-	0	0	4	2.0	SC
08	-	Summer Internship #2[2]	5, 8, 9, 10, PSO 1	0	0	0	3.0	IN
			Sub-total	16	0	08	**23.0**	

Semester VIII

No.	Code	Course	Pos	L	T	P	C	
01	-	Full Semester Internship[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
02	-	Capstone Project[3]	5-10, PSO 1, PSO 2	0	0	0	06	IN
			Sub-total	0	0	0	**12.0**	
			Total Credits	-	-	-	**160**	

[2] The work pertaining to Summer Internship #1 and #2 shall be completed at the end of Semesters IV and VI respectively. The assessment shall be carried out during Semesters V and VII

[3] The students opting for FSI in VII Semester should take up the courses of VII Semester in VIII Semester

List of Electives

		Professional Elective #1						
1	20ME001	Applied Thermodynamics	-	3	0	0	3.0	PE
2	20ME002	Unconventional Machining Processes	-	3	0	0	3.0	PE
3	20ME003	Rotor Dynamics	-	3	0	0	3.0	PE
4	20ME004	Composite Materials	-	3	0	0	3.0	PE
5	20ME005	Product Design	-	3	0	0	3.0	PE
6	20ME006	Production Planning and Control	-	3	0	0	3.0	PE
		Professional Elective #2						
7	20ME007	Refrigeration and Air Conditioning	-	3	0	0	3.0	PE
8	20ME008	Flexible Manufacturing Systems	-	3	0	0	3.0	PE
9	20ME009	Optimization Techniques	-	3	0	0	3.0	PE
10	20ME010	Material Characterization	-	3	0	0	3.0	PE
11	20ME011	CAD/CAM	-	3	0	0	3.0	PE
12	20ME012	Total Quality Management	-	3	0	0	3.0	PE
		Professional Elective #3						
13	20ME013	Power Plant Engineering	-	3	0	0	3.0	PE
14	20ME014	Advanced Welding Technology	-	3	0	0	3.0	PE
15	20ME015	Finite Element Method	-	3	0	0	3.0	PE
16	20ME016	Condition Monitoring	-	3	0	0	3.0	PE
17	20ME017	Computer Integrated Manufacturing	-	3	0	0	3.0	PE
18	20ME018	Operations Research	-	3	0	0	3.0	PE
		Professional Elective #4						
19	20ME019	Gas Dynamics and Jet Propulsion	-	3	0	0	3.0	PE
20	20ME020	Advance Metal Casting	-	3	0	0	3.0	PE
21	20ME021	Design Innovations	-	3	0	0	3.0	PE
22	20ME022	Non Destructive Evaluation	-	3	0	0	3.0	PE
23	20ME023	Robotics and Automation	-	3	0	0	3.0	PE
24	20ME024	Project Planning and Management	-	3	0	0	3.0	PE
		Professional Elective #5						
		The curriculum provides academic flexibility to choose any of the domain specific courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration (4-credits) and the assessment shall be as per the academic regulation 2020.						PE
		Open Elective #1						
25	20CEO01	Urban Environmental Service	-	3	0	0	3.0	OE
26	20CSO01	Data Structures and Algorithms	-	3	0	0	3.0	OE
27	20AIO01	Machine Learning for Engineers	-	3	0	0	3.0	OE
28	20DSO01	Introduction to Database Management Systems	-	3	0	0	3.0	OE
29	20ECO01	Architectures and Algorithms of IoT	-	3	0	0	3.0	OE
30	20EEO01	Introduction to Renewable Energy Sources	-	3	0	0	3.0	OE
31	20MEO01	Nano Technology	-	3	0	0	3.0	OE
32	20SHO01	Women and Society	-	3	0	0	3.0	OE
		Open Elective #2						
33	20CEO02	Ecology, Environment and Resources	-	3	0	0	3.0	OE
34	20CS004	Internet of Things	-	3	0	0	3.0	OE
35	20AIO02	Fundamentals of Deep Learning	-	3	0	0	3.0	OE
36	20DSO02	Introduction to Data Science	-	3	0	0	3.0	OE
37	20ECO02	IoT for Smart Grids	-	3	0	0	3.0	OE
38	20EEO02	Electrical Safety and Management	-	3	0	0	3.0	OE
39	20MEO02	Fundamentals of Automobile Engineering	-	3	0	0	3.0	OE
40	20SHO02	Design the Thinking	-	3	0	0	3.0	OE
		Open Elective #3						
41	20CEO03	Disaster, Risk Mitigation and Management	-	3	0	0	3.0	OE
42	20CS302	Operating Systems	-	3	0	0	3.0	OE
43	20AIO03	Intelligent Robots and Drone Technology	-	3	0	0	3.0	OE
44	20DSO03	Introduction to Big Data	-	3	0	0	3.0	OE
45	20ECO03	Privacy and Security in IoT	-	3	0	0	3.0	OE
46	20EEO03	Low-cost Automation	-	3	0	0	3.0	OE
47	20MEO03	Industrial Automation	-	3	0	0	3.0	OE

		Open Elective #4						
		The curriculum provides academic flexibility to choose any of the inter-disciplinary courses from MOOCs as approved by the respective Board of Studies and Academic Council. The students can take up this course on self-study mode. The course shall be of 45 – 60 hours duration and the assessment shall be as per the academic regulation 2020.						OE

B. Tech. (Honors)

Category I

1	20MEH01	Advanced Thermodynamics	-	4	0	0	4.0	HO
2	20MEH02	Advanced Heat Transfer	-	4	0	0	4.0	HO
3	20MEH03	Jet Propulsion and Rocket Engineering	-	4	0	0	4.0	HO

Category II

4	20MEH04	Design and Analysis of Engineering Materials	-	4	0	0	4.0	HO
5	20MEH05	Advanced Manufacturing Methods	-	4	0	0	4.0	HO
6	20MEH06	Rapid Prototyping	-	4	0	0	4.0	HO

Category III

7	20MEH07	Advanced Strength of Materials	-	4	0	0	4.0	HO
8	20MEH08	Advanced Finite Element Analysis	-	4	0	0	4.0	HO
9	20MEH09	Advanced Optimization Techniques	-	4	0	0	4.0	HO

Category IV

10	20MEH10	Integrated Computer Aided Design	-	4	0	0	4.0	HO
11	20MEH11	Industrial Robotics	-	4	0	0	4.0	HO
12	20MEH12	Design of Smart Technologies	-	4	0	0	4.0	HO

B. Tech. (Minor with Specialization)

Category I

1	20CEM01	Air Pollution	-	3	0	0	3.0	MI
2	20CSM01	E-Commerce	-	3	0	0	3.0	MI
3	20MEM01	Biomaterials	-	3	0	0	3.0	MI
4	20EEM01	Basic Control Systems	-	3	0	0	3.0	MI
5	20ECM01	Fundamentals of Electronics	-	3	0	0	3.0	MI
6	20AIM01	Fundamentals of Neural Networks	-	3	0	0	3.0	MI
7	20DSO03	Introduction to R Programming	-	3	0	0	3.0	MI

Category II

8	20CEM02	Climate Change Mitigation and Adaptation	-	3	0	0	3.0	MI
9	20CSM02	Knowledge Discovery and Databases	-	3	0	0	3.0	MI
10	20MEM02	Micro Electromechanical Systems	-	3	0	0	3.0	MI
11	20EEM02	Design of Photovoltaic systems	-	3	0	0	3.0	MI
12	20ECM02	Digital Electronics	-	3	0	0	3.0	MI
13	20AIM02	Machine Learning with Python	-	3	0	0	3.0	MI
14	20DSM02	Data Management and Analysis	-	3	0	0	3.0	MI

Category IIII

15	20CEM03	Sustainability and Pollution Prevention Practices	-	3	0	0	3.0	MI
16	20CSM03	Database Security	-	3	0	0	3.0	MI
17	20MEM03	Surface Engineering	-	3	0	0	3.0	MI
18	20EEM03	Electrical Engineering Material Science	-	3	0	0	3.0	MI
19	20ECM03	Analog Electronic Circuits	-	3	0	0	3.0	MI
20	20AIM03	Interpretable Deep Learning	-	3	0	0	3.0	MI
21	20DSM03	Data Governance	-	3	0	0	3.0	MI

List of Honors offered by Mechanical Engineering Program

1. Advanced Thermal Systems
2. Smart Manufacturing
3. Integrated Product Development

List of Minor with Specialization offered by Mechanical Engineering Program

1. Electromechanical Systems using Biomaterials and Surface Engineering

| HS | 20HSX01 Communicative English | 3 | 0 | 0 | 3 |

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

| Code | Course Outcomes | Mapping with POs | | DoK |
		PO10	PO12	
20HSX01.1	Appreciate and comprehend social as well as business dialogues spoken by the native speakers of english by identifying the topic, context and specific information	3	1	L1, L2
20HSX01.2	Question and respond to queries on familiar topics as well as to use appropriate expressions for various functions of language	3	1	L1, L2
20HSX01.3	Implement suitable strategies for scanning the idea of the text so as to be able to find exact information	3	1	L1, L2
20HSX01.4	Grasp paragraph structure and be able to implement the same in their writing	3	1	L1, L2
20HSX01.5	Articulate fluently and accurate as per the context and need	3	1	L1, L2
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create. DoK: Depth of Knowledge				

Unit I: Presidential Address by Dr. A. P. J. Abdul Kalam   9 Hours
Chapter titled "Presidential Address by Dr. A. P. J. Abdul Kalam" from "Fluency in English– A Course Book for Engineering Students" published by Orient Black Swan, Hyderabad.
Listening: Listening to discussion on "Presidential Address by Dr. A.P.J. Abdul Kalam." Speaking: Elocution for short duration. Reading: Reading and Its Importance - Techniques for Effective Reading - Signal Words. Writing: Sentences - Techniques for Effective Writing – Paragraph Writing - Types, Structure and Features of a Paragraph. Vocabulary: Word Formation – Root Words –The Use of Prefixes and Suffixes – Collocations. Grammar: Punctuation – Parts of Speech. Non-Detail: *"Deliverance"* by Munshi Prem Chand from the book Individual Society
Intrapersonal skills and Interpersonal Skills

Unit II: Nehru's Letter to Daughter Indira on her Birthday   9 Hours
Chapter titled "Nehru's Letter to Daughter Indira on Her Birthday" from InfoTech English Language referred from JNTUK.
Listening: Interpretation of the motive behind the letter related to the subject. Speaking: Discussion in Pairs/Small Groups on specific topics. Reading: Identifying sequence of ideas; recognizing verbal techniques. Writing: Letter Writing –Format, Styles, Parts, Language to be used in Formal Letters- Letter of Apology – Letter of Complaint-Letter of Inquiry with Reply – Letter of Requisition. Vocabulary: Antonyms and Synonyms; Homonyms, Homophones, Homographs. Grammar: Articles & Prepositions. Non-Detail: "Bosom Friend" by Hira Bansode from the book Individual Society
Creative Thinking and Teamwork

Unit III: Satya Nadella - Email to Employees on his First Day as CEO   9 Hours
Chapter titled "Satya Nadella: Email to Employees on his First Day as CEO" from Fluency in English– A Course Book for Engineering Students" Published by Orient Black Swan, Hyderabad. Listening: Discussion on innovative methods of communication. Speaking: Change in the style of communication i.e., Face book, twitter, Instagram etc. Reading: Sub - skills of Reading - Skimming, Scanning and Skipping. Writing: Email Etiquette; Cover Letter; Resume writing. Vocabulary: One-word substitutes. Grammar: Verb & its kinds and Tenses. Non-Detail: "Shakespearean Sister "by Virginia Woolf from the book Individual Society
Communication Skills and Leadership Skills

Unit IV: Stay Hungry, Stay Foolish   9 Hours

Chapter titled "Stay Hungry, Stay Foolish"– from InfoTech English Language referred from JNTUK. Listening: Answering a set of questions (from the context of the lesson) in a group. Speaking: Formal oral Presentations on topics from Academic contexts. Reading: Intensive and extensive Reading. Writing: Psychological stressors; Summarizing & Paraphrasing. Vocabulary: Similar words, elaborate meaning of the words. Grammar: Reported Speech: Exercises; Reporting Verbs for academic purposes, Editing Texts. Non-Detail: "Telephone Conversation" by Wole Soyinka from the book Individual Society

Thinking Skills and Problem Solving

Unit V: Stephen Hawking – Positivity Benchmark   9 Hours

Chapter titled "Stephen Hawking – Positivity Bench Mark" from InfoTech English Language referred from JNTUK. Listening: Listening to discussions on "Stephen Hawking – positivity Bench Mark." Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed. Reading: Reading between the lines; Critical Reading for Evaluation. Writing: Precise writing & Essay Writing. Vocabulary: Connotation & Denotation. Grammar: Voice, Concord (Subject – Verb Agreement). Non-Detail: "Still I Rise" from Maya Angelou from the book Individual Society

Positive Attitude and Self Esteem

Text Books

1. "Infotech English Language" – A Text book referred by the JNTUK University Marathi, Publications, 2019
2. "Fluency in English– A Course book for Engineering Students" Published by Orient Black Swan, Hyderabad, 2017
3. "The Individual and Society" – Non-Detailed book referred by the JNTUK University, Pearson Publications, 2020

Reference Books

1. Bailey, Stephen, "Academic writing: A handbook for international students", Routledge, 2014
2. Chase, Becky Tarver, "Pathways: Listening, Speaking and Critical Thinking" Henley ELT; 2nd Edition, 2018
3. Skilful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational Publishers, 2013
4. Hewing's, Martin, "Cambridge Academic English" (B2), CUP, 2012

Web References

1. https://www.youtube.com/watch?v=Zd9mE0d2M9k
2. https://www.thenewleam.com/2019/11/the-letters-that-cultivated-indira-gandhi/
3. https://www.youtube.com/watch?v=PK2XvOs8e1s
4. https://www.youtube.com/watch?v=U36o3UzGY-I
5. https://blogs.microsoft.com/blog/2014/02/04/microsoft-employees-give-new-ceo-satya-nadella-a-12th-man-welcome

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What suggestions did Nehru give to Indira in his letter?
2. "The only way to do great work is to love what you do." Do you think that Steeve Job's statement is worthy in every one's life? Why?
3. What does the phrase 'great drama' refer to?
4. During the freedom movement, what did Gandhiji focus on? Answer with reference to the text
5. Steve Jobs said, "You have to trust in something – your gut, destiny, life, karma, whatever." can you explain a few instances where Steeve Jobs followed his philosophy in his life
6. Write about the early life and education of Stephen Hawking
7. Who did Virginia Woolf sketch the character of Judith?
8. What was the second story of Steve jobs is all about?
9. What was the work done by Steve Jobs in mobile industry?

L2: Understand

1. What have you admired most about Prof. Hawking?
2. According to pt. Nehru, how does a great leader help?
3. Steve Jobs frequently uses the words "drop out' and 'drop in' in his first story. How these words are closely related to his 'connecting dots theory'?
4. "Prof. Hawking's works are larger than his life." Comment briefly
5. What are the eight lessons that one can learn from Prof. Hawking's life?
6. What is a turning point? How does it affect one's life? Discuss it with reference to Prof. Stephen Hawking's life?
7. What things influenced you from the life of Satya Nadella?
8. Do you agree that 'Death is very likely the single best invention of Life'? Why? Think and note some cultures/life styles/gadgets/beliefs which have died in the past decades/ century giving place to new approaches
9. What has influenced you from the life of Abdul Kalam?
10. Why do we want to 'stay hungry, stay foolish', when we can 'stay full, stay smart'?

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Chairman
Board of Studies (Communicative English)

BS   20BSX11 Linear Algebra and Differential Equations   3   1   0   3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX11.1	Solve homogenous & non- homogenous linear system of equations using rank of a matrix	3	1	L1, L2, L3
20BSX11.2	Apply Cayley Hamilton theorem to find inverse & powers of a matrix and identify the nature of the quadratic forms	3	1	L1, L2, L3
20BSX11.3	Solve linear differential equations of first order	3	1	L1, L2, L3
20BSX11.4	Solve higher order ordinary D.E's with constant coefficients related to various engineering fields	3	1	L1, L2, L3
20BSX11.5	Relate the mean value theorems and find Jacobian, Maxima and Minima of functions of several variables in calculus to engineering problems	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Solving Systems of Linear Equations, Eigen Values and Eigen Vectors   11 + 1 Hour
Rank of a matrix-Echelon form - Normal form; solving homogeneous and non-homogeneous system of linear equations – Gauss Elimination for solving system of equations; Eigen values and Eigen vectors

Types of Matrices, Rank by using Minor Method, By using Elementary Transformation Method to find Inverse of the Matrix, Gauss- Jorden Method: Properties of Eigen Values and Eigen Vectors

Unit II: Cayley-Hamilton Theorem and Quadratic Forms   11 + 1 Hour
Cayley-Hamilton theorem (without proof) – Finding inverse and power of a matrix by Cayley-Hamilton theorem, Reduction to Diagonal form. Quadratic forms**:** Quadratic forms and nature of the quadratic forms – Reduction of quadratic form to Canonical forms by diagonalization and Orthogonal transformation. Singular values of a matrix- singular value decomposition- Pseudo inverse by singular value decomposition

Symmetric and Skew-Symmetric Matrices, Orthogonal Matrix, Complex Matrix, Hermitian of a Matrix, Unitary of a Matrix

Unit III: Differential Equations of First Order and First Degree   11 + 1 Hour
Linear differential equations–Bernoulli's equations – Exact equations and equations reducible to exact form. Applications: Newton's Law of cooling – Law of natural growth and decay – Orthogonal Trajectories

Formation of Ordinary Differential Equation, Variable and Separable, Homogeneous and Non- Homogeneous Differential Equations by using Substitution Method

Unit IV: Linear Differential Equations of Higher Order   11 + 1 Hour
Homogeneous and Non-homogeneous equations of higher order with constant coefficients – with RHS term of the type e^{ax}, sinax, cosax, Polynomials in x, $e^{ax}V(x)$ and $xV(x)$ – Method of Variation of parameters. Applications: LC circuits - CR circuits - LCR circuits   .

Simple Harmonic Motion, Higher Order Differential Equation with Variable Coefficient

Unit V: Mean Value Theorems and Functions of Several Variables   11+1 Hour
Mean Value Theorems (without proof): Rolle's Theorem – Lagrange's mean value theorem – Cauchy's mean value theorem – Taylor's and Maclaurin's series expansion of functions of one variable. Functions of Several Variables: Introduction – Partial differentiation - Homogeneous function – Euler's theorem –Jacobian – Functional dependence - Taylor's and Maclaurin's series expansion of functions of two variables. Applications: Maxima and Minima of functions of two variables with and without constraints - Lagrange's method of undetermined multipliers

The Chain Rule of Partial Differentiation, Total Derivative, Implicit Function and Jacobian Implicit Function

Text Books

1.   Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2015

2. Ramana B. V., "Higher Engineering Mathematics",Tata McGraw Hill Education, 2018

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics",10th Edition, Wiley, India, 2015
2. Bali N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018
3. Peter o'Neil, "Advanced Engineering Mathematics" 7th Edition, Cengage Publications, 2012
4. Dr. Iyenger T. K. V., Dr. Prasad. M. V. S. S. N., Ranganatham S. and Dr. Krishna Gandhi B., "Engineering Mathematics I, II & III ", S. Chand Publications, 2019

Web References

1. http://nptel.ac.in/courses/
2. https://onlinecourses.nptel.ac.in
3. https://www.classcentral.com/course/swayam-basic-linear-algebra-13003
4. https://ocw.mit.edu/courses

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	50	40
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State Cayley-Hamilton theorem
2. What is Bernoulli's equation?
3. State Euler' theorem
4. Write   Leibnitz's linear equation
5. Write Bernouli's differential equation in y
6. State Cayley–Hamilton theorem
7. What is an orthogonal transformation?
8. When a given non-homogenous system AX=B is consistent
9. What is the nature of the quadratic form?
10. State Rolle's Theorem

L2: Understand

1. Reduce the matrix $\begin{bmatrix} -2 & -1 & -3 & -1 \\ 1 & 2 & 3 & -1 \\ 1 & 0 & 1 & 1 \\ 0 & 1 & 1 & -1 \end{bmatrix}$ into normal form and find the rank of the matrix
2. Represent $x^2y + 3y - 2$ in powers of $(x - 1)$ & (y+2) up to third degree terms using Taylor's theorem
3. Check the consistency of the system x+y+z=4, 2x+3y-2z=3, x+7y-7z=5
4. Find whether the homogenous system x+y-3z+2w=0,2x-y+2z-3w=0,3x-2y+z-4w=0,-4x+y-3z+w=0 possess non trivial solution
5. Represent $x^2y+3y-z$ in powers of x & y using Maclaurin's series expansion
6. Verify Rolle's theorem for f(x) = (x+2)3(x-3)4 in (-2,3)
7. Solve (1+y²) dx +(x-$e^{\tan^{-1}x}$) dy=0
8. Solve $\frac{2x}{y^3}$ dx +$\frac{y^2-3x^2}{y^4}$ dy=0
9. Solve (D2+3D+2)y=4 cos²x
10. If u= $\tan^{-1}(\frac{x^3+y^3}{x-y})$ prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = \sin 2u$

L3: Apply

1. Apply Cayley –Hamilton theorem to find inverse and A^4 of the matrix A=$\begin{bmatrix} 2 & -1 & 2 \\ 1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$ and also verify the Cayley-Hamilton theorem

2. The number N of bacteria in a culture grew at a rate proportional to N. The Value of N was initially 100 and increased to 332 in one hour. What is the value of N after $1\frac{1}{2}$ hours

3. A condenser of capacity C discharged through an induction L and resistance R in series and the charge q at time t satisfies the equation $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{C} = 0$, Given **L = 0.25** henries, **R = 250** ohms, **C =2×10^{-6}** farads and that when **t =0,** charge **q is 0.002** coulombs and the current $\frac{dq}{dt}$ **= 0.** Obtain the value of q in terms of t

4. Find the volume of the largest rectangular parallelepiped that can be inscribed in the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2}$ = 1

5. A body is originally at 80 ℃ and cools down to 60 ℃ in 20 minutes if the temperature of air is 40 ℃. Find the temperature of body after 40 minutes

6. Find the shortest distance from origin to the surface $xyz^2 = 2$

7. Prove that system of parabola $y^2 = 4a(x + a)$ is it self-orthogonal

8. Find the points on the surface $z^2 = xy + 1$ that are nearest to the origin

9. Find the orthogonal trajectories of the family of cardioids $r = a(1 - \cos\theta)$

10. A generator having emf 100 volts is connected in series with a 10 ohm resistor and an inductor of 2 henries. If the switch is closed at a time t = 0, find the current at time t >0

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Chairman Board of Studies
(**Mathematics**)

| BS | 20BSX21 Engineering Chemistry | | 3 | 0 | 0 | 3 |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX21.1	Demonstrate the corrosion prevention methods and factors affecting corrosion	3	1	L1, L2
20BSX21.2	Explain the preparation, properties, and applications of thermoplastics & thermosetting plastics, elastomers & conducting polymer	3	1	L1, L2
20BSX21.3	Explain calorific values, octane number, refining of petrol and cracking of oils	3	1	L1, L2
20BSX21.4	Explain the manufacturing of Portland cement and concrete formation	3	1	L1, L2
20BSX21.5	Summarize the application of SEM, TEM and X-ray diffraction in surface characterization	3	1	L1, L2
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create. DoK: Depth of Knowledge			

Unit I: Water and its Treatment   11 + 1 Hour
Introduction –Soft Water and hardness of water, Determination of hardness of water by EDTA Method - Boiler troubles - scale and sludge, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards(BIS) and World health organization(WHO) standards, zeolite and ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electro dialysis

Advanced Water Technology, Types of Hardness of Water, Internal Treatment, Caustic Embritilliment, Break Point Chlorination

Unit II: Electrochemical Cells and Corrosion and its Prevention   11 + 1 Hour
Single electrode potential, electrochemical series and uses of series, standard hydrogen electrode, calomel electrode, construction of glass electrode, batteries (Dry cell, Li ion battery and zinc air cells), fuel cells (H_2-O_2, CH_3OH-O_2, phosphoric acid and molten carbonate).
Corrosion: Definition, theories of corrosion (chemical and electrochemical), galvanic corrosion, differential aeration corrosion, stress corrosion, galvanic series, factors influencing rate of corrosion, corrosion control (proper designing and cathodic protection), Protective coatings (surface preparation, cathodic coatings, anodic coatings, electroplating and electroless plating (nickel), Paints (constituents, functions and special paints)

Fundamentals and Applications of Electrochemistry, Nano Electrochemical Sensor, Storage Cells, Advanced Corrosion Protective Coatings

Unit III: Chemical Energy Sources   11 + 1 Hour
Fuels: Introduction, calorific value, higher calorific value, lower calorific values, problems using Dulong's formula, proximate and ultimate analysis of coal sample and their significance, numerical problems, petroleum (refining-cracking), synthetic petrol (Fischer Tropsch and Bergius), petrol knocking, diesel knocking, octane and cetane ratings, anti-knocking agents, Introduction to alternative fuels (Bio-diesel, ethanol, methanol, natural gas, liquefied petroleum gas, compressed natural gas), Flue gas analysis by Orsat apparatus, rocket fuels

Advanced Fuel Technology, Bio Fuels, Biogases, Advanced Techniques of Synthetic Petrol, Propellants

Unit IV: Engineering Materials   11 + 1 Hour
Plastics and Polymers: Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth and coordination polymerization, Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of PVC and Bakelite
Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils and Applications

Building materials- Portland cement, constituents, phases and reactivity of clinker, Setting and Hardening of cement

Advanced Polymer Characterizations, Homo and Heterogeneous Methods, Natural Polymer, Designs Building Materials

Unit V: Surface Chemistry and Nanomaterials   11+1 Hour

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (any two methods with examples), chemical and electrochemical methods (not more than two methods) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, characterization of surface by physicochemical methods (SEM, TEM, X-ray diffraction), solid-gas interface, solid-liquid interface, adsorption isotherm, BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors

Advanced Colloids Techniques, Optical Methods, Nano Techniques, Nano Sensors, Advanced Surface Technology

Text Books

1. Jain and Jain, "Engineering Chemistry", 16th Edition, Dhanpatrai Publications, 2013
2. Peter Atkins, Julio de Paula and James Keeler, Atkins "Physical Chemistry", 10th Edition, Oxford University Press, 2010
3. Rajaram R. and Kuariacose J. "Chemistry in Engg. &Technology" Volume 2, 2014
4. Robert J. Silbey, Robert A Alberty and Mounngi G Bawendi, "Physical chemistry" Wiley, 2004

Reference Books

1. Taylor H. F. W., "Cement Chemistry", 2nd edition, Thomas Telford Publications, 1997
2. Shaw D. J., "Introduction to Colloids and Surface Chemistry" Butterworth-Heineman,1992
3. Skoog and West, "Principles of Instrumental Analysis", 6th Edition, Thomson, 2007

Web References

1. http://link.springer.com/chemistry
2. http://www.thphys.chemistry.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define brackish water
2. Write the structure of EDTA
3. What is a polymer?
4. What is meant by degree of polymerization?
5. Define thermoplastic polymers and give two examples
6. What is primary Battery?
7. What are single electrode potentials?
8. What is Reverse Osmosis?
9. Define adsorption
10. How to prepare nanomaterial?

L2: Understand

1. Explain the free radical polymerization mechanism
2. Differentiate between addition polymerization and condensation polymerization
3. Explain the standard electrode potential by taking calomel electrode as an example
4. Write the construction & working of hydrogen-oxygen fuel cell
5. Demonstrate one or two applications of Zinc-air cell with chemical equations
6. By which methods, the underground pipelines are protected from corrosion? Explain the involved mechanisms
7. Explain with a neat sketch the various steps involved in municipal solid wastewater treatment
8. Explain various factors influencing the rate of corrosion
9. Explain electrochemical theory of corrosion
10. Explain preparation of any two methods of nanomaterial

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Chairman
Board of Studies (Chemistry)

| **ES** | **20ESX01 Engineering Drawing** | | | | | **1** | **0** | **4** | **3** |

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

Code	Course Outcomes	Mapping with POs				DoK
		PO1	PO5	PO10	PO12	
20ESX01.1	Apply BIS standards and conventions while drawing Lines, curves, polygons and scales.	3	3	3	1	L1, L2, L3, L4
20ESX01.2	Classify the systems of projection of points and Lines with respect to the observer, object and the reference planes	3	3	3	1	L1, L2, L3, L4
20ESX01.3	Classify the systems of projection of planes and solids with respect to the observer, object and the reference planes	3	3	3	1	L1, L2, L3, L4
20ESX01.4	Construct orthographic views of an object when its position with respect to the reference planes is defined	3	3	3	1	L1, L2, L3, L4
20ESX01.5	Construct 2D (orthographic) and 3D (isometric) views in CAD environment	3	3	3	1	L1, L2, L3, L4
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos						
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create, DoK: Depth of Knowledge						

Unit I: Introduction of Geometrical Constructions   10 Hours
Overview of the course: Types of lines, Lettering and Dimensioning. Geometrical Constructions of Polygons: Constructing regular polygons by general methods, Inscribe and Circumscribe polygons. Curves: Ellipse, Parabola and Hyperbola by general and special methods, tangent and normal for the curves. Scales: Plain scales, diagonal scale and venires scale.

Involutes, Cycloids, Epi-Cycloids and Hypo-Cycloids

Unit II: Introduction of Orthographic Projections   10 Hours
Reference plane and planes projections. Projections of Straight lines: line parallel to both the planes, line inclined to one plane and parallel to other plane and line inclined to both the planes. Determination of true lengths, angle of inclination and traces.

Principle of Auxiliary Plane

Unit III: Projections of Planes   10 Hours
Planes parallel / Perpendicular to one reference plane and inclined to the other and inclined to both the reference planes.

Projection of Plane Surface using Auxiliary Planes

Unit IV: Projections of Solids   10 Hours
Prisms, Pyramids, Cones and Cylinders with the axis inclined to both the planes.

Auxiliary Projections of solids, Sectional Views

Unit V: Conversion of Views   20 Hours
Part A: Conversions of isometric to orthographic views; Conversion of orthographic to isometric views.
Part-B: Auto-CAD Practice: Introduction To Auto-CAD, DRAW Tools, MODIFY Tools, TEXT, DIMENSION And PROPERTIES.

Note: In the End Examination there will be no question from PART-B

Development of Surfaces

Text Books

1. Bhatt N. D., "Engineering Drawing", 53rd Edition, Chariot Publications, 2018
2. Agarwal and Agarwal, "Engineering Drawing", 3rd Edition Tata McGraw Hill Publishers, 2017
3. Sham Tickoo, "AutoCAD 2017", Engineers & Designers", 23rd Edition, Dreamtech Press, 2016

Reference Books

1. Narayana K. L. and Kannaiah P., "Engineering Drawing", 5th Edition, Scitech Publishers, 2017
2. John K .C., "Engineering Graphics for Degree", PHI Publishers, 2018
3. Varghese P. I., "Engineering Graphics", McGraw Hill Publishers, 2013
4. Venugopal K. Prabhu Raja V., "Engineering Drawing + AutoCad", 5th Edition, New Age Publications, 2011

Web References

1. https://nptel.ac.in/courses/112/103/112103019/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	-	10
L2	20	20
L3	60	30
L4	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Divide a straight line AB of 60 mm long into eight numbers of equal parts
2. How to draw an Octagon given the length of side 25 mm?
3. Find an equilateral triangle of 75 mm side and inscribe a circle in it
4. Label a regular pentagon about a circle of 100 mm diameter
5. How a point P does is 20 mm below HP and lies in the third quadrant?

L2: Understand

1. Construct a cycloid given the radius of the generating circle is 30 mm. Also draw a tangent and normal at any point on the cycloid
2. A line AB is on HP and its one end A is 20 mm in front of VP. The line makes an angle of 45° with VP and its front view is 60 mm long. Draw the projections of the line and determine the true length
3. A regular hexagon of 40 mm side has a corner in the HP. Its surface inclined at 45° to the HP. and the top view of the diagonal through the corner which is in the HP. makes an angle of 60° with the VP. Demonstrate its projections
4. A pentagonal pyramid has an edge of the base in the VP and inclined at 30° to the HP, while triangular face containing that edge makes an angle of 45° with the VP. Illustrate the three views of the pyramid. Length of side of the base is 30 mm, while that of the axis is 65 mm
5. A square pyramid, side of 35 mm and axis 55 mm is resting on HP. Extend its projections when all the sides of the bases equally inclined to VP

L3: Apply

1. The major axis of an ellipse is 130 mm and the minor axis is 80 mm long. Find the foci and draw the ellipse by arcs of circles method. Draw a tangent to the ellipse at a point on it 25 mm above the major axis

2. A thin circular plate of 45 mm diameter with its center 35 mm above HP and 40 mm in front of VP is perpendicular to VP and inclined to HP at angle of 30°. Develop the projections of the plate

3. A square pyramid of base 40 mm and height 60 mm is on HP with one of its base edges so that the axis is making 45^0 with HP and the base edge making 30° with VP. Construct the projections

4. Construct a scale of 1.5 inches =1 foot to show inches and long enough to measure up to 4 feet
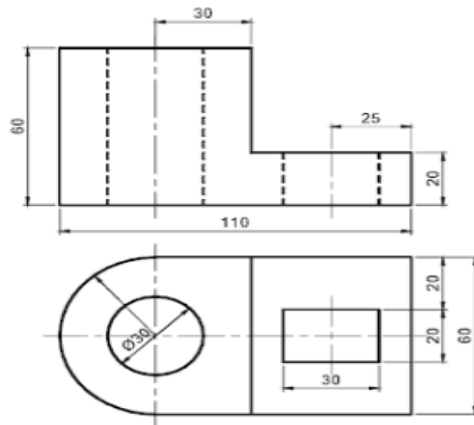
5. Build the Isometric view
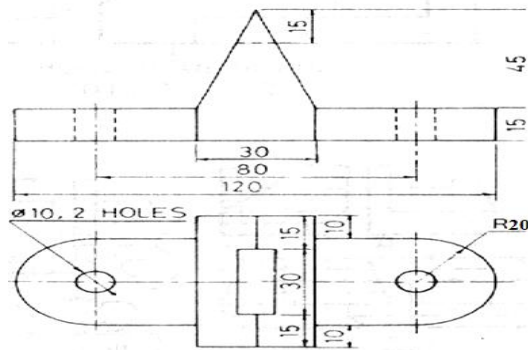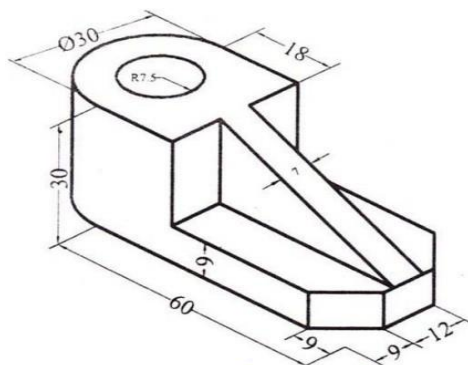
L 4: Analyze

1. Examine (i) Front View (ii) Top View (iii) Side View
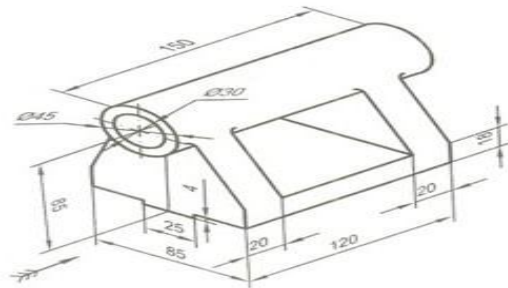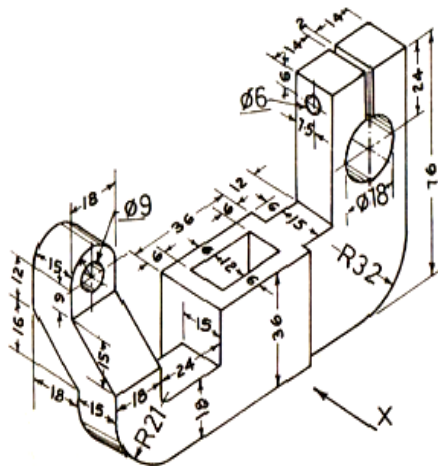

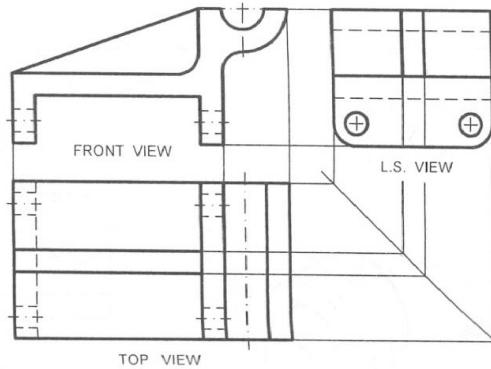2. Analyze the front and top views of an object and Construct the isometric view

3. Draw the three orthographic views

4. Draw (i) Front View (ii) Top View (iii) Left Hand Side View

5. Draw the Isometric view assuming suitable data

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Chairman
Board of Studies (ME)

| ES | **20ESX02 Programming for Problem Solving Using 'C'** | 3 | 0 | 0 | 3 |

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

Code	Course Outcomes	Mapping with POs PO1	PO12	DoK
20ESX02.1	Demonstrate the process of problem-solving using algorithm, pseudo code and flowchart	3	1	L1, L2, L3
20ESX02.2	Demonstrate conditional and iterative statements to write programs	3	1	L1, L2, L3
20ESX02.3	Illustrate the use of arrays and strings	3	1	L1, L2, L3
20ESX02.4	Describe and use pointers & functions	3	1	L1, L2, L3
20ESX02.5	Understand and apply the file manipulation functions to handle data files	3	1	L1, L2, L3

1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge

Unit I: Introduction to Problem Solving and Programming   11 + 1 Hour
Introduction to Problem Solving: Problem Solving Aspect, Top-down Approach, Algorithm, Flowchart, Pseudo code. Programming Fundamentals: C Language: Character set, C tokens – Data types, Identifiers, Keywords, Variables, Operators, Expressions, Precedence, Associatively, Type Conversion; Structure of C program: Program Development Process, Creating and Executing C Program, Input/output functions: Statements

Size of Operator, Escape Sequences

Unit II: Bitwise Operators, Conditional Branching and Loops   11 + 1 Hour
Bitwise Operators: Exact Size Integer Types, Logical Bitwise Operators, Shift Operators, Tips and Common Programming Errors, Key Terms, Summary, Practice Set. Control Structures: Declaration, expression, control flow statements–Branching– if, if-else, if-else-if ladder, nested if, switch-case, Loop control – while, do-while, for; goto, Continue, Break, Exit Statements. Storage classes-extern, auto, register, static, scope rules, example C programs

Nested Loop Control Structures

Unit III: Arrays and Functions   11 + 1 Hour
Arrays: Definition, declaration, accessing elements, storing elements, 2-Darrays, Multi dimensional arrays, Strings and string manipulations. Functions: Standard Library Functions: User Defined Functions-Function prototypes, Function definition, Function call, Example Programs, Passing Parameters-Call by value

Macros

Unit IV: Pointers and Structures   11 + 1 Hour
Pointers: Definition, Pointer Compatibility, Dynamic Memory Allocation, Pointer Arithmetic, Arrays and Pointers, Array of pointers, Pointers and Functions, Call by reference. Structure: Definition, Declaration, Initialization, Nested structures, Array of structures, Self-Referential Structures, Enumerated Data type, Structures and Functions, Structures and Pointers, Union

Pointers to Pointers

Unit V: Files   11 + 1 Hour
Files: Types of files, Modes of Operations, File input and output, File Handling Functions, Random Access Functions, Command Line Arguments, Preprocessor Directives

Error Handling Functions

Text Books
1. Byron Gottfried, "Programming with C", 3rd Edition, Tata McGraw Hill, 2017
2. Herbert Schildt, "C The Complete Reference", 4th Edition, TMH, 2017

3. Dromey R .G., "How to solve it by Computer", Pearson Education India, 2008

Reference Books
1. Kanetkar Y., "Let us C", 8th Edition, BPB Publication, 2004
2. ISRD Group, "Programming and Problem Solving Using C", Tata McGraw Hill, 2008
3. Prasad F. E. V., "C Programming: A Problem-Solving Approach", Giliberg, Cengage Learning, 2010
4. Balagurusamy E., "Programming in ANSI C" , 3rd Edition, TMH, 2004

Web References
1. https://www.geeksforgeeks.org/c-programming-language
2. https://www.tutorialspoint.com/cprogramming/index.html
3. https://www.javatpoint.com/c-programming-language-tutorial

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	20
L2	30	40
L3	40	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What do you mean by flowchart? What are the components in the flowchart and explain with example?
2. List the steps involved in creating and running a C program
3. What are various storage classes in C? Discuss their uses and scope?
4. What is string? Explain about declaration and initialization of string in C. How strings are displayed with different formats with examples?
5. Write a C program to copy one string to another
6. Write a C program to read and display the content of a file
7. What is recursive function? What are the constraints for defining a recursive function with an example?
8. Why switch statement is more advantageous than nested if-else statement
9. What is meant by a variable in C programming? How a variable is initialized? What are the rules of defining c variable name? Give an example?
10. Write a c program to count number of vowels and consonants in a string using pointers

L2: Understand

1. Explain about enumerated types with example
2. Explain counter controlled and exit controlled loops with examples
3. Write a program to compare2 strings for equality without using strcmp() function
4. What is string? Demonstrate about declaration and initialization of string in C. How strings are displayed with different formats? Explain with examples?
5. Illustrate a C program to find the sum of first and last digit of a number
6. Illustrate a C program to merge two files into single file
7. Explain different looping statement with syntax and example
8. Classify looping statement with syntax and example
9. Explain function prototype and explain different methods to call the function
10. Explain in detail about array of structure and pointer to structure with example
11. Discuss the usage of bitwise logical operators used in C? Compare them from logical operators with suitable program
12. Explain about call by value and call by reference with reference to functions with example
13. Explain the term dynamic memory allocation and the terms malloc(), calloc() and realloc() functions

L3: Apply

1. Write a C program to check whether the given number is palindrome or not
2. Write a C program to solve the factorial of a given number using for loop

3. Write an algorithm, flowchart and pseudo code to identify largest of given 3 numbers using conditional operator
4. Write a C program to perform the operation of multiplication of two matrices
5. Write a C program to interchange the largest and smallest elements in an array
6. Write a C program by applying pointers to count number of vowels and consonants in a string
7. Write a C program to select any arithmetic operations using switch cases
8. Write a C program to find given number is Armstrong or not
9. Write a C program to check whether the given string is palindrome or not
10. List File handling functions. Utilize file handling functions with an example

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Chairman
Board of Studies (CSE)

HS **20HSX02 Communicative English Lab**   **0   0   3   1.5**

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

Code	Course Outcomes	Mapping with POs	
		PO10	PO12
20HSX02.1	Developed better understanding nuances of English Language through audio – visual experience and group activities	3	3
20HSX02.2	Learnt to use neutralization of accent for intelligibility	3	3
20HSX02.3	Improved communicative competence that include clarity and confidence which in turn enhances their employability skills and ability to communicate in formal and informal situations	3	3
20HSX02.4	To Cultivate communicative Competence	3	3
20HSX02.5	To make them ready for Industry	3	3
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos		

List of Experiments

1. Understand: Listening Skill- Its importance – Purpose – Process – Types - Barriers
   Practice: Introduction to Phonetics – Speech Sounds – Vowels and Consonants – Minimal Pairs - Consonant Clusters
2. Understand: Spoken vs Written language - Formal and Informal English
3. Practice: Ice - Breaking Activity and JAM Session - Dialogues – Greetings – Taking Leave – Introducing Oneself and Others
4. Understand: Structure of Syllables – Word Stress – Sentence Stress – Intonation
5. Practice: Basic Rules of Word Accent - Stress Shift - Sentence Stress – Intonation
6. Understand: Features of Good Conversation – Strategies for Effective Communication. Practice: Situational Dialogues – Role-Play - Expressions in various Situations
7. Understand: Descriptions- Picture Description - Story Narrations - Giving Directions. Practice: Giving Instructions – Seeking Clarifications– Making Suggestions, Describing people, places and things
8. Understand: Public Speaking – Exposure to Structured Talks – Non-verbal Communication-Presentation Skills
9. Practice: Making a short speech – Extempore - Making a Presentation
10. Understand: Group Discussion - Interview Skills. Practice: Participation in Group Discussion and Mock Interviews

References

1. Lab Manual for Communicative English, Department of Basic Science and Humanities, NSRIT

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Chairman
Board of Studies (English)

| BS | **20BSX22 Engineering Chemistry Lab** | | **0** | **0** | **3** | **1.5** |

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20BSX22.1	Estimate of Vitamin-C	3	3	1
20BSX22.2	Determine the cell constant and conductance of solutions	3	3	1
20BSX22.3	Prepare advanced polymer materials	3	3	1
20BSX22.4	Calculate the hardness of water	3	3	1
20BSX22.5	Determine the functioning of the instruments such as pH and Potentiometric meters	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Determination of HCl using standard Na_2CO_3 solution (Acid-Base Titration)
2. Determination of Mn using standard oxalic acid solution (Redox Titration)
3. Determination of ferrous iron using standard $K_2Cr_2O_7$ solution (Redox Titration)
4. Determination of copper (II) using standard hypo solution (Iodimetric Titration)
5. Determination of temporary and permanent hardness of water using standard EDTA solution
6. Determination of iron (III) by a colorimetric method
7. Estimation of Vitamin C
8. Determination of the concentration of acetic acid using sodium hydroxide (pH-metry method)
9. Determination of the concentration of strong acid vs strong base (by Conductometric method)
10. Determination of strong acid vs strong base (by Potentiometric method)
11. Determination of Viscosity of lubricating oil by Red Viscometer
12. Determination of percentage Moisture content in a coal sample
13. Determination of acid value and saponification value of a given lubricant
14. Adsorption of acetic acid by charcoal
15. Preparation of a polymers: Nylon-6,6 and phenol-formaldehyde (Bakelite)
16. Preparation of Nanomaterials (ex: Fe/ Zn/ Ferrite)

Text Books

1. Arthur J Vogel, "A Textbook of Quantitative Analysis", 2nd Edition, 1909

References

1. Mendham J., Denney R. C., Barnes J. D., Thosmas M. and Sivasankar B., "Vogel's Quantitative Chemical Analysis" 6th Edition, Pearson Publishers, 2000
2. Bhasin N. K. and Sudha Rani, "Laboratory Manual on Engineering Chemistry" 3rd Edition, Dhanpat Rai Publishing Company, 2007
3. Lab Manual for Applied Chemistry, Department of Basic Science and Humanities, NSRIT, 2017

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Chairman
Board of Studies (Chemistry)

ES **20ESX07 Programming for Problem Solving Using 'C' Lab**   0   0   3   1.5

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20ESX07.1	Demonstrate the process of problem-solving using algorithm, pseudo code , flowchart, Compile and Debug programs	3	3	1
20ESX07.2	Summarize the concepts of control statements, pointers & functions and solvethe problem using C programming	3	3	1
20ESX07.3	Implement the concepts of Arrays, Strings & functions	3	3	1
20ESX07.4	Demonstrate the use of Pointers & Structures	3	3	1
20ESX07.5	Demonstrate the use of Files	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Demonstrate to usage of computer system, installation of operating systems
2. Write programs to illustrate the usage of operators and input-output statements
3. Write programs to demonstrate the use of selective flow control statements
4. Write programs to demonstrate the use of loop control statements
5. Write programs to demonstrate the use of one-dimensional arrays
6. Write programs to demonstrate the use of multi-dimensional arrays
7. Write programs to demonstrate the usage of strings
8. Write programs to demonstrate the usage of user-defined functions
9. Write programs to demonstrate the usage of structures and array of structures
10. Write programs to demonstrate the usage of pointers
11. Write programs to demonstrate the usage of files

References

1. Lab Manual for Programming for Problem Solving using 'C', Department of Computer Science and Engineering, NSRIT

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Chairman
Board of Studies (CSE)

BS **20BSX12 Partial Differential Equations and Vector Calculus**   **3   1   0   3**

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20BSX12.1	Solve linear and non linear partial differential equations	3	1	L1, L2, L3
20BSX12.2	Identify solution methods for second and higher order partial differential equations	3	1	L1, L2, L3
20BSX12.3	Find double, triple integrals and improper integrals using Beta-Gamma functions	3	1	L1, L2, L3
20BSX12.4	Apply Gradient, Divergence, Curl and Laplacian to various functions of several variables	3	1	L1, L2, L3
20BSX12.5	Apply Greens, Stokes and Gauss divergence theorems to calculate line ,surface and volume integrals	3	1	L1, L2, L3
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create. DoK: Depth of Knowledge			

Unit I: Partial Differential Equations of First Order   **11 + 1 Hour**

Formation of Partial Differential Equations by Elimination of Arbitrary Constants and Arbitrary Functions; Solutions of First Order Linear Equation by Lagrange's Method and Non-Linear Equations of Standard Types

Solution of Equation by Direct Method, Charpit's Method

Unit II: Second Order Partial Differential Equations   **11 + 1 Hour**

Second Order PDE: Solutions of Homogenous and Non-Homogeneous Linear Partial Differential Equations with Constant Coefficients – RHS term of the type e^{ax+by} , Sin(ax+by), Cos(ax+by), $x^m y^n$; Classification of Second Order Partial Differential Equations - Method of Separation of Variables

Monge's Method, Classification of One Dimensional Wave, Heat and Two-Dimensional Laplace Equation

Unit III Gamma, Beta Functions and Multiple Integrals   **11 + 1 Hour**

Gamma, Beta Functions and their Properties - Relation between Beta and Gamma Functions - Evaluation of Improper Integrals. Multiple Integrals: Double Integrals - Change of Variables- Change of Order of Integration - Triple Integrals - Change of Variables.

Area and Volume using Double and Triple Integral

Unit IV: Vector Differentiation   **11 + 1 Hour**

Gradient – Divergence - Curl –Potential function - Laplacian and Second Order Operators - Vector Identities (Without Proof).

Geometrical meaning of Gradient, Physical Interpretation of Divergence and Curl

Unit V: Vector Integration   **11 + 1 Hour**

Line Integral, Surface and Volume Integrals, Vector Integral Theorems (without proof) - Green's, Stoke's and Gauss Divergence Theorems.

Green's, Stoke's and Gauss Divergence Theorems with Proofs

Text Books

1. Grewal B. S., "Higher Engineering Mathematics", 44th Edition, Khanna Publishers, 2018
2. Ramana B. V., "Higher Engineering Mathematics", Tata McGraw Hill Education, 2018

Reference Books

1. Erwin Kreyszig, "Advanced Engineering Mathematics", 10th Edition, Wiley, India, 2015
2. Bali N. P., "Engineering Mathematics", 22th Edition, Lakshmi Publications, 2018
3. Peter O' Neil," Advanced Engineering Mathematics", 8th Edition, Cengage Publications, 2017
4. Iyenger T. K. V., Dr. Prasad M. V. S. S. N., Ranganatham S. and Krishna Gandhi B., "Engineering Mathmematics III", 2nd Edition, S. Chand Publications, 2020

Web References

1. http://nptel.ac.in/courses/
2. https://onlinecourses.nptel.ac.in
3. https://nptel.ac.in/courses/111/108/111108144/
4. https://ocw.mit.edu/courses

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	50	50
L3	30	30
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define PDE
2. Solve the PDE z=px+qy-2$\sqrt{\mathbf{pq}}$
3. Solve (D²-2DD¹+1)z=0
4. Find P.I of (D²-DD¹+D¹-1)z= e^{x+y}
5. Define Gamma and Beta function

L2: Understand

1. Solve (D²-DD1+D1-1)z= cos(x+2y)+ey-x
2. Solve $\dfrac{\partial u}{\partial x} = 2\dfrac{\partial u}{\partial t} + u$ where $u(x,0) = 6e^{-3x}$ by the method of separation of variables
3. Find the directional derivative of the function $\emptyset = \mathbf{xy^2 + yz^3}$ at the point (2,-1,1) in the direction of the normal to the surface $\mathbf{xlogz - y^2 + 4 = 0}$ at (-1,2,1)
4. If F=x²yz,G= xy⁻³z² Then find div(grad F x grad G)
5. Find $\iint \bar{\mathbf{f}}.\bar{\mathbf{n}}\,\mathbf{ds}$ if $\mathbf{F = xy\bar{\imath} + z^2\bar{\jmath} + 2yz\bar{k}}$ over the tetrahedron bounded by x=0, y=0, z=0 and the plane $\mathbf{x + y + z = 1}$

L3: Apply

1. Solve $(\mathbf{1 + q})\mathbf{p = qz}$
2. Solve $\mathbf{z^2}\,({}\mathbf{p^2x^2 + q^2}\,) = \mathbf{1}$
3. Find the area of the circle using double integral
4. Find by double integration the area lying between the curve $\mathbf{y = x^2 - 2x - 8}$
5. Evaluate by Gauss divergence theorem $F = (x^3 - yz)$i− 2 x²y J− z K taken over the surface of the cube formed by the planes $x = y = z = a$

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Chairman Board of Studies
(Mathematics)

BS **20BSX31 Engineering Physics**   3   1   0   3

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

Code	Course Outcomes	Mapping with POs			DoK
		PO1	PO3	PO12	
20BSX31.1	Illustrate the experimental evidence of wave nature of light and interference in thin films, Diffraction Grating and Polarization	3	1	1	L1, L2
20BSX31.2	Classify various types of Lasers & Optical Fibres	3	1	1	L1, L2
20BSX31.3	Explain the concepts and applications of Magnetic and Dielectric materials	3	1	1	L1, L2
20BSX31.4	Summarize the acoustic properties in buildings and use of Ultrasonics in flaw detection	3	1	1	L1, L2
20BSX31.5	Interpret the crystal structures and XRD techniques	3	1	1	L1, L2
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create, DoK: Depth of Knowledge					

Unit I: Wave Optics   11 + 1 Hour
Interference: Introduction**,** Interference in Thin Films by Reflection – Newton's Rings (Theory, Experimental Study), Applications (Wave Length of a Source and Refractive Index of a Liquid). Diffraction: Concept of Diffraction Difference between Fresnel's and Fraunhofer Diffraction - Fraunhofer Diffraction at Single Slit (Quantitative) , Diffraction at Double Slit(Qualitative) Diffraction Grating. Raleigh's Criteria, Resolving Power of Grating. Polarization: Types of Polarization, Polarization by Reflection, Refraction and Double Refraction – Nicol's Prism Construction and Working Wave Plates: Half Wave Plate and Quarter Wave Plate.

Concepts of Ray Optics, Young's Double Slit Experiment, Circular Aperture - Airy's Correction, Transverse Nature of Light by Polarization

Unit II: Lasers & Fiber Optics   11 + 1 Hour

Laser: Concept of Laser, Characteristics of Laser, Spontaneous and Stimulated Emission of Radiation, Einstein's Coefficients, Pumping Mechanisms, Ruby Laser, Helium Neon Laser - Applications of Laser. Fiber Optics: Introduction to Optical Fiber, Principle and Structure of Optical Fiber, Classification of Optical Fibers (Based on Modes and Refractive Index Profile). Acceptance Angle, Acceptance Cone Numerical Aperture - Applications of Optical Fiber.

Concepts of MASER, Working of 3 Level and 4 Level LASER Systems, Principles of Light

Unit III: Magnetic materials & Dielectric materials   11 + 1 Hour
Magnetic Materials: Introduction, Magnetic Dipole Moment ,Magnetic Susceptibility - Magnetic Permeability – Classification of Magnetic Materials – Dia, Para, Ferro, Weiss Domain Theory (Qualitative) Hysteresis Curve, Soft And Hard Magnetic Materials – Applications, Dielectric Materials: Dielectric Polarization – Dielectric Polarizability, Susceptibility and Dielectric Constant - Types of Polarizations: Electronic, Ionic and Orientational Polarizations (Qualitative), Lorentz Internal Field, Claussius - Mossoti Equation - Applications of Dielectrics.

Basic Definitions of Magnetism, Curie's Law, Curie - Weiss Law, Relation bBetween D, E and P, Dielectric Losses

Unit IV: Acoustics & Ultrasonics   11 + 1 Hour
Acoustics: Introduction – Reverberation - Reverberation Time - Sabine's Formula (Derivation using Growth and Decay Method)–Absorption Coefficient and its Determination- Factors Affecting Acoustics of Buildings and their Remedies. Ultrasonics: Production of Ultrasonics by Magneto Striction and Piezoelectric Methods, Non - Destructive Testing (NDT) - Pulse Echo System through Transmission and Reflection Modes – Applications of NDT.

Principles of Sound Waves, Propagation of Sound Waves, Acoustic Spectrum

Unit V: Crystallography & X-Ray Diffraction   11 + 1 Hour
Crystallography: Introduction, Space Lattice, Basis, Unit Cell, Bravais Lattices – Crystal Systems – Structures and Packing Fractions of SC, BCC And FCC. X-Ray Diffraction Directions and Planes in Crystals – Miller Indices – Separation between Successive (H K L) Planes – Bragg's Law. Bragg's Spectrometer, X-Ray Diffraction Methods (Powder and Laue).

Types of Solids, Concept of Brillouin Zones, Diffraction Techniques

Text Books

1. Dekker A. J., "Solid State Physics", 1st Edition, McMillan India Ltd., 2000
2. Avadhanulu M. N. & Kshirasagar P. G., "A Text Book of Engineering Physics", 1st Edition, S. Chand Publications, 2011
3. Palanisamy P. K., "Engineering Physics", 4th Edition, SciTech Publishers, 2014
4. Srinivasan M. R., "Engineering Physics", 2nd Edition, New Age International Publishers, 2014

Reference Books

1. Charles Kittle, "Introduction to Solid State Physics", 5th Edition, Wiley India Pvt. Ltd., 2012
2. Arumugam M., "Applied Physics", 4th Edition, Anuradha Agencies, 2013
3. Bhattacharya D. K., "Engineering Physics", 2nd Edition ,Oxford University Press, 2010
4. Sanjay D. Jain and Girish G. Sahasrabudhe, "Engineering Physics", 1st Edition, University Press, 2010
5. Pandey B.K. and Chaturvedi S., "Engineering Physics", 1st Edition ,Cengage Learning, 2012
6. Robert Resnick, Jearl Walker, David Halliday "Principles of Physics", 10th Edition, Wiley, 2015
7. Gour R .K. and Gupta S. L., " Engineering Physics", Dhanpat Rai Publications, 2011

Web References

1. http://link.springer.com/physics
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com
5. https://nptel.ac.in

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	50	50
L2	50	50
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. Define pinciple of Superposition
2. Define types of polarization
3. State Dielectric polarization and Dielectric polarizability
4. What are Newton's rings? How are they formed?
5. What is meant by diffraction of light?

L2: Understand

1. Explain the construction and working principle of Nicol's prism
2. Demonstrate working principle of Ruby laser with energy level diagram
3. Outline De Broglie concept of matter waves
4. Discuss polarization by reflection
5. Explain the pumping mechanisms of lasers

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Chairman
Board of Studies (Physics)

ES **20ESX05 Basic Electrical and Electronics Engineering**   3   1   0   3

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20ESX05.1	Apply Network laws to Electrical cCrcuits, and solving A.C. Networks	3	1	L1, L2, L3
20ESX05.2	Explain the working of D.C. Machines	3	1	L1, L2
20ESX05.3	Illustrate the working of Alternators and Induction Motor	3	1	L1, L2, L3
20ESX05.4	Interpret the working of a Transformer and its operation in different conditions	3	1	L1, L2, L3
20ESX05.5	Classify basic operation of Rectifiers and Integrated Circuits operate for different applications	3	1	L1, L2, L3
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create. DoK: Depth of Knowledge			

Unit I: Introduction to Electric Circuits   11 + 1 Hour
Basic Definitions, Electrical Circuit Elements (R, L And C), Ohm's Law, Voltage and Current Sources, Series & Parallel Circuits, Kirchhoff's Laws, Star-Delta and Delta-Star Transformations, Simple Problems with D.C. Excitation
A.C. Circuits: Representation of Sinusoidal Waveforms, Peak and Rms Values, Phasor Representation, Analysis of Single-Phase A.C. Circuits Consisting of R, L, C, RL, RC, RLC Combinations (Series Only), Real Power, Reactive Power, Apparent Power, Power Factor, Sample Problems.

Real Time Applications of D.C. and A.C. Circuits, Source Transformation, Concept of Impedance and Reactance

Unit II: D.C. Machines   11 + 1 Hour
Generator-Principle of Operation, Construction, E.M.F. Equation, Classification, O.C.C, Internal and External Characteristics of Shunt Generator, Motor-Principle of Operation, Torque Equation, Speed Control Methods, Brake Test on D.C. Shunt Motor, Swinburne's Test on D.C. Shunt Machine, Operation of 3 Point Starter.

Electromechanical Energy Conversion, Application of Generators in Domestic Purposes, Application of Motors in Toys

Unit III: A.C. Machines   11 + 1 Hour
Alternators: Construction and Induced EMF, Voltage Regulation by Synchronous Impedance Method (Simple Problems).
Induction Motors: Principle of Operation of 3-Φ Induction Motor, Power and Torque Equations, Speed-Torque Characteristics of 3- Φ Induction Motor.

Types of A.C. Machines, Application of Alternators, Application of Induction Motors

Unit IV: Transformers   11 + 1 Hour
Operation of a Single Phase Transformer, Construction Features of Single Phase Transformer, E.M.F. Equation, Losses, Regulation and Efficiency of a Single Phase Transformer, O.C. And S.C. Tests, Numerical Problems.

Application of Transformers in Substations, Step up and Step Down Transformers

Unit V: Rectifiers & Linear ICs   11 + 1 Hour
PN Junction Diodes – Diode Applications (Half Wave and Bridge Rectifiers), Zener Diode, Characteristics of Operation Amplifiers (OP-AMP) – Application of OP-Amps (Inverting, Non-Inverting, Integrator and Differentiator) - Numerical Problems.

Basic Semiconductor Devices, Thyristors, Advanced Applications of Operational Amplifiers

Text Books

1. Mehta V. K., "Principles of Electrical and Electronics Engineering", 2nd Edition S. Chand & Co., 2015
2. Kothari D. P. and Nagrath I. J., "Basic Electrical Engineering", 4th Edition, Tata McGraw Hill, 2010

Reference Books

1. Wadhwa C. L., "Basic Electrical Engineering", 4th Edition, New Age Publications, 2007

2. Kulshreshtha D. C., "Basic Electrical Engineering", 1st Edition, McGraw Hill, 2017
3. Naidu M. S. and Kamakshaiah S., "Introduction to Electrical Engineering", 2nd Edition, TMH Publications, 2017
4. Theraja B. L. and Theraja A. K., "Basic Electrical Engineering" 23rd Edition, S. Chand, 1959

Web References

1. https://nptel.ac.in/courses/108/108/108108076/
2. https://nptel.ac.in/courses/117/106/117106108/

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	10
L2	50	50
L3	30	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. What is Ohm's Law?
2. Define RMS and Peak values
3. What is Form Factor?
4. Define Time Period
5. What is the purpose of Commutator in D.C. Machines?

L2: Understand

1. Explain in detail about Kirchhoff's Current and Voltage Law
2. Explain working principle of D.C. Shunt Generator
3. Explain the operation of Single Phase Transformer
4. Explain Speed Torque characteristics of 3 Phase Induction Motor
5. Explain the VI characteristics of PN Junction Diode with neat diagram

L3: Apply

1. Three resistances 750 Ω, 600 Ω and 200 Ω are in parallel. The total current is 1 A. Determine the voltage applied and current in each branch
2. Using Δ-Y or Y-Δ conversion, find the current I in the circuit shown in figure
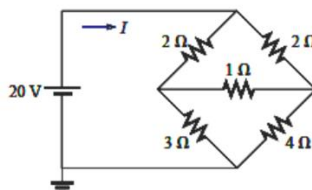
3. Determine the efficiency of a 15 KVA transformer for the following conditions:
   (i)full-load, unity power factor
   (ii) 0.8 full-load, unity power factor
   (iii) half full-load, 0.8 power factor
   Assume that iron losses are 200 W and the full-load copper loss is 300 W
4. A 3-phase star connected alternator is rated at 100 kVA. On short-circuit a field current of 50 amp gives the full load current. The e.m.f. generated on open circuit with the same field current is 1575 V/phase. Calculate the voltage regulation at (a) 0.8 power factor lagging, and (b) 0.8 power factor leading by synchronous impedance method. Assume armature resistance is 1.5 Ω

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Chairman
Board of Studies (EEE)

| ES | **20ESX04 Engineering Mechanics** | | **3** | **1** | **0** | **3** |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	PO12	
20ESX04.1	Draw free body diagrams for particles and rigid bodies in plane and space and problems to solve the unknown forces, orientations and geometric parameters	3	1	L1, L2
20ESX04.2	Explain the concepts of trusses and friction, direction and its application	3	1	L1, L2, L3
20ESX04.3	Identify the centroid, Centre of Gravity of composite figures and bodies, Determine area and mass movement of inertia for composite sections	3	1	L1, L2, L3
20ESX04.4	Apply the fundamental concepts of Kinematics and kinetics of particles to the analysis of simple, practical problems	3	1	L1, L2, L3
20ESX04.5	Find the motion of particles and rigid bodies and apply the principles of motion, work energy and impulse – momentum	3	1	L1, L2, L3
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create, DoK: Depth of Knowledge					

Unit I: Introduction, Equilibrium of Systems of Forces   11 + 1 Hour
Introduction to Engg. Mechanics, Basic Concepts. Systems of Forces: Coplanar Concurrent Forces, Components in Space, Resultant, Moment of Force and its Application, Couples and Resultant of Force Systems. Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical Method for the Equilibrium, Triangle Law of Forces, Converse of the Law of Polygon of Forces Condition of Equilibrium, Equations of Equilibrium for Spatial System of Forces, Numerical Examples on Spatial System of Forces.

Examples on Spatial System of Forces by using Vector Approach

Unit II: Trusses and Friction   11 + 1 Hour
Plane Trusses, Method of Joints, Method of Sections, Plane Frame, Method of Members, Friction: Introduction, Limiting Friction and Impending Motion, Coulomb's Laws of Dry Friction, Coefficient of Friction, Cone of Friction.

Applications of Friction and Study of Velocity and Acceleration in Automobile Area

Unit III: Centroid, Centre of Gravity, Area moments of Inertia, Mass Moment of Inertia   11 + 1 Hour
Centroid: Centroids of Simple Figures (From Basic Principles), Centroids of Composite Figures, Centre of Gravity: Centre of Gravity of Simple Body (From Basic Principles), Centre of Gravity of Composite Bodies, Pappus Theorems.
 Area Moments of Inertia: Definition, Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia. Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of Composite Bodies.

Radius of Gyration and its Analysis on System of Forces

Unit IV: Kinematics, Kinetics   11 + 1 Hour
Rectilinear and Curvilinear Motion of A Particle: Kinematics and Kinetics- Work Energy Method and Applications to Particle Motion- Impulse Momentum Method.

Radial and Tangential Flow of Particles Motion and its Study

Unit V: Work – Energy Method   11 + 1 Hour
Rigid Body Motion: Kinematics and Kinetics of Translation, Rotation about Fixed Axis and Plane Motion, Work Energy Method and Impulse Momentum Method.

Synthesis of Rigid Body and its Study

Text Books

1. Timoshenko S. and Young D. H., "Engineering Mechanics", 5th Edition. McGraw Hill Publications, 2013
2. Bavakatti S. S., "Engineering Mechanics Statics", 4th Edition, New Age International Publications, 2012
3. Tayal. A. K., "Engineering Mechanics Statics and Dynamics", 6th Edition, Umesh Publications, 2006

Reference Books

1. Kurmi R. S., "Engineering Mechanics Statics", 10th Edition, S. Chand Publications, 2005
2. Vijay Kumar Reddy K. and Suresh Kumar J., "Mechanics: Statics and Dynamics", 3rd Edition, B S Publications, 2010
3. Ferdinand P. Beer, Russell Johnston Jr. E., "Vector Mechanics for Engineers Statics and Dynamics", 9th Edition, McGraw Hill Publications, 2011

Web References

1. https://www.iitg.ac.in/rkbc/me101/Presentation/L01-03.pdf
2. https://drive.google.com/file/d/12V_O8G7OrSnZMiFDjrJhF5sOEbGXstkQ/view

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	20	20
L2	20	20
L3	60	60
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. State the conditions for equilibrium of a rigid body in three dimensions
2. What is the principle of transmissibility?
3. State the Parallel axis theorem
4. Define centroid and centre of gravity
5. State triangular law of forces. What is the use of this law?

L2: Understand

1. Explain Pappus theorem I & II
2. Differentiate between polar moment of inertia and product of inertia
3. Write impulse momentum equation
4. What is a rolling body? Explain its importance
5. Explain work-energy method for a plane motion

L3: Apply

1. Two forces of magnitude 50 N and 30 N are acting at a point. If the angle between the two forces is 60⁰, determine the magnitude and direction of the resultant force
2. A force has the components Fx = 100 N; Fy = 65 N; Fz = 80 N. Find the magnitude of the force and the angles θx ,θy and θz from the axes X, Y and Z respectively
3. A system of four forces acting on a body is shown in figure. Determine the resultant force and its direction
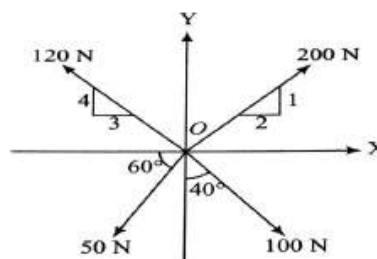
4. Two spheres each of 1000 N and of radius 25 cm rest in a horizontal channel of width 90 cm as shown in figure. Find the reaction at the point of contact A, B and C
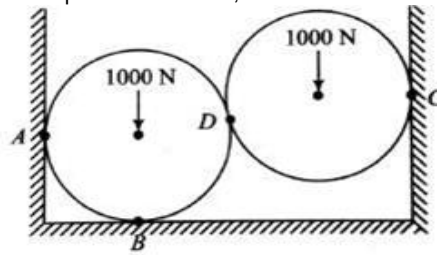
5. For the T - Section shown in figure, determine the moment of inertia of the section about the horizontal and vertical axes, passing through the centre of gravity of the section
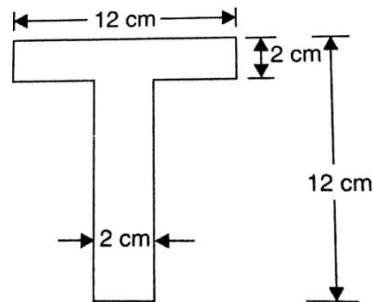
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Board of Studies (ME)

| ES | **20ME201 Computer Aided Engineering Drawing** | | | **1** | **0** | **4** | **3** |

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

Code	Course Outcomes	Mapping with POs					DoK
		PO1	PO5	PO10	PO12	PSO1	
20ME201.1	Get the sectional views for solid structures with the help of CAD software	3	1	1	1	-	L1
20ME201.2	Develop the intersection of solid structures with the help of CAD software	3	1	1	1	-	L2
20ME201.3	Systematize CAD commands to draft the isometric projections	3	2	2	1	2	L3
20ME201.4	Standardize CAD commands to Transmission of projections for Engineering components	3	2	2	1	2	L3
20ME201.5	Label the principles to draw the Perspective projections	3	2	2	1	2	L4
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective POs						
L1: Remember	L2: Understand	L3: Apply	L4: Analyze	L5: Evaluate	L6: Create DoK: Depth of knowledge							

Unit I: Development of Surfaces with Sectional View   12 Hours
AutoCAD: Introduction to AutoCAD: Geometrical Construction. Development of Surfaces with Sectional View: Sections and Sectional Views, Sections of Right Regular Solids, Prisms, Pyramids, Cylinders and Cones, Auxiliary Views, Development of Surfaces.

Development of Surfaces of Right Regular Solids Prisms, Pyramids, Cylinders and Cones

Unit II: Intersection of Solids   12 Hours
Intersection of Solids: Intersection of Prism versus Prism, Cylinder versus Prism, Cylinder versus Cylinder and Cylinder versus Cone.

Intersection of Solids with Front and Side Views

Unit III: Isometric Projections   12 Hours
Isometric Projections: Principles of Isometric Projections, Isometric Scale, Isometric Views and Conventions. Isometric Views of Lines, Planes, Simple and Compound Solids, Isometric Views of Objects having Spherical Parts.

Iso- Ortho and Ortho- Iso with Simple and Compound Solids

Unit IV: Transformation of Projections   12 Hours
Transformation of Projections: Conversion of Isometric Views to Orthographic Views, Conventions for Simple Objects.

Construction of Orthographic Projections for given Isometric Projections

Unit V: Perspective Projections   12 Hours
Perspective Projections: Perspective View of Points, Lines, Plane Figures and Simple Solids, Vanishing Point Method.

Visual Ray Method Demonstration

Text Books

1. Bhatt. N. D., "Engineering Drawing", 53rd Edition, Charotar Publishers, 2016
2. Narayana K. L. and Kannaiah. P., "Engineering Drawing", 3rd Edition, Scitech Publishers, Chennai, 2012

Reference Books

1. Dhanajay A. Jolhe, "Engineering Drawing", 3rd Edition, Tata McGraw Hill, 2009
2. Shah and Rana, "Engineering Drawing", 2nd Edition, Pearson Education, 2009
3. Venugopal, "Engineering Drawing and Graphics", 3rd Edition, New Age Publishers, 2000
4. John.K.C., "Engineering Graphics", 2nd Edition, Eastern Economy Edition, 2013

Web References

1. https://www.wiziq.com/tutorials/engineering-drawing

2. www.me.umn.edu/courses
3. Youtube: http-sewor,Carleton.cag,kardos/88403/drawings.html conic sections-online, red woods.edu

Internal Assessment Pattern

Cognitive Level	Internal Assessment #1 (%)	Internal Assessment #2 (%)
L1	30	10
L2	30	20
L3	20	30
L4	20	40
Total (%)	100	100

Sample Short and Long Answer Questions of Various Cognitive Levels

L1: Remember

1. How to identify ellipse, parabola, and hyperbola?
2. Point F is 50 mm from a line AB. A point P is moving in a plane such that the ratio of its distances from F and line AB remains constant and equals to 3/2. Draw locus of point P
3. Point F is 50 mm from a vertical straight line AB. Draw locus of point P, moving in a plane such that it always remains equidistant from point F and line AB
4. A triangular prism, side of base 30 mm and axis 50 mm long is lying on the HP on one of its rectangular faces with its axis inclined at 30° to the VP. It is cut by a horizontal section plane at a distance of 12 mm above the ground. Draw its front view, side view and sectional top view
5. Draw the top view, sectional front view and the auxiliary front view on an AVP parallel to the section plane

L2: Understand

1. A cube of 70 mm long edges has its vertical faces equally inclined to the VP. It is cut by an AIP in such a way that the true shape of the cut part is a regular hexagon. Determine the inclination of the cutting plane with the HP. Draw FV, sectional TV and true shape of the section
2. A cylinder 50mm dia. and 70 mm axis is completely penetrated by another of 40 mm dia. and 70 mm axis horizontally both axes intersect & bisect each other. Draw projections showing curves of intersections
3. A cylinder 50 mm diameter and 70 mm axis is completely penetrated by a square prism of 25 mm sides and 70 mm axis, horizontally. Both axes. Intersect & bisect each other. All faces of prism are equally inclined to Hp. Draw projections showing curves of intersections. A pentagonal pyramid has an edge of the base in the VP and inclined at 30° to the HP, while triangular face containing that edge makes an angle of 45° with the VP. Illustrate the three views of the pyramid. Length of side of the base is 30 mm, while that of the axis is 65 mm
4. A sq. prism 30 mm base sides and 70 mm axis is completely penetrated by another square prism of 25 mm sides and 70 mm axis, horizontally. Both axis Intersects & bisect each other. All faces of prisms are equally inclined to Vp. Draw projections showing curves of intersections
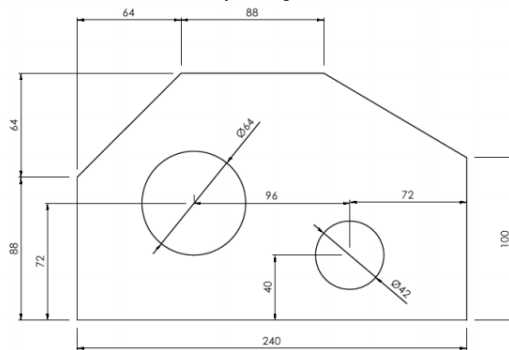
L3: Apply

1. Build the Isometric view by using AUTOCAD software
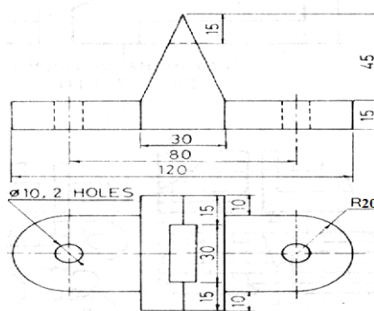
2. Draw the line of length 150 straight (with 0 degree to the ground) before rotating it when you are done with it
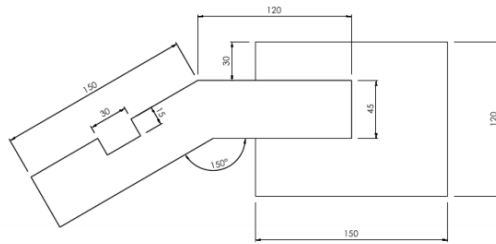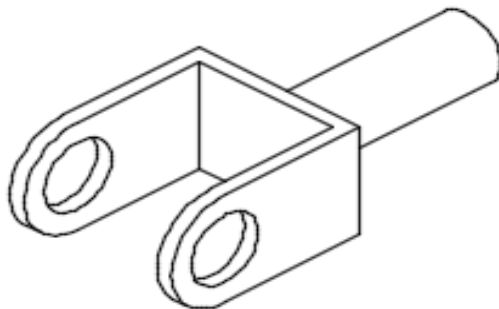
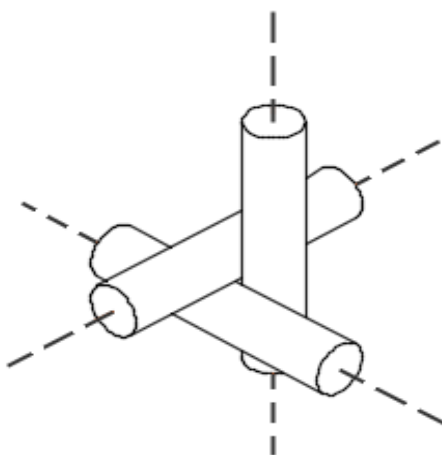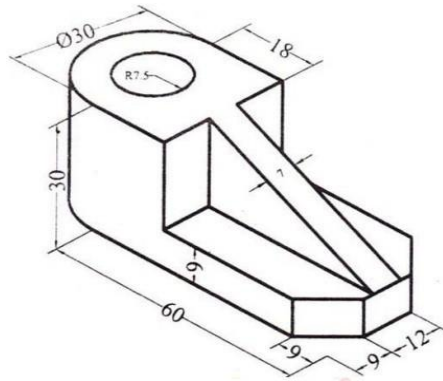3. Build the Isometric view by using AUTOCAD software

L4: Analyze

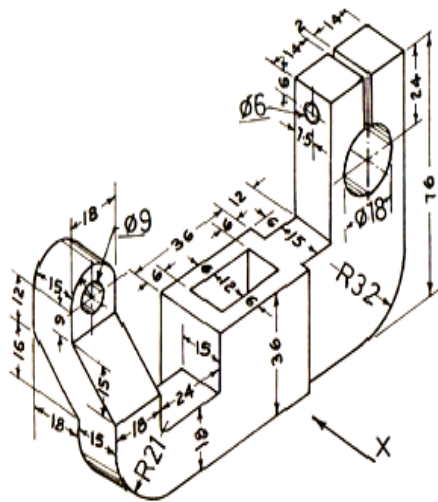1. Examine (i) Front View (ii) Top View (iii) Side View

2. Analyze the front and top views of an object and Construct the isometric view
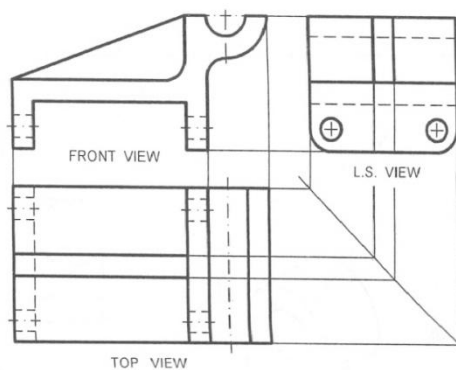
3. Draw the three orthographic views

4. Draw (i) Front View (ii) Top View (iii) Left Hand Side View

5. Draw the Isometric view assuming suitable data

| BS | **20BSX32 Engineering Physics Lab** | 0 | 0 | 3 | 1.5 |

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20BSX32.1	Relate the principle of physics in engineering field and compare the results with theoretical calculations	3	3	1
20BSX32.2	Understand modern engineering physics techniques and tools in real time applications in engineering studies	3	3	1
20BSX32.3	Distinguish the characteristics of materials in a practical manner and gain knowledge of its usage	3	3	1
20BSX32.4	Develop the laboratory skills in handling of electrical and optical instruments	3	3	1
20BSX32.5	Demonstrate the interference and diffraction phenomena of light	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Determination of Rigidity Modulus of Material (wire)- (Torsional Pendulum)
2. Determination of Wavelength of a Source using Diffraction Grating Normal Incidence Method
3. Newton's Rings -Determination of Radius of Curvature of Plano Convex Lens
4. Determination of Thickness of Thin Object- Air Wedge Method
5. Determination of Wavelength of Laser Source-Single Slit Diffraction
6. Determine Acceleration due to Gravity and Radius of Gyration using Compound Pendulum
7. Determination of Velocity of Sound in Air using Volume Resonator
8. Verify Magnetic Field along the Axis of a Current carrying Coil – Stewart and Gee's Apparatus
9. Verification of Laws of Stretched String by using Sonometer
10. Calculate the Energy Loss in a given Ferromagnetic Material by plotting B-H Curve
11. To find the Energy Band Gap of a Semiconductor using P - N Junction
12. Study the Characteristics of a Thermistor and obtain its Temperature Coefficient
13. Determination of Dielectric Constant using charging Discharging Method
14. Determination of resolving Power of a Grating

References

1. Lab Manual for Applied Physics, Department of Basic Science and Humanities, NSRIT

| ES | **20ESX08 Basic Electrical and Electronics Engineering Lab** | 0 | 0 | 3 | 1.5 |

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

Code	Course Outcomes	Mapping with POs		
		PO1	PO4	PO12
20ESX08.1	Analyse the characteristics of DC shunt motors	3	3	1
20ESX08.2	Understand speed torque characteristics of 3 phase induction motor	3	3	1
20ESX08.3	Analyse the efficiency and regulation of transformers and assess their performance	3	3	1
20ESX08.4	Understand operating characteristics of diodes	3	3	1
20ESX08.5	Understand operating characteristics of different rectifiers	3	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

1. Speed Control of D.C. Shunt Motor
2. O.C. and S. C. Test on a Single Phase Transformer
3. Brake Test on 3 - Phase Induction Motor
4. Regulation of Alternator by Synchronous Impedance Method
5. Swinburne's Test on D.C. Shunt Machine (Predetermination of Efficiency of a given D.C. Shunt Machine working as Motor and Generator)
6. Brake Test on 1 - Phase Induction Motor
7. Diode Characteristics - Cut-In Voltage, Static Resistance, Dynamic Resistance Calculations
8. Zener Diode Characteristics - Breakdown Voltage, % Regulation
9. Half Wave Rectifier with and without Filters - Ripple Factor, % Regulation, Load Regulation
10. Full Wave Rectifier with and without Filters - Ripple Factor, % Regulation, Load Regulation
11. Common emitter Characteristics - Current Gain Calculation

Text Books

1. Bhattacharya S .K., "Basic Electrical Engineering", 1st Edition, Pearson Education, 2019

References

1. Lab Manual for Basic Electrical Engineering, Department of Electrical and Electronics Engineering, NSRIT

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Board of Studies (EEE)

| ES | **20ESX06 Engineering Workshop** | 0 | 0 | 3 | 1.5 |

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

		Mapping with POs	
Code	**Course Outcomes**	**PO4**	**PO12**
20ESX06.1	Construct regular metal products with simple hand cutting process	3	1
20ESX06.2	Construct the simple wooden products	3	1
20ESX06.3	Develop metal products with and without application of heat	3	1
20ESX06.4	Organize basic electrical engineering knowledge for simple house wiring	3	1
20ESX06.5	Choose the apt low heat application joining process of different metals	3	1
1. Weakly Contributing	2. Moderately Contributing	3. Strongly Contributing, for the attainment of respective Pos			

List of Experiments

Student shall do two experiments from each trade

1. Fitting
   - a. V-Fit
   - b. Square Fit
   - c. Half Round Fit
   - d. Dove Tail Fit

2. Carpentry
   - a. T-Lap Joint
   - b. Cross Half Lap Joint
   - c. Mortise and Tenon Joint
   - d. Dove Tail Joint

3. Tin Smithy& Black Smithy:[*One Experiment from Each Trade*]
   Tin Smithy
   - a. Taper Tray
   - b. Funnel

   Black Smithy
   - a. Round Rod to S – Hook
   - b. Round Rod to Flat Ring

4. House Wiring
   - a. Stair Case Wiring
   - b. Fluorescent Lamp Fitting
   - c. Parallel/Series Connections of Bulbs
   - d. Measurement of Earth Resistance
   - e. Stair Case Wiring

5. Joining Process
   - a. Brazing
   - b. Soldering

6. IT Workshop
   - a. Assembly of Computer
   - b. Disassembly of Computer

Text Books

1. Kannaiah P. and Narayana K. L., "Workshop Manual", Scitech Publications, 2015
2. Hajra Choudhury S. K., Hajra Choudhury A. K. and Nirjhar Roy S. K., "Elements of Workshop Technology", Media Promoters and Publishers Pvt. Ltd., Mumbai, Volume I, 2008 and Volume II, 2010

Reference Books

1. Kalpakjian S. and Steven S. Schmid, "Manufacturing Engineering and Technology", 4th Edition, Pearson Education India, 2002
2. Gowri P. Hariharan and Suresh Babu A., "Manufacturing Technology - I", Pearson Education, 2008
3. Lab manual on Engineering workshop, Department of Mechanical Engineering, NSRIT (A)

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Board of Studies (ME)

| MC | **20MCX01 Environmental Science** | | 0 | 0 | 3 | 0 |

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

Code	Course Outcomes	Mapping with POs		DoK
		PO1	**PO12**	
20MCX01.1	Gain in-depth knowledge on importance of environment, natural resources utilization and exploitation	3	1	L1, L2
20MCX01.2	Understand the concept of an ecosystem and Identify their interconnections	3	1	L1, L2
20MCX01.3	Develop an understanding on values, threats and conservation of biodiversity	3	1	L1, L2
20MCX01.4	Illustrate the impacts of ever increasing environmental pollution and understand the issues on global environment	3	1	L1, L2
20MCX01.5	Understand various acts formulated by Govt. of India and apply the knowledge gained in conserving energy and environmental protection	3	1	L1, L2
1. Weakly Contributing | 2. Moderately Contributing | 3. Strongly Contributing, for the attainment of respective Pos				
L1: Remember | L2: Understand | L3: Apply | L4: Analyze | L5: Evaluate | L6: Create. DoK: Depth of Knowledge				

Unit I: Natural Resources   **12 Hours**
Introduction: Definition, Scope and Importance-Need for Public Awareness
Natural Resources: Classification of resources–Forest resources: Use and Over-exploitation, Deforestation- Mining, Water resources –Use and over utilization of surface and ground water–Floods, Drought, Conflicts over water, Dams-Benefits and Problems – Mineral resources: Use and exploitation, Environmental effects of extracting and using mineral resources–Energy resources: Renewable and Non- Renewable sources of energy- Solar energy, Wind energy.

Unit II: Ecosystems   **12 Hours**
Concept of an Ecosystem–Structural features of ecosystem- Producers, Consumers and Decomposers–-Biogeochemical cycles- Carbon cycle and Nitrogen cycle-Ecological succession-Food chains, Food webs and Ecological pyramids–Energy flow in the ecosystem-Types of ecosystems (a) Forest ecosystem (b) Aquatic ecosystems.

Unit III: Biodiversity and its Conservation   **12 Hours**
Introduction, Definition, Genetic, Species and Ecosystem diversity, India as a mega-diversity nation, Hot spots of biodiversity, Values of biodiversity, Threats to biodiversity, Endemic, Endangered and Extinct species of India, In-Situ and Ex-situ conservation of biodiversity.

Unit IV: Environmental Pollution and Global Environmental Issues   **12 Hours**
Environmental Pollution: Air pollution, Water pollution, Noise pollution, Effects-Global warming, Acid Rain and Ozone layer depletion and controlling measures.
Global Environmental Issues: Population Growth, Urbanization, Climate change and impacts on human environment.
Solid Waste Management: Causes, Effects and Control measures of Municipal solid wastes – E - Waste Management, Role of an individual in prevention of pollution.

Unit V: Environmental Legislation, Laws, Policies for Sustainable Development   **12 Hours**
Environmental Legislation, Environmental Protection act – Air Prevention and Control of Pollution act–Water Prevention and control of Pollution act– Wildlife protection act – Forest conservation act.
From Unsustainable to sustainable development, Role of IT in Environment-Remote Sensing and GIS methods for Sustainable development

Text Books

1. Erach Bharucha, "Text Book of Environmental Studies", 1st Edition, University Grants Commission, University Press (India) Pvt. Ltd., 2010
2. Kaushik A. and Kaushik C. P., "Environmental Sciences", 5th Edition, New Age International Publishers, 2015
3. Anji Reddy M., "Text Book of Environmental Science and Technology", 3rd Edition, B. S. Publications, 2010

Reference Books

1. Anil Kumar and Arnab Kumar De, "Environmental Studies", 3rd Edition, New Age International Publishers, 2015
2. Trivedi R. K., "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", 2nd Edition, Voume I and II, Enviro Media, 2012
3. Rajagopalan R., "Environmental Studies-From Crisis to Cure", 2nd Edition, Oxford University Press, 2005

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Board of Studies (Chemistry)