INSTITUTE VISION

To be a preferred institution in Engineering Education by achieving excellence in teaching and research and to remain as a source of pride for its commitment to holistic development of individual and society.

INSTITUTE MISSION

To continuously strive for the overall development of students, educating them in a state of the art infrastructure, by retaining the best practices, people and inspire them to imbibe real time problem solving skills, leadership qualities, human values and societal commitments, so that they emerge as competent professionals.

DEPARTMENT VISION

To be a centre of excellence in teaching and learning to produce the competent & socially responsible professionals in the domain of Electrical & Electronics Engineering.

DEPARTMENT MISSION

I. To educate students with core knowledge of Electrical and Electronics Engineering to excel in their professional career.

II. To develop problem solving skills, professional skills and ethical values among the students for the betterment of mankind.

III. To prepare technically competent and socially responsible Electrical Engineer to serve the future needs of the society.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

Graduates of the program will be able to

PEO1: Achieve successful professional career in Electrical Engineering and allied disciplines.

PEO2: Pursue higher studies and continuously engage in upgrading the professional skills.

PEO3: Demonstrate professional & ethical values, effective communication skills and teamwork to solve issues related to profession, society and environment.

PROGRAM OUTCOMES (POs):

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PROGRAM SPECIFIC OUTCOMES (PSOs) :

PSO1: Apply knowledge & competencies to analyze & design Electrical & Electronics Circuits, Controls and Power Systems, Machines & Industrial Drives.

PSO2: Use Software/Hardware tools for the design, simulation and analysis of Electrical and Electronics Systems.

Contents of VI-SEM

1.0 Student Help Desk

Sl. No	Coordination Work	Contact Person	
		Faculty	Instructor
01	Attestations	Dr.B.V.Madiggond	-
02	Exam forms signature, Overall department administration, Counseling/ interaction with Parents/Students.		
03	Research Centre Coordinator, Academic Coordinator		
04	Project Coordinator, KSCST Coordinator, Hobby & Mini Project Coordinator, Dept. Library Coordinator	Prof. S. D. Hirekodi	-
05	Academic Coordinator	Prof. H. R. Zinage	-
06	First Year Coordinator, Dept. NBA Coordinator, Alumni Coordinator	Dr. M. P. Yenagimath	-
07	Dept. Association Coordinator	Prof. O. B. Heddurshetti	-
08	AICTE/VTU/NIRF/LIC Coordinator, AICTE Activity Coordinator, Professional Body (ISTE & IEEE) Coordinator	Prof. A. U. Neshti	-
09	IA & EMS Coordinator	Prof. S. J. Patil	Shri. S. B. Beelur
10	News letter/Technical Magazine Coordinator, News & Publicity Coordinator, Website Coordinator, Mentorship Coordinator	Prof. S. G. Huddar	--
11	TP Cell Coordinator, IIIC Cell, Internship Coordinator, Technical Seminar Coordinator	Prof. P. I. Savadatti	--
12	Dispensary	Dr.ArunG.Bullannavar,ContactNo.9449141549	
Class Teacher			
13	4th Semester	Prof. S. D. Hirekodi	Shri. S.B.Beelur
14	6th Semester	Prof. A. U. Neshti	Shri.V.M. Mutalik
15	8th Semester	Prof. H. R. Zinage	Shri.R.S.Bardol

2.0 Departmental Resources

Department of Electrical and Electronics Engineering was established in the year 1996 and is housed in a total area of **1339 Sq. Mtrs.**

2.1 Faculty Position

S.N.	Category	No. in position	Average experience
1	Teaching faculty	10	19 Y
2	Technical supporting staff	3	27 Y
3	Helper	2	21 Y

2.2 Major Laboratories

SL. No.	Name of the laboratory	Area in Sq. Mtrs	Amount Invested (Rs)
01	Electronics Lab	71	4,49,488.00
02	Operational Amplifier & Linear Integrated Lab		1,29,776.00
03	Power Electronics Lab	92	7,85,162.00
04	Control Systems Lab		2,14,127.00
05	Power System Simulation Lab	71	17,95,111.00
06	Computer Aided Electrical Drawing Lab		6,50,988.40
07	Microcontroller Lab/ Digital Signal Processing Lab	72	5,94,122.00
09	Electrical Machines Lab	200	14,85,725.0
10	Relay & High Voltage Lab	94	11,72,383.00
11	Basic Electrical Engg. Lab	96	42,321.00
	Total	**696**	73,19,203.40

3.0 Faculty Details

S.N.	Faculty Name	Designation	Qualification	Area of specialization	Professional membership	Industry Experience (in years)	Teaching Experience (in years)	Contact Nos.
01	Dr. B. V. Madiggond	HOD/Prof.	Ph.D	Power Electronics	LMISTE, YHAI	-	31	9343454993
02	Prof. V. B. Dhere	Asst. Prof.	M. Tech,(Ph.D)	Electronics &Telecommunication	LMISTE, IMPARC	4	27	9886597573
03	Prof. S. D. Hirekodi	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	24	9480849338
04	Prof. H. R. Zinage	Asst. Prof.	M. Tech.	Power System	LMISTE	-	24	9480849335
05	Dr. M. P. Yenagimath	Asst. Prof.	Ph.D	VLSI&ES	LMISTE	1	18.5	9341449466
06	Prof.O.B. Heddurshetti	Asst. Prof.	M. Tech.	Power Electronics	LMISTE	1	17	9448420509
07	Prof. A. U. Neshti	Asst. Prof.	M. Tech.	Digital Electronics	ISTE	-	16	9538223362
08	Prof. S. G. Huddar	Asst. Prof.	M. Tech.	Power System Engg.	LMISTE	-	11	9742066852
09	Prof. P. I. Savadatti	Asst. Prof.	M. Tech.	Digital Electronics	-	-	09	9964315436
10	Prof. S. J. Patil	Asst. Prof.	M. Tech.	Industrial Electronics	-	-	12.5	9880931802

S J P N Trust's
Hirasugar Institute of Technology, Nidasoshi.
Approved by AICTE, New Delhi, Permanently Affiliated to VTU, Belagavi Recognized under 2(f) & 12B of UGC Act, 1956
Accredited at 'A+' Grade by NAAC & Programmes Accredited by NBA:CSE & ECE

IQAC
Institute CoE
AY:2024-25 (Even)
Rev: 03

INSTITUTE CALENDAR OF EVENTS (CoE)

AY: 2024-25 (Even Sems.: II , IV, VI & VIII) (w.e.f.: 10th Feb. 2025)

Ref:
1. VTU CoE Notifications No.: VTU/BGM/BoS/Academic Calendar/2024-25/5487 &5601, Dated :24th /29th Jan. 2025
2. IQAC Meeting No.:HSIT/NDS/NAAC/IQAC/Meeting-Actions-Proceedings/2024-25/32, Dated: 29th Jan. 2025
3. VTU CoE Notifications No.: VTU/BGM/BoS/Academic Calendar/2024-25/6056, Dated :21st Feb. 2025

Hirasugar Institute of Technology NIDASOSHI. Dist: Belgaum.

February -2025

Sun	Mon	Tue	Wed	Thu	Fri	Sat
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	

26th Feb. 2025 GH: Maha Shivaratri
27th Feb. 2025 LH: Mahadasoha of Shri. Math (UHV Program Org. by NSSD, DSCs & UHV Coordinator)

March-2025

Sun	Mon	Tue	Wed	Thu	Fri	Sat
30	31					1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29

30th March 2025 GH: Yugadi Festival
31st March 2025 GH: Kutub-A-Ramjan
19th March 2025 LH: Rang Panchami (Tentative)

April -2025

Sun	Mon	Tue	Wed	Thu	Fri	Sat
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

10th April 2025 GH: Mahaveer Jayanti
14th April 2025 GH: Dr. B.R. Ambedkar Jayanti
18th April 2025 GH: Good Friday
30th April 2025 GH: Basav Jayanti/Aksay-Trutiya

May -2025

Sun	Mon	Tue	Wed	Thu	Fri	Sat
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

1st May 2025 GH: Labours Day

June -2025

Sun	Mon	Tue	Wed	Thu	Fri	Sat
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Date	Events & Holidays
10th Feb. 2025	Commencement of IV & VI Sem Classes & COP in 1st Week
11th Fab. 2025	International Day of Women & Girls in Science (Org. by WEC)
15th Feb. 2025	Commencement of 15 Weeks Industry/Research Internship (For VIII Sem ME, EE & CV)
21st -22nd Feb. 2025	Major Project Synopsis Presentation Cum Idea Presentation (For VIII Sem. CSE & ECE, Org. by DAs & DSCs)
27th -28th Feb. 2025	Major Project (Phase-I), Synopsis Presentation Cum Idea Presentation (For VI Sem. all branches, Org. by DSCs)
28th Feb. 2025	National Science Day (Org. by FYD)
7th -8th March 2025	International Conference:ICRTET-25 (Org. by R&D Cell)
8th March 2025	International Women's Day (Org. by WEC & DSCs,)
12th-14th March 2025	1st IAT for IV & VI Sems. (On 01 CO/Module)
14th March 2025	1st Feedback on T&L Process by IV & VI Sems. Students.
17th March 2025	Commencement of Classes of II Sem & Student Induction Program (SIP) Phase-II (Tentative)
18th March 2025	Display of 1st IAT Marks of IV & VI Sems
20th March 2025	International Day of Happiness (Org. by NSSD & YRCD)
29th March 2025	Technovision-2025 (Host by CSE Dept. Org. by DSCs)
17th April 2025	Annual Sports Day (Host by: Sports Dept. & Org. by DSCs)
24th -26th April 2025	1st IAT for II Sem (On 01 CO/Module)& 2nd IAT for IV & VI Sems. (On 02 COs/ Modules covered after 1st IAT) (On 24th National Panchayathraj Day, Org. by NSSD & DSCs)
26th April 2025	1st Feedback on T&L Process by II Ses. Students. 2nd Feedback on T&L Process by IV & VI Sems. Students. (World Intellectual Property Day, Org. by DSCs, R&D Cell, ED Cell)
29th April 2025	1st Lab IAT for IV & VI Sems. (On 02 COs/5 Expts)
2nd May 2025	Display of 2nd /1st IA Test Marks of IV & VIII Sems
8th -9th May 2025	HSIT-QUEST-2025 (Host by ME Dept. Org. by DSCs) (On 8th World Red Cross Day, Org. by YRC, DSCs)
10th May 2025	SEE of NSS/PE/YOGA for VIII Sem (2021 Scheme)
13th -14th May 2025	Technical Seminar Presentation, (For VIII Sem: All branches , Org. by DAs)
12th -16th May 2025	Fun Week (Social & Cultural Activities) (Org. by NSS Cell & Sports Dept, DSCs & Host by EEE Dept.)
16th -17th May 2025	Project Exhibition (VI: All Branches & VIII Sem: CS & EC) (Org. by DAs & DSCs)
15th May 2025	Last Working Day of VIII Sems
20th May 2025	HSIT Shambhrama-25 (Host by EEE Dept. Org. by DSCs)
21st May 2025	Graduation Day (Host by ECE Dept. Org. by DSCs)
26th -28th May 2025	2nd IAT for II Sem, (On 02 COs/ Modules covered after 1st IAT) 3rd IAT for IV & VI Sems., (On 02 COs/Modules covered after 2nd IAT)
28th May 2025	2nd Feedback on T&L Process by II Sem. Students.
30th May 2025	Display of 3rd /2nd IA Test Marks of IV & VIII Sems
30th May 2025	2nd Lab IAT for IV&VI Sems. (On remaining 03 COs/5Expts)
31st May 2025	Last Working Day of IV & VI Sems (World Tobacco Day, Org. by DSCs, NSSD & YRCD)
2nd June 2025	Display of final CIE (IAT+CCA) marks
16th-26th May 2025	VTU Theory Examinations (SEE) (For VIII Sems.)
27thMay -2nd June 2025	VTU Practical/Internship/Project Examinations (For VIII Sem.)
13th-15th June 225	Alumni Meet/Re-Union/Activities (Org. by AA)
2nd -13th June 2025	VTU Practical Examinations (For IV & VI Sems.)
23rd -25th June 2025	3rd IAT II Sem. (On 02 COs/Modules covered after 2nd IAT)
28th June 2025	Last Working Day of II Sem
30th June 2025	Display of 3rd Test Marks of II Sem.
16th June-1st Aug. 2025	VTU Theory Examinations (SEE) (For IV & VI Sems.)
1st July -11th July 2025	VTU Practical Examinations (For II Sem.)
14th July-9th Aug. 2025	VTU Theory Examinations (SEE) (For II Sem.)
4th Aug. 2025	Commencement of AY: 2025-26, III & V Sems.
One week	Evaluation of COs-POs-PSOs Attainments through Direct & Indirect Methods after SEE revaluation results
5th June 2025	World Environment Day/Plastic free Awareness & Pledge, Org. by NSSD
12th June 2025	World Blood Donor Day, Org. by DSCs, YRCD & NSSD
21st June 2025	International YOGA Day, Org. by DSCs, Sports Dept. & NSSD

GH: General Holiday LH: Local Holiday NSS: National Service Scheme WEC: Women Empowerment Cell R&D: Research & Development YRC: Youth Red Cross CO: Course Outcome PO: Program Outcome IAT: Internal Assessment Test SIP: Student Induction Program COP: Course Orientation Program AA: Alumni Association SEE: Semester End Exams DSC: Dept. Student Council DA: Dept. Association ED: Entrepreneurship Development T&L: Teaching & Learning

Dr. S. N. Topannavar
IQAC Coordinator
Hirasugar Institute of Technology
Nidasoshi-591236

Dr. S.C. Kamate
Professor & Principal
Hirasugar Institute of Technology,
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Copy to all key authorities, displayed on N/Bs and circulated to all students through WhatsApp groups

Nidasoshi, Taq: Hukkeri, Dist: Belgaum, Karnataka - 591 236
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VISVESVARAYA TECHNOLOGICAL UNIVERSITY, BELAGAVI

B.E. in Electrical & Electronics Engineering

Scheme of Teaching and Examinations2022

Outcome Based Education (OBE) and Choice Based Credit System (CBCS)

(Effective from the academic year 2023-24)

VI SEMESTER

Sl. No	Course and Course Code		Course Title	Teaching Department (TD) and Question Paper Setting Board (PSB)	Teaching Hours /Week				Examination				Credits
					Theory Lecture	Tutorial	Practical/ Drawing	Self -Study	Duration in hours	CIE Marks	SEE Marks	Total Marks	
					L	T	P	S					
1	IPCC	BEE601	Power system Analysis - I	EEE	3	0	2		03	50	50	100	4
2	PCC	BEE602	Control Systems	EEE	3	2	0		03	50	50	100	4
3	PEC	BEE613x	Professional Elective Course	EEE	3	0	0		03	50	50	100	3
4	OEC	BEE654x	Open Elective Course	EEE	3	0	0		03	50	50	100	3
5	PROJ	BEE685	Project Phase I	EEE	0	0	4		03	100	--	100	2
6	PCCL	BEEL606	Control System Lab	EEE	0	0	2		03	50	50	100	1
7	AEC/SDC	BEE657x	Ability Enhancement Course/Skill Development Course - V	EEE	If the course is Theory				01	50	50	100	1
					1	0	0						
					If course is practical				02				
					0	0	2						
8	MC	BNSK658	National Service Scheme (NSS)	NSS coordinator	0	0	2			100	---	100	0
		BPEK658	Physical Education (PE) (Sports and Athletics)	Physical Education Director									
		BYOK658	Yoga	Yoga Teacher									
9	MC	IKS	Indian Knowledge System		1	0	0			100	0	100	0
									Total	**500**	**300**	**800**	**18**

Professional Elective Course

BEE613A	Medium Voltage Substation Design	BEE613C	FACTS and HVDC Transmission
BEE613B	Embedded SystemDesign	BEE613D	Electric Motor and Drive Systems for Electric Vehicles

Open Elective Course			
BEE654A	Utilization of Electrical Power	BEE654C	Industrial Servo Control Systems
BEE654B	Technologies of Renewable Energy Sources	BEE654D	Semiconductor Devices
Ability Enhancement Course / Skill Enhancement Course-V			
BEE657A	Energy Management in Electric Vehicles	BEEL657C	Energy Audit Project
BEEL657B	Simulation of Control of Power Electronics Circuits	BEEL657D	Project on Renewable Energy Sources

PCC: Professional Core Course, **PCCL**: Professional Core Course laboratory, **UHV**: Universal Human Value Course, **MC**: Mandatory Course (Non-credit), **AEC**: Ability Enhancement Course, **SEC**: Skill Enhancement Course, **L:** Lecture, **T**: Tutorial, **P**: Practical **S= SDA**: Skill Development Activity, **CIE**: Continuous Internal Evaluation, **SEE**: Semester End Evaluation. **K :** The letter in the course code indicates common to all the stream of engineering. **PROJ**: Project /Mini Project. **PEC**: Professional Elective Course. **PROJ**: Project Phase -I, **OEC**: Open Elective Course

Professional Core Course (IPCC): Refers to Professional Core Course Theory Integrated with practicals of the same course. Credit for IPCC can be 04 and its Teaching–Learning hours (L : T : P) can be considered as (3 : 0 : 2) or (2 : 2 : 2). The theory part of the IPCC shall be evaluated both by CIE and SEE. The practical part shall be evaluated by only CIE (no SEE). However, questions from the practical part of IPCC shall be included in the SEE question paper. For more details, the regulation governing the Degree of Bachelor of Engineering /Technology (B.E./B.Tech.) 2022-23

National Service Scheme /Physical Education/Yoga: All students have to register for any one of the courses namely National Service Scheme (NSS), Physical Education (PE)(Sports and Athletics), and Yoga(YOG) with the concerned coordinator of the course during the first week of III semesters. Activities shall be carried out between III semester to the VI semester (for 4 semesters). Successful completion of the registered course and requisite CIE score is mandatory for the award of the degree. The events shall be appropriately scheduled by the colleges and the same shall be reflected in the calendar prepared for the NSS, PE, and Yoga activities. These courses shall not be considered for vertical progression as well as for the calculation of SGPA and CGPA, but completion of the course is mandatory for the award of degree.

Professional Elective Courses (PEC): A professional elective (PEC) course is intended to enhance the depth and breadth of educational experience in the Engineering and Technology curriculum. Multidisciplinary courses that are added supplement the latest trend and advanced technology in the selected stream of engineering. Each group will provide an option to select one course. The minimum number of students' strengths for offering professional electives is 10. However, this conditional shall not be applicable to cases where the admission to the program is less than 10. As there are 5 verticals with four courses in each vertical, **Mentors are required to guide students in deciding PEC as per verticals.**

Open Elective Courses:

Students belonging to a particular stream of Engineering and Technology are not entitled to the open electives offered by their parent Department. However, they can opt for an elective offered by other Departments, provided they satisfy the prerequisite condition if any. Registration to open electives shall be documented under the guidance of the Program Coordinator/ Advisor/Mentor. The minimum numbers of students' strength for offering Open Elective Course is 10. However, this condition shall not be applicable to class where the admission to the program is less than 10.

Project Phase-I : Students have to discuss with the mentor /guide and with their help he/she has to complete the literature survey and prepare the report and finally define the problem statement for the project work.

Subject Title	**POWER SYSTEM ANALYSIS-1**		
Subject Code	BEE601	**CIE Marks**	50
Number of Lecture Hrs / Week (L:T:P:S)	40 hours Theory + 10 Lab slots	**SEE Marks**	50
Total Number of Lecture Hrs	40	**Exam Hours**	03
			Credits-04

FACULTY DETAILS:		
Name: Sujata G Huddar	**Designation:** Asst. Professor	**Experience:** 11
No. of times course taught: 04 (including present)	**Specialization:** Power Systems Engineering	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical and Electronics Engg	III	EPG
02	Electrical and Electronics Engg	V	TD

2.0 Course Objectives

- To introduce the per unit system and explain its advantages and computation and explain the concept of single line diagram and its implementation in problems.
- To explain analysis of three phase symmetrical faults on synchronous machine and simple power systems.
- To explain symmetrical components, their advantages and the calculation of symmetrical components of voltages and currents in un-balanced three phase circuits.
- To explain the concept of sequence impedance and sequence networks in three phase unbalanced circuits.
- To explain the analysis of synchronous machine and simple power systems for different unsymmetrical faults using symmetrical components.
- Discuss stability and types of stability for a power system and the equal area criterion for the evaluation of stability of a simple system.

3.0 Course Outcomes

After successful completion of this course, the student will be able to,

	Course Outcome	Cognitive Level	POs
C315.1	Model the power system components & construct per unit impedance diagram of power system.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C315.2	Analyze three phase symmetrical faults on power system.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C315.3	Compute unbalanced phasors in terms of sequence components and vice versa, also develop sequence networks.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C315.4	Analyze various unsymmetrical faults on power system.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
C315.5	Examine dynamics of synchronous machine and determine the power system stability.	L1,L2,L3,L4	PO1, PO2, PO4,PO8,PO12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1

Representation of Power System Components : Introduction, Single-phase Representation of Balanced Three Phase Networks, One-Line Diagram and Impedance or Reactance Diagram, Per Unit (PU) System, Steady State Model of Synchronous Machine, Power Transformer, Transmission of electrical Power, Representation of Loads . **08 Hours**

Module-2

Symmetrical Fault Analysis: Introduction, Transient on a Transmission Line, Short Circuit of a Synchronous Machine(On No Load), Short Circuit of a Loaded Synchronous Machine, Illustrative simple examples on power systems. Selection of Circuit Breakers. **08 Hours.**

Module-3

Symmetrical Components: Introduction, Symmetrical Component Transformation, Phase Shift in Star-Delta Transformers, Sequence Impedances of Transmission Lines, Sequence Impedances and Sequence Network of Power System, Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines, Sequence Impedances and Networks of Transformers, Construction of Sequence Networks of a Power System. **08 Hours.**

Module-4

Unsymmetrical Fault Analysis: Introduction, Symmetrical Component Analysis of Unsymmetrical Faults, Single Line-To-Ground (LG) Fault, Line-To-Line (LL) Fault, Double Line- To-Ground (LLG) Fault, Open Conductor Faults. **08 Hours.**

Module-5

Power System Stability: Introduction, Dynamics of a Synchronous Machine, Review of Power Angle Equation. Simple Systems, Steady State Stability, Transient Stability, Equal Area Criterion, Factors Affecting Transient Stability, Multi machine stability studies, classical representation. **08 Hours.**

Sl.NO	Experiments
1	Write a program to draw power angle curves for salient and non-salient pole synchronous machines, reluctance power, excitation, EMF and regulation.
2	Write a program to calculate Sag of a transmission line for i)Poles at equal height ii)Poles at unequal height
3	Write a program to determine the efficiency, Regulation, ABCD parameters for short and long transmission line and verify AD-BC=1.
4	Write a program to determine the efficiency, Regulation and ABCD parameters for medium transmission line for i) Π- configuration ii) T- Configuration and verify AD-BC=1.
5	Write a program to calculate sequence components of line voltages given the unbalanced phase voltages.
6	Write a program to calculate the sequence components of line currents, given the unbalanced phase currents in a three phase i) 3-wire system ii) 4 wire system.
7	Determination of fault currents and voltages in a single transmission line for i) Single Line to Ground Fault. ii)Line to Line Fault iii) Double Line to Ground Fault Using suitable simulating software package.
8	Determination of fault currents and voltages in a single transmission line for Three phase Fault Using suitable simulating software package.
9	Write a program to obtain critical disruptive voltage for various atmospheric and conductor conditions.
10	Write a program to evaluate transient stability of single machine connected to infinite bus.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VII	Computer techniques in power system analysis	All
02	VII	Power system simulation lab	Swing curve, power angle curve, fault analysis
03	VIII	Power system operation & control	All

6.0 Relevance to Real World

SL.No	Real World Mapping
01	Power system modeling
02	Analyze power system stability
03	Fault analysis of power system by software tools.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Practical	Doing fault analysis using mi-power simulation & obtaining power angle curve using MATLAB.

8.0 Books Used and Recommended to Students

Text Books

1. Modern Power System, D. P. Kothari, McGraw Hill, 4th Edition, 2011.

Reference Books

1. Elements of Power System, William D. Stevenson Jr, McGraw Hill, 4th Edition, 1982.
2. Power System Analysis and Design, J. Duncan Glover et al, Cengage, 4th Edition, 2008.
3. Power System Analysis, Hadi Sadat, McGraw Hill, 1st Edition, 2002.

Additional Study material & e-Books

1. Power system analysis and stability by V. Neelakantan
2. http://ebookkdownload.blogspot.in/search/label/Electrical%20Engineering

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

1) http://www.power-eng.com/index.html
2) http://www.ieee-pes.org/
3) http://www.electricalsolutions.net.au/content/efficiency-renewables/article/emergency-lighting-an-essential-service-783180538
4) http://www.edisontechcenter.org/LauffenFrankfurt.html

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Transactions on power system	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=59
2	IEEE power engineering review	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=39
3	Power and Energy technology systems journal	http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=6687318

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous InternalEvaluation) and SEE (Semester End Examination) taken together.

The IPCC means the practical portion integrated with the theory of the course. CIE marks for the theory component are **25 marks** and that for the practical component is **25 marks**.

CIE for the theory component of the IPCC

- 25 marks for the theory component are split into **15 marks** for two Internal Assessment Tests (Two Tests, each of 15 Marks with 01-hour duration, are to be conducted) and **10 marks** for other assessment methods mentioned in 22OB4.2. The first test at the end of 40-50% coverage of the syllabus and the second test after covering 85-90% of the syllabus.

Scaled-down marks of the sum of two tests and other assessment methods will be CIE marks for the theory component of IPCC (that is for 25 marks).

- The student has to secure 40% of 25 marks to qualify in the CIE of the theory component of IPCC.

CIE for the practical component of the IPCC

- **15 marks** for the conduction of the experiment and preparation of laboratory record, and **10 marks** for the test to be conducted after the completion of all the laboratory sessions.
- On completion of every experiment/program in the laboratory, the students shall be evaluated including viva voce and marks shall be awarded on the same day.
- The CIE marks awarded in the case of the Practical component shall be based on the continuous evaluation of the laboratory report. Each experiment report can be evaluated for 10 marks. Marks of all experiments' write-ups are added and scaled down to **15 marks**.
- The laboratory test **(duration 02/03 hours)** after completion of all the experiments shall be conducted for 50 marks and scaled down to **10 marks.**
- Scaled-down marks of write-up evaluations and tests added will be CIE marks for the laboratory component of IPCC for **25 marks**.
- The student has to secure 40% of 25 marks to qualify in the CIE of the practical component of the IPCC. **SEE for IPCC**

<u>Semester End Examination</u>

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours**)

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored by the student shall be proportionally scaled down to 50 Marks

The theory portion of the IPCC shall be for both CIE and SEE, whereas the practical portion will have a CIE component only. Questions mentioned in the SEE paper may include questions from the practical component.

 The minimum marks to be secured in CIE to appear for SEE shall be 10 (40% of maximum marks-25) in the theory component and 10 (40% of maximum marks -25) in the practical component. The laboratory component of the IPCC shall be for CIE only. However, in SEE, the questions from the laboratory component shall be included**.** The maximum of 04/05 sub-questions are to be set from the practical component of IPCC, the total marks of all questions should not be more than 20 marks.

 SEE will be conducted for 100 marks and students shall secure 35% of the maximum marks to qualify for the SEE. Marks secured will be scaled down to 50.

 The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
I	1.	**Representation of Power System Components :** Introduction	20
	2.	Single-phase Representation of Balanced Three Phase Networks	
	3.	One-Line Diagram and Impedance or Reactance Diagram	
	4.	Per Unit (PU) System, Steady State Model of Synchronous Machine	
	5.	Power Transformer, Transmission of electrical Power, Representation of Loads.	
	6.	Numerical	
	7.	Numerical	
	8.	Numerical	
II	9.	**Symmetrical Fault Analysis:** Introduction	20
	10.	Transient on a Transmission Line	
	11.	Short Circuit of a Synchronous Machine(On No Load)	
	12.	Short Circuit of a Loaded Synchronous Machine	
	13.	Illustrative simple examples on power systems, Selection of Circuit Breakers	
	14.	Numerical	
	15.	Numerical	
	16.	Numerical	
III	17.	**Symmetrical Components:** Introduction	20
	18.	Symmetrical Component Transformation	
	19.	Phase Shift in Star-Delta Transformers	
	20.	Sequence Impedances of Transmission Lines , Sequence Impedances and Sequence Network of Power System	
	21.	Sequence Impedances and Networks of Synchronous Machine, Sequence Impedances of Transmission Lines , Sequence Impedances and Networks of Transformers	
	22.	Construction of Sequence Networks of a Power System	
	23.	Numerical	
	24.	Numerical	
IV	25.	**Unsymmetrical Fault Analysis:** Introduction, Symmetrical Component Analysis of Unsymmetrical Faults	20
	26.	Single Line-To-Ground (LG) Fault	
	27.	Line-To-Line (LL) Fault	
	28.	Double Line- To-Ground (LLG) Fault	
	29.	Open Conductor Faults	
	30.	Numerical	
	31.	Numerical	
	32.	Numerical	
V	33.	**Power System Stability:** Introduction	20
	34.	Dynamics of a Synchronous Machine	
	35.	Review of power angle equations , Simple Systems	
	36.	Steady State Stability, Transient Stability	
	37.	Equal Area Criterion	
	38.	Factors Affecting Transient Stability	
	39.	Multi machine stability studies, classical representation	
	40.	Numerical	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl.No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment test 1: Module 1-5	Students study 3ph-symmetrical faults & get practice to solve university questions.	All 5 Modules syllabus	4	Individual Activity. Written solution expected.	Text Book 1, additional reference 1,3
2	Assignment 2: Technical quiz including all 5 modules	Students study the unsymmetrical faults & get practice to solve University question papers	All 5 Modules syllabus	9	Individual Activity. Written solution expected.	Text Book 1, additional reference 1,3

14.0 QUESTION BANK

Module I (Representation of power system components)

1. What is reactance diagram?
2. What is Per Unit of a quantity? Illustrate by example.
3. Define per unit quantity & mention advantages of per unit system.
4. Show that Per Unit impedance of a transformer is same on either side of it.
5. Explain change of base quantities.
6. Write the advantages of per unit computations.
7. With an suitable examples explain one line diagram & discuss the elements represented.
8. What is single line diagram? Hence, explain the procedure of finding reactance diagrams, by listing all the assumptions individual.
9. Define per unit quality. Mention the advantages of P.U system.
10. Show that per unit impedance of a transformer remains same on both primary & secondary sides.
11. State the rule of inspection for finding bus admittance matrix, giving the expression for the matrix elements. Also indicate the situations where in this rule is not applicable.
12. A 300 MVA, 20KV 3-phase generator has a sub-transient reactance of 20%. The generator supplies two synchronous motors over a transmission line 64Km long. The rated input to the motor are 200MVA,& 100MVA respectively. The motors have a sub-transient reactance of 20%each. The 3-phase transformer T1 is rated 350MVA, 230Y/20Δ KV with leakage reactance of 10%. The transformer T2 is composed of three, 1-phase transformers connected as 3-phase, Y-Δ bank & each rated 100MVA, 127/13.2KV with leakage reactance of 20% each. The reactance of transmission line is 0.5Ω/Km. Draw the P.U. reactance diagram of the power system, selecting the generator rating as base in the generator circuit. If the motors M1 &M2 have outputs of 120MW &60MW respectively at 13.2 KV & both operating at u.p.f. find the voltage at the terminals of the generator.

Module II (Symmetrical fault analysis)

1. Show that the subtransient reactance of the synchronous machine is the smallest and the steady state reactance of the machine is highest among all the reactance's. i.e X"d < Xd'< Xd
2. Write about selection of circuit breakers.
3. Write about transients on a transmission line due to short circuit.
4. Explain the analysis of three-phase symmetrical faults by Kirchoffs laws
5. Explain symmetrical fault analysis by Thevenin's Theorem.
6. With the help of oscillagrams of short circuit current, of a synchronous generator, operating on no load, distinguish between sub-transient, transient & steady state periods. Also write the corresponding equivalent circuits, which are used in computing Xd", Xd' & Xd.
7. Explain why with reference to a synchronous machine, Xd"< Xd' < Xd with usual rotations.
8. Write a note on the selection of circuit breakers.
9. A 25MVA, 11Kv generator with Xd"=20% is connected through a transformer, line & a transformer to a bus. The load at bus consists of 3 motors each having Xd"=25% & Xd'=30% on a base of 5MVA, 6.6Kv. Transformer T1 is rated 25MVA,11/66kv with a leakage reactance of 10% & transformer T2 is rated 25MVA, 66/6.6KV with a

leakage reactance of 10%. The bus voltage at the motor is 6.6kv. When a 3-phase fault occurs at F for the specified fault
Compute:
i)subtransient current in the fault
ii)subtransient current in the breaker B
iii)Current to be interrupted by the breaker B in five cycles

10. A synchronous generator and motor are rated 30MVA, 13.2 kV and both have subtransient reactance of 20%. The line connecting them has a reactance of 10% on the base of the machine ratings. The motor drawing 20MW at 0.8 p.f leading and a terminal voltage of 12.8kV, when a symmetrical three phase fault occurs at the motor terminals. Find the subtransient current in the generator, motor and the fault by using internal voltages of the machines.

Module III (Symmetrical Components)

1. With the help of relevant vector diagrams for voltages establish the phase shift of symmetrical components in Y-Δ transformer bank.
2. Derive an expression for the 3Φ complex power in terms of symmetrical components.
3. What are symmetrical components? How they are useful in solution of power system.
4. What are sequence impedances and sequence networks?
5. Draw the zero sequence networks for various winding configurations of transformer.
6. Explain what symmetrical components are & how they are useful in solving the power system problems.
7. Write brief note on the significance of the operator "a".
8. Establishing the relation In = 3Iao with usual notations.
9. Prove that zero sequence component of currents only, flow through neutral.
10. Show that the symmetrical component transformation is power invariant.
11. Discuss on the phase shift of currents or voltages in Y- Δ transformers.
12. Define sequence impedances & sequence networks. Hence, indicate the zero sequence diagrams for various primary & secondary winding connection of a 3- ø transformer.
13. Show that positive, negative sequence voltages & currents undergo a phase shift, in passing through Y-Δ transformer & the phase shift is dependent on labeling of terminals.
14. Three identical resistors are star connected. The magnitude of the voltage at the terminals are Vab=200V, Vbc=290V, Vca=250V. Determine the sequence components of line to neutral voltage of phase 'a'.
15. The sequence components of the line to neutral voltage of a 3-phase system are, Va1=100<0V, Vb2=(10-j15)V, Vco=j15V. Determine line to neutral voltages.

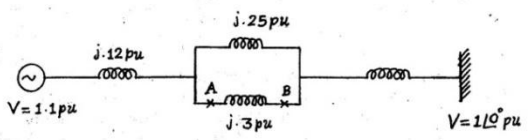
Module IV (Unsymmetrical fault analysis)

1. Derive an expression for fault current for LG fault on terminals of synchronous machine without Zf.
2. Derive an expression for fault current for LL fault on terminals of synchronous machine without Zf.
3. Derive an expression for fault current for LLG fault on terminals of synchronous machine with Zf.
4. Derive an expression for fault current for LG fault on Power system.
5. Write a note on open conductor faults on Power system.
6. Write a note on the significance of unsymmetrical fault analysis by symmetrical component transformation.
7. Define sequence impedances & sequence networks. Hence, indicate the zero sequence diagrams for various primary & secondary winding connection of a 3-ø transformer.
8. A single L-G fault occurs on phase 'a of an unloaded synchronous generator. Derive an expression for the fault current & for the post fault line to line voltages. Also prove that the equivalent circuit under fault conditions comprises of +ve, -ve & zero sequence networks in series.
9. Derive an expression for the fault current in terms of the sequence impedances & hence arrive at the connection diagram of sequence networks for a L-L fault at the terminals of a star connected generator.
10. A double line to ground fault occurs at the terminals of unloaded generator. Derive an expression for the fault currents, draw the connection of sequence networks.
11. A synchronous generator has its neutral ground through a reactance Xn. Zero sequence reactance of the generator is larger that the +ve & -ve sequence reactances.
12. Obtain expression for Xn such that SLG ault current is less than the 3-ø fault current.
13. Derive the expression for fault current if
    i) LG ii) LL iii) DLG
    fault occurs through a fault impedance Zf in a power system. Show the connections of sequence network to represent the fault.
14. Write a note on open conductor faults in power system.
15. A 30MVA,13.8Kv alternator has Xd"=15%, X2=15%, Xo=5%. The alternator supplies two motors over a transmission line having transformers at both ends. The motors have rated inputs of 20MVA & 10MVA. Both 12.5KV with 20% sub-transient reactance & X2=20%, & Xo=5%. The current limiting reactors of 2.0 Ω each are

in the neutral of the alternator & the larger motor. The 3-phase transformers are both rated 35MVA, 13.2Δ/115Y KV, with leakage reactance of 10% Series reactance of line is 80 Ω The zero sequence reactance of line is 200 Ω. Determine the fault current when i)L-G fault ii)L-L fault & iii)L-L-G fault takes place at point P on transmission line near transformer T1. Assume Vpf=1KV.

Module V (Power system stability)

1. Derive an expression for the swing equation.
2. Explain the terms: 1) Steady state stability ii) Transient stability and iii) dynamic stability as applied to power systems.
3. Derive a power angle equation for a non salient pole machine.
4. Explain the equal area criteria.
5. Discuss the methods of improving transient stability
6. Define inertia constant M&H for a synchronous machine. How they relate to each other?
7. What are the assumptions made in stability studies? How do you justify them?
8. Distinguish between steady state stability limit &transient limit.
9. Derive the power angle equation of a salient pole synchronous machine connected to an infinite bus. Draw the power angle curve.
10. Derive swing equation with usual notations.
11. Write a note on equal area criterion of stability.
12. A 4pole , 50 Hz 60 MW 0.8pf lag generator with a moment of inertia 30000kg-m2 is connected through a short line to another 2 pole, 50 Hz, 80MW, 0.85pf lag generator with moment of inertia 10000kg-m2. Determine the inertia constant of the equivalent single machine on a base of 20 MVA.
13. Determine the critical clearing angle for the network shown in fig, when a 3-phase fault takes place at B and the breaker at A and B operate simultaneously. The generator is delivering 1 pu power before fault takes place. Assume the inertia constant H=4.0



14. An a.c. generator is delivering 50% of maximum power to an infinite bus. Due to a sudden short circuit, the reactance between generator & infinite bus increases to 300% of the value before fault. The maximum power that can be delivered after clearance of fault is 70% of the original maximum value. Calculate the critical clearing angle to maintain the stability of the system.

Prepared by	Checked by		
Prof. Sujata G Huddar	**Prof. H. R. Zinage**	**HOD**	**Principal**

Subject Title	**CONTROL SYSTEMS**		
Subject Code	BEE602	**CIE Marks**	50
Number of Lecture Hrs / Week(L:T:P:S)	3:2:0:0	**SEE Marks**	50
Total Hours of Pedagogy	50	**Exam Hours**	03
			CREDITS – 04

FACULTY DETAILS:		
Name: Prof.O.B.Heddurshetti	**Designation:** Asst. Professor	**Experience:** 18
No. of times course taught: 05	**Specialization:** Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical &Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical &Electronics Engineering	I/II	Engineering Mathematics
03	Electrical &Electronics Engineering	III	Electrical Circuit Analysis

2.0 Course Objectives

- To analyze and model electrical and mechanical system using analogous systems.
- To formulate transfer functions using block diagram and signal flow graphs.
- To analyze the transient and steady state time response.
- To illustrate the performance of a given system in time and frequency domains, stability analysis using Rootlocus and Bode plots.
- To discuss stability analysis using Nyquist plots, Design controller and compensator for a given specification.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

	Course Outcome	RBT Level	POs
C316.1	Analyze and model electrical and mechanical system using analogous.	L4	1,2,3,8,12
C316.2	Determine transfer functions using block diagram and signal flow graphs.	L4	1,2,3,8,12
C316.3	Evaluate the stability of control system, ability to determine transient and steady state time response.	L5	1,2,3,8,12
C316.4	Evaluate the performance of a given system in time and frequency domains, analyze the stability using Root locus and Bode plots.	L5	1,2,3,8,12
C316.5	Discuss controllers and various compensators.	L3	1,2,3,8,12

4.0 Course Content

Module-1
Introduction to control systems: Introduction, classification of control systems.
Mathematical models of physical systems: Modeling of mechanical system elements, electrical systems, Analogous systems, Transfer function, Single input single output systems, Procedure for Deriving transfer functions, servomotors, gear trains.

Module-2
Block diagram: Elements of Block Diagram, Block diagram of a closed loop system, Block diagram reduction techniques, procedure for block diagram reduction to find transfer function. Numerical.
Signal flow graphs: Construction of signal flow graphs, definition of some important terms, basic properties of signal flow graph, Mason's gain formula, signal flow graph algebra, Numerical

Module-3
Time Domain Analysis: Introduction**,** Standard test signals, time response of first order systems, time response of second order systems, Time response specifications, steady state errors and error constants, Approximation of higher order systems and step response of second order systems withzero's.
Routh Stability criterion: BIBO stability, Necessary conditions for stability, Routh stability criterion, difficulties in formulation of Routh table, application of Routh stability criterion to linear feedback systems, relative stability analysis. Numerical

Module-4
Root locus : Introduction, root locus concepts, construction of root loci, rules for the construction of root locus. Numerical
Frequency domain analysis: Introduction, Co-relation between time and frequency response of 2^{nd}order systems only.
Bode plots: Basic factors G(iw)/H(jw), General procedure for constructing Bode plots, computation of gain margin and phase margin. Numerical

Module-5
Control Systems – Compensators and Controllers: Introduction, Phase-Lead Compensator, Phase-Lag Compensator, Lead-Lag Compensator. Proportional controller, Derivative controller, Integral controller, PD Controller, PI Controller, PID Controller,
State space model- Concepts of State, State variable and State model, State Model for linear continuous time systems, Transfer Function from State Space Model, State Transition Matrix and its Properties, Solution of state equation.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VI, VII & VIII	Project	Design of open loop and closed loop systems

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Design of control systems for Automobiles, including PEM fuel cells.
02	Industrial control of machines and processes.
03	Development of prototype models.

7.0 Gap Analysis and Mitigation

Sl No	Delivery Type	Details
01	Practical	Practical implementation of theoretical concepts can be done during practical sessions of the course control systems laboratory

8.0 Books Used and Recommended to Students

Text Books

1. Control Systems by Anand Kumar, 2nd Edition, 2014, PHI.

Reference Books

1. Automatic Control Systems by FaridGolnaraghi, Benjamin C. Kuo, Wiley , 9th Edition, 2010.
2. Control Systems Engineering by Norman S. Nise, 4th Edition, 2004.
3. Modern Control Systems by Richard C Dorf et al, Pearson, 11th Edition, 2008.
4. Control Systems, Principles and Design by M.Gopal,McGaw Hill, 4th Edition, 2012.
5. Control Systems Engineering by S. Salivahanan et al, Pearson, 1st Edition, 2015.

Additional Study material & e-Books

1. Control Engineering by Ganesh Rao and Chennavenkatesh, Pearson.

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

https://nptel.ac.in/courses/107/106/107106081/

https://www.tutorialspoint.com › control_systems

http://www.mee.tcd.ie/~sigmedia/pmwiki/uploads/Teaching.3C1/control_systems.pdf

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Xplore: IEEE Control Systems Magazine	www.ieeexplore.ieee.org
2	Journal of Control Theory and Applications, Journal of Real-Time Image Processing etc	www.Springer.com

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- There are 25 marks for the CIE's Assignment component and 25 for the Internal Assessment Test component.
- Each test shall be conducted for 25 marks. The first test will be administered after 40-50% of the coverage of the syllabus, and the second test will be administered after 85-90% of the coverage of the syllabus. The average of the two tests shall be scaled down to 25 marks.
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The schedule for assignments shall be planned properly by the course teacher. The teacher should not conduct two assignments at the end of the semester if two assignments are planned. Each assignment shall be conducted for 25marks. (If two assignments are conducted then the sum of the two assignments shall be scaled down to 25 marks)
- The final CIE marks of the course out of 50 will be the sum of the scale-down marks of tests and assignment/s marks.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (**duration 03 hours).**

- The question paper will have ten questions. Each question is set for 20 marks.
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module(total for 100marks).
- Marks scored shall be proportionally reduced to 50 marks.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
1	1	Introduction	20
	2	Classification of control systems	
	3	Modelling of mechanical system elements	
	4	Electrical systems	
	5	Analogous systems	
	6	Transfer function	
	7	Single input single output systems	
	8	Procedure for deriving transfer functions	
	9	Servomotors	
	10	Gear trains	
2	11	Block diagram of a closed loop system,	20
	12	procedure for drawing block diagram	
	13	Block diagram reduction problems	

	14	Block diagram reduction to find transfer function	
	15	Construction of signal flow graphs	
	16	Basic properties of signal flow graph	
	17	Signal flow graph algebra	
	18	construction of signal flow graph for control systems	
	19	Problems	
	20	Problems	
3	21	Standard test signals	20
	22	Time response of first order systems	
	23	Time response of second order systems	
	24	Steady state errors	
	25	Error constants	
	26	Types of control systems	
	27	Routh Stability criterion: BIBO stability	
	28	Necessary conditions for stability, Routh stability criterion	
	29	Difficulties in formulation of Routh table	
	30	Application of Routh stability criterion to linear feedback systems, relative stability analysis	
4	31	Introduction	20
	32	Root locus concepts	
	33	Construction of root loci	
	34	Rules for the construction of root locu	
	35	Frequency Response analysis: Co-relation between time and frequency response – 2 nd order systems only	
	36	Bode plots introduction	
	37	Bode plots: Basic factors G(iw)/H(jw	
	38	General procedure for constructing bode plots	
	39	computation of gain margin	
	40	computation of phase margin	
5	41	PD Controller	20
	42	PI Controller	
	43	PID Controller, Phase-Lead Controller	
	44	Phase - Lag Controller	
	45	Lead-Lag Controller	
	46	Concepts of State, State variable and State model	
	47	State Model for linear continuous time systems	
	48	Transfer Function from State Space Model	
	49	State Transition Matrix and its Properties	
	50	Solution of state equation.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

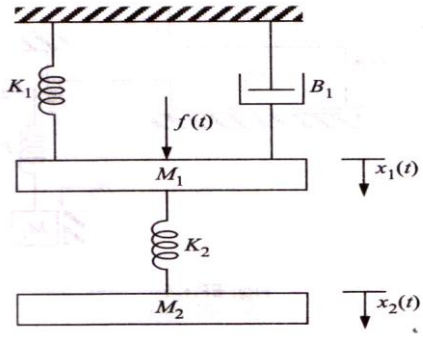
Sl.No	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1	Students will be able to demonstrate the mathematical modelling of electrical,	Module 1& 2 of the syllabus	4	Individual Activity.	Text Book 1

		mechanical and analogous systems and to apply block diagram and signal flow graph methods to obtain transfer function of systems.				
2	Assignment 2	Students will be able to investigate the performance of a given system, determine the stability of the system and design control system using different controllers.	Module 3, 4 & 5 of the syllabus	9	Individual Activity.	Text Book 1

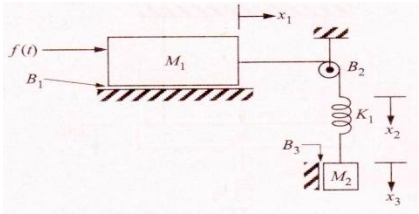
15.0 QUESTION BANK

MODULE 1

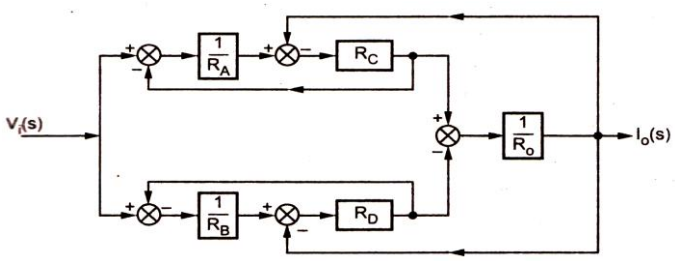
1) Define and compare open loop control systems with closed loop control system, with examples.
2) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force voltage analogy.



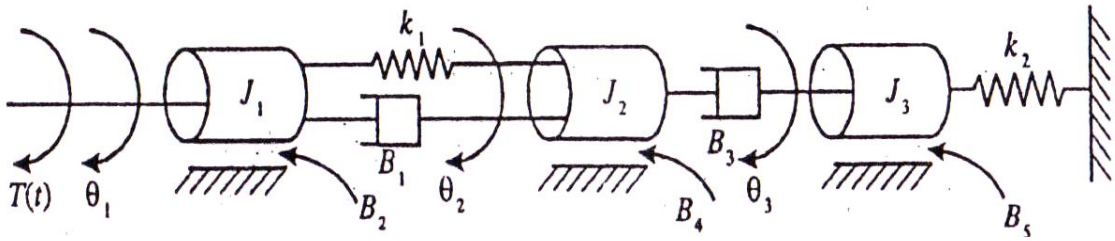
3) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force current.



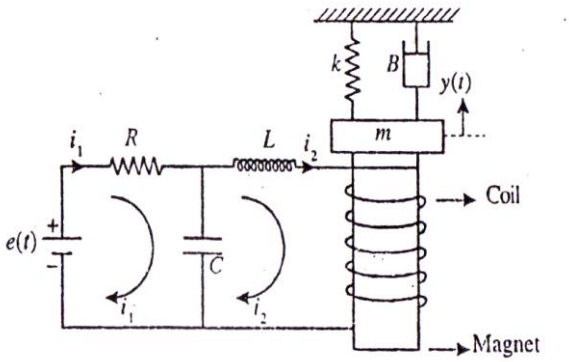
4) For the system shown in Fig. below determine $I_0(s)/V_i(s)$ by block diagram reduction technique.



5) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force voltage.



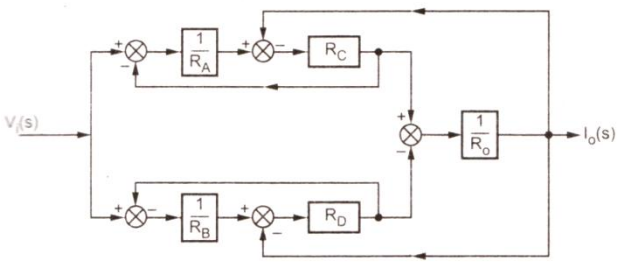
6) For the system shown in Fig. Write the equations of performance and draw its analogous circuit based on force voltage.



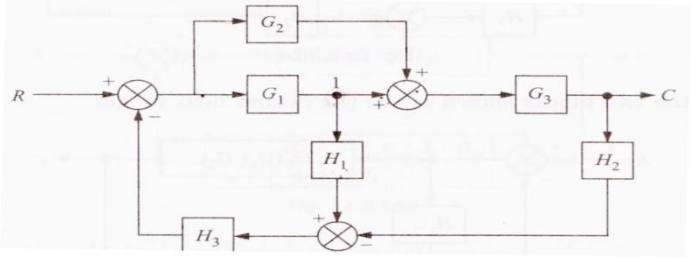
7) Obtain the transfer function of an armature controlled DC servomotor.
8) Mention merits and demerits of open loop and closed loop control systems and give an example for each.

MODULE 2

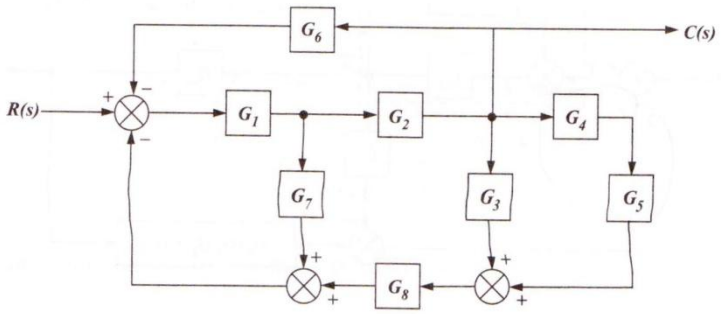
1) Determine the transfer function C(s)/R(s) of the system shown below by block diagram reduction method.



2) Determine the transfer function C(s)/R(s) of the system shown below by block diagram reduction method.

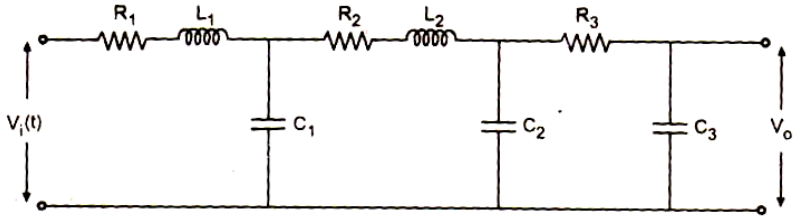


3) Determine the transfer function C(s)/R(s) of the system shown below by block diagram reduction method.

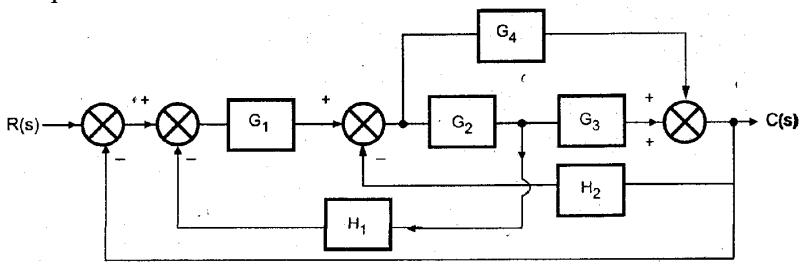


4) Discuss rule of block reduction technique in detail.

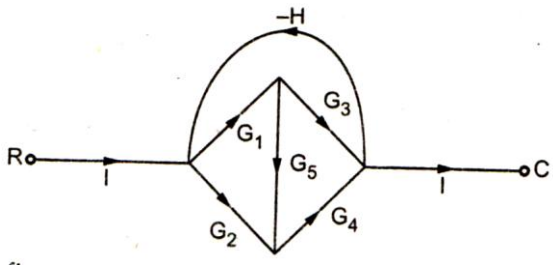
5) Draw a block diagram to describe the electrical circuit given in the Fig.



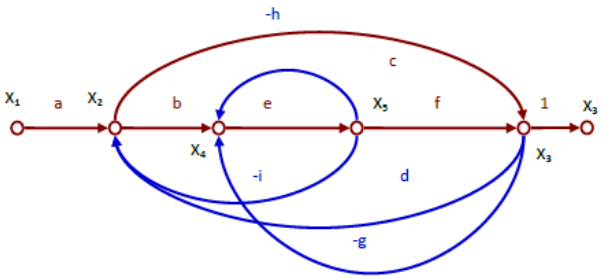
6) Obtain the overall transfer function for the block diagram shown below by the block diagram reduction technique.



7) Obtain MGF.



8) For the system described by the signal flow graph shown in fig, obtain the closed loop transfer function C(s) / R(s), using Mason's gain formula.



MODULE 3

1) Define the following for an under damped second order system.
   a) Rise Time b) Peak overshoot c) Settling Time.
2) Define the following terms
   a) Transient response b) steady state response.

3) Derive the expression for peak time.

4) The loop transfer function of transfer function is given by
   i) Determine the static error coefficients
   ii) Determine steady state error coefficients for the input r(t) = 2t2 + 5t +10

$$G(s)H(s) = \frac{100}{s^2(s+4)(s+12)}$$

5) Derive expressions for peak response time tpand maximum overshoot Mpof an under damped second order control system subjected to step input
6) For a unity feedback control system with G(s) = 10(S+2) / S2 (S+1). Find
   i) The static error coefficients
   ii) Steady state error when the input transform is

$$R(s) = \frac{3}{s} - \frac{2}{s^2} + \frac{1}{3s^2}$$

7) Explain Routh-Hurwitz's criterion for determining the stability of a system and mention any three limitations of R-H criterion.
8) Define: i) Marginally stable systems; ii) absolutely stable system; iii) conditionally stable systems.

MODULE 4

1) Sketch the root locus for a unity feedback control system with open loop transfer function:

$$G(s) = \frac{K}{s(s+6s+25)}$$

2) The open loop transfer function of a feedback control system in

$$G(s)H(s) = \frac{K}{(s+1)(s+2)(s+3)}$$

Check whether the following points are on the root locus. If so, find the value of K at these points, i) S = -1.5 ii) S = -0.5 + j2.

3) Sketch the root locus plot for a negative feedback control system characterized by an open loop transfer function, Comment on stability.

$$G(s)H(s) = \frac{K}{s(s+3)(s^2+3s+11.2s)}.$$

4) Define brake away / in point on a root locus. Explain any one method of determining the same.
5) State the advantages and limitations of frequency domain approach.
6) Determine the transfer function, of a system whose asyptotic gain plot is shown in fig.

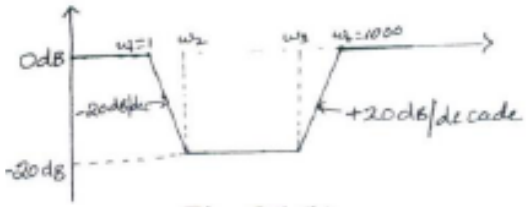


Fig. Q6 (b)

7) List the effects of lead compensation.

MODULE 5

1) What is Proportional controller and what are its advantages?
2) Explain the drawbacks in P-controller?
3) What is integral control action?
4) What are the advantages and disadvantages in integral controller?
5) What is PI controller?
6) What is PD controller?
7) What is PID controller?
8) Derive expressions for the transfer function of lead, lag and lead-lag compensators.
9) Explain the effects and limitations of phase lag control.

Prepared by	Checked by		
Prof. O. B. Heddurshetti	**Prof. H. R. Zinage**	**HOD**	**Principal**

Subject Title	**Embedded System Design**		
Subject Code	BEE613B	**CIE Marks**	50
Number of Lecture Hrs / Week (L:T:P:S)	3:0:0:0	**SEE Marks**	50
Total Number of Lecture Hrs	40 hours	**Exam Hours**	03
CREDITS – 03			

FACULTY DETAILS:		
Name: Prof. P. I. Savadatti	**Designation:** Asst. Professor	**Experience:**09
No. of times course taught:01	**Specialization:** Digital Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical and Electronics Engineering	III	Digital System Design

2.0 Course Objectives

To teach students

1. Introductory topics of Embedded System design
2. Characteristics & attributes of Embedded System
3. Introduction of Embedded System Software and Hardware development
4. RTOS based Embedded system design

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

	Course Outcome	Cognitive Level	POs
C318.1	Explain characteristics of Embedded System design	L_1,L_2,L_3	PO1, PO2, PO8, PO10, PO12
C318.2	Acquire knowledge about basic concepts of circuit emulators, debugging and RTOS	L_1,L_2,L_3	PO1, PO2, PO3, PO8, PO10, PO12
C318.3	Analyse embedded system software and hardware requirements	L_1,L_2,L_3	PO1, PO2, PO3, PO8, PO10, PO12
C318.4	Develop programming skills in embedded systems for various applications	L_1,L_2,L_3	PO1, PO2, PO3, PO8, PO10, PO12
C318.5	Design basic embedded system for real time applications	L_1,L_2,L_3	PO1, PO2, PO3, PO8, PO10, PO12
Total Hours of instruction		**40**	

4.0 Course Content

MODULE – 1

Introduction: Embedded Systems and general purpose computer systems, history, classifications, applications and purpose of embedded systems. Core of Embedded Systems : Microprocessors and microcontrollers, RISC and CISC controllers, Big endian and Little endian processors, Application specific ICs, Programmable logic devices, COTS, sensors and actuators, communication interface, embedded firmware, other system components, PCB and passive components.

MODULE – 2

Characteristics and quality attributes of embedded systems: Characteristics, Operational and nonoperational quality attributes, application specific embedded system - washing machine, domain specific – automotive.

MODULE - 3

Hardware Software Co design and Program Modelling : Fundamental issues in Hardware Software Co-design, Computational models in Embedded System Design Embedded Hardware Design and Development: Analog Electronic Components, Digital Electronic Components, VLSI & Integrated Circuit Design, Electronic Design Automation Tools.

MODULE – 4

Embedded Firmware Design and Development: Embedded Firmware Design Approaches, Embedded Firmware Development Languages, Embedded System Development Environments: Types of files generated on cross compilation (only explanation – programming codes need not be dealt), disassemble/decompliler, Simulators, Emulators and Debugging.

MODULE – 5

Real-time Operating System(RTOS) based Embedded System Design: Operating System basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling.

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VIII	Project work	Automation

6.0 Relevance to Real World

SL.No	Real World Mapping
01	8051 chips are used in a wide variety of control systems, telecom applications
02	Robotics as well as in the automotive industry.

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Additional programs related real world interfacing.

8.0 Books Used and Recommended to Students

Text Books: Suggested Learning Resources
1) Shibu K V, "Introduction to Embedded Systems", Second Edition, McGraw Hill Education

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
(1) NPTEL Lectures: https://nptel.ac.in/courses/108102045 Embedded Systems, IIT Delhi, Prof. Santanu Chaudhary

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	International journal of innovative research in technology	www.ijirt.org/master/publishedpaper/IJIRT.
2	Science Direct	www.sciencedirect.com/science/book

11.0 Examination Note

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered.

- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination: Theory SEE will be conducted by University as per the scheduled timetable, with common question papers for the course (duration 03 hours).

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), should have a mix of topics under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks.

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecture	% of Portion
1	1	Introduction: Embedded Systems and general purpose computer systems	20
	2	History, classifications, applications and purpose of embedded systems	
	3	Core of Embedded Systems : Microprocessors and microcontrollers	
	4	RISC and CISC controllers	
	5	Big endian and Little endian processors	
	6	Application specific ICs, Programmable logic devices, COTS	
	7	Sensors and actuators, communication interface, embedded firmware	
	8	other system components, PCB and passive components	
2	9	Characteristics of embedded systems	20
	10	Quality attributes of embedded systems	
	11	Operational quality attributes	
	12	Operational quality attributes	
	13	Nonoperational quality attributes	
	14	Application specific embedded system- washing machine	
	15	Application specific embedded system- domain specific	
	16	Application specific embedded system- automotive.	
3	17	Hardware Software Co design and Program Modelling	20
	18	Fundamental issues in Hardware Software Co-design	
	19	Computational models in Embedded System Design	
	20	Embedded Hardware Design and Development	
	21	Analog Electronic Components	
	22	Digital Electronic Components	
	23	VLSI & Integrated Circuit Design	
	24	Electronic Design Automation Tools	
4	25	Embedded Firmware Design and Development	20
	26	Embedded Firmware Design Approaches	
	27	Embedded Firmware Development Languages	
	28	Embedded System Development Environments	
	29	Types of files generated on cross compilation (only explanation – programming codes need not be dealt)	
	30	Disassemble/decompliler	
	31	Simulators	
	32	Emulators and Debugging	

5	33	Real-time Operating System(RTOS) based Embedded System Design	20
	34	Operating System basics	
	35	Types of Operating Systems	
	36	Tasks, Process	
	37	Threads	
	38	Multiprocessing	
	39	Multitasking	
	40	Task Scheduling	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1:	Students study the importance of Embedded system design.	Module 1 to 5	8	Individual Activity.	Text book no.1
2	Online Quiz	Students study the topics of all five modules.	All Modules of the syllabus.	12	Individual Activity.	Text book no.1

14.0 QUESTION BANK

Module 1:
1) Explain the different characteristics of embedded systems in detail
2)Explain the types of memory;
3)Explain Programmable Logic devices
4)Differentiate between microprocessor and microcontroller.
5)Differentiate between RISC and CISC.
6)Explain in detail Big endian and Little endian processors/controllers.
7)Differentiate between Harvard architecture and von-neumann architecture.

Module 2:
1)Explain the characteristics of an embedded systems.
2)Discuss in detail Quality Attributes of Embedded Systems.
3)Explain about product life cycle curve.
4)Explain the functionality of washing machine.
5)Explain the working of automotive embedded system.

Module 3:
1)Explain the fundamental issues in hardware software co-design.
2)Explain about the computational models in embedded design.
3)Discuss about sequential program model.
4)Explain object-oriented model.
5)Explain about hardware software trade offs

Module 4:
1)Explain about embedded firmware design approaches.
2)Describe the embedded firmware development languages.
3)Explain about the integrated development environment (IDE).
4)Explain about the types of files generated on cross-compilation.
5)Describe about disassemble/decompiler
6)Explain about simulators, emulators and debugging.

Module 5:
1)Explain about operating system basics.
2)Describe about types of operating systems.
3)Discuss in detail tasks, process and threads.
4) Differentiate between thread and process.
5)Explain in detail multiprocessing and multitasking.
6)Explain about task scheduling.

Prepared by	Checked by		
			
Prof. P. I. Savadatti	**Dr. M. P. Yenagimath**	**HOD**	**Principal**

Subject Title	PROJECT MANAGEMENT		
Subject Code	BME654A	**IA Marks**	50
Number of Lecture Hrs / Week	03	**SEE**	50
Total Number of Lecture Hrs	40	**Exam Hours**	03
		CREDITS – 03	

FACULTY DETAILS:		
Name: M S Futane	**Designation:** Asst. Professor	**Experience:**20
No. of times course taught:00	**Specialization:** Computer Integrated Manufacturing	

1.0 Course Objectives

1. To understand how to break down a complex project into manageable segments and use of effective project management tools and techniques to arrive at solution and ensure that the project meets its deliverables and is completed within budget and on schedule.
2. To impart knowledge on various components, phases and attributes of a project.
3. To prepare students to plan, develop, lead, manage and successfully implement and deliver projects within their chosen practice area.

2.0 Course Outcomes

On completion of the course, the students will be able to;

1. Understand the selection, prioritization and initiation of individual projects and strategic role of project management.
2. Understand the work breakdown structure by integrating it with organization also the scheduling and uncertainty in projects.
3. Understand risk management planning using project quality tools also the activities like purchasing, acquisitions, contracting, partnering and collaborations related to performing projects.
4. Determine project progress and results through balanced score card approach.
5. Draw the network diagram to calculate the duration of the project and reduce it using crashing.

3.0 Course Content

MODULE – 1

INTRODUCTION

Definition of project, characteristics of projects, understand projects, types of projects, scalability of project tools, project roles Project Selection and Prioritization– Strategic planning process, Strategic analysis, strategic objectives, portfolio alignment– identifying potential projects, methods of selecting projects, financial mode/scoring models to select projects, prioritizing projects, securing and negotiating projects. **08 hours**

MODULE 2

Planning Projects: Defining the project scope, Project scope checklist, Project priorities, Work Breakdown Structure (WBS), Integrating WBS with organization, coding the WBS for the information system.

Scheduling Projects: Purpose of a project schedule, historical development, how project schedules are limited and created, develop project schedules, uncertainty in project schedules, Gantt chart.

08hours

MODULE 3

Resourcing Projects: Abilities needed when resourcing projects, estimate resource needs, creating staffing management plant, project team composition issues.

Budgeting Projects: Cost planning, cost estimating, cost budgeting, establishing cost control.

Project Risk Planning: Risk Management Planning, risk identification, risk analysis, risk response planning,

Project Quality Planning and Project Kickoff: Development of quality concepts ,project quality management plan, project quality tools, kickoff project, baseline and communicate project management plan using Microsoft Project for project baselines. **08 hours**

MODULE 4

Performing Projects: Project supply chain management: -Plan purchasing and acquisitions, plan contracting, contact types, project partnering and collaborations, project supply chain management.

P**roject Progress and Results:** Project Balanced Score card Approach, Internal project, customer, financial issues,

Finishing the project: Terminate project early, finish projects on time, secure customer feedback and approval, knowledge management, perform administrative and contract closure.

08 hours

MODULE 5

Network Analysis: Introduction, network construction - rules, Fulkerson's rule for numbering the events, AON and AOA diagrams; Critical path method (CPM) to find the expected completion time of a project, floats; PERT for finding expected duration of an activity and project, determining the probability of completing a project, predicting the completion time of project; crashing of simple projects.

08 hours

4.0 Relevance to future subjects

Sl.No	Semester	Subject	Topics
01	VIII	Project work	Planning Projects, Scheduling Projects, Resourcing Projects, Budgeting Projects and Performing Projects.

5.0 Relevance to Real World

Sl. No	Real World Mapping
01	While working in an industry on project.

6.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Topic: Machining of difficult to machine materials

7.0 Books Used and Recommended to Students

Text Books
1 Project Management Timothy JK loppenborg Cengage Learning Edition2009
2 Project Management-A systems approach to planning scheduling and controlling Haroldkerzner CBS publication
3 Project Management S Choudhury McGraw Hill Education (India) Pvt. Ltd. New Delhi 2016
Reference Books
1 Project Management Penningt on Lawrence Mc Graw Hill
2 Project Management A Moder Joseph and Phillips New Yark Van Nostrand Reinhold
3 Project Management, Bhavesh M. Patel Vikas publishing House
Additional Study material & e-Books
1. "Contemporary project management" by Thimothy J Kloppenberg

8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
1) https://en.wikipedia.org/wiki/Project_management
2) https://www.manage.gov.in/studymaterial/PPM-E.pdf
3) https://www.scribd.com/document/475871105/FINAL-Word
4) https://www.planview.com/resources/guide/what-is-project-management/

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	Project management journal	https://journals.sagepub.com/toc/pmxa/current
2	International journal of project management	https://www.sciencedirect.com/science/article/pii/S0263786315001027
3	Complexity in project management	https://www.sciencedirect.com/science/article/pii/S1877050917323001
4	Project management planning and control	https://www.sciencedirect.com/book/9780081020203/project-management-planning-and-control

10.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passingmarkfortheCIEis40% of the maximum marks (20marksoutof 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20Marks (duration 01 hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the15thweek of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the Cos and Pos for **20Marks** (**duration01 hour**)

- At the end ofthe13thweek of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common/repeated for any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled time table, with common question papers f or the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.

The students have to answer 5 full questions, selecting one full question from each module **Assessment Details (both CIE and SEE)**

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The

minimum passing mark for the CIE is 40% of the maximum marks (20marksoutof 50). A student shall be deemed to have satisfied the academic requirements and earned the credits allotted to each subject/ course if the student secures not less than 35% (18 Marks out of 50) in the semester-end examination (SEE), and a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

Continuous Internal Evaluation:

Three Unit Tests each of **20Marks (duration01hour**)

- First test at the end of 5th week of the semester
- Second test at the end of the 10th week of the semester
- Third test at the end of the15th week of the semester

Two assignments each of **10 Marks**

- First assignment at the end of 4th week of the semester
- Second assignment at the end of 9th week of the semester

Group discussion/Seminar/quiz any one of three suitably planned to attain the Cos and Pos for **20 Marks (duration01 hours)**

- At the end of the13th week of the semester

The sum of three tests, two assignments, and quiz/seminar/group discussion will be out of 100 marks and will be **scaled down to 50 marks**

(To have less stressed CIE, the portion of the syllabus should not be common/repeated or any of the methods of the CIE. Each method of CIE should have a different syllabus portion of the course).

CIE methods/question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examination:

Theory SEE will be conducted by University as per the scheduled time table, with common question papers for the subject (**duration 03 hours)**

- The question paper will have ten questions. Each question is set for 20 marks. Marks scored shall be reduced proportionally to 50 marks
- There will be 2 questions from each module. Each of the two questions under a module (with a maximum of 3 sub-questions), **should have a mix of topics** under that module.
- The students have to answer 5 full questions, selecting one full question from each module.

11.0 Course Delivery Plan

Module	Lecture No.	Content of Lecturer	% of Portion
Module 1:	1	Introduction to Project Management, Definition of project, characteristics of projects, understand projects	20
	2	types of projects, scalability o project tools	
	3	project roles Project Selection and Prioritization – Strategic planning process	
	4	Strategic analysis, strategic objectives	
	5	portfolio alignment – identifying potential projects	
	6	methods of selecting projects	
	7	financial mode / scoring models to select projects	
	8	Prioritizing projects, Securing and negotiating projects.	
Module 2:	9	**Planning Projects:** Defining the project scope, Project scope checklist	20
	10	Project priorities, Work Breakdown Structure (WBS)	
	11	Integrating WBS with organization, coding the WBS for the information system.	
	12	**Scheduling Projects:** Purpose of a project schedule	
	13	historical development, how project schedules are limited and created	

	14	develop project schedules	
	15	uncertainty in project schedules	
	16	Gantt chart.	
Module 3:	17	**Resourcing Projects:** Abilities needed when resourcing projects, estimate resource needs	20
	18	creating staffing management plant, project team composition issues	
	19	**Budgeting Projects:** Cost planning, cost estimating	
	20	Cost budgeting, establishing cost control.	
	21	**Project Risk Planning**: Risk Management Planning, risk identification, risk analysis, risk response planning	
	22	**Project Quality Planning and Project Kick off:** Development of quality concepts, project quality management plan	
	23	project quality tools, kick off project, baseline and	
	24	Communicate project management plan using Microsoft Project for project baselines.	
Module 4:	25	**Performing Projects and Project supply chain management:** - Plan purchasing and acquisitions, plan contracting	20
	26	Contact types, project partnering and collaborations, project supply chain management.	
	27	**Project Progress and Results:** Project Balanced Scorecard Approach	
	28	Internal project, customer, financial issues	
	29	**Finishing the project:** Terminate project early, finish projects on time	
	30	secure customer feedback and approval	
	31	Knowledge management	
	32	Perform administrative and contract closure.	
Module 5:	33	**Network Analysis:** Introduction	20
	34	network construction - rules	
	35	Fulkerson's rule for numbering the events, AON and AOA diagrams	
	36	Critical path method (CPM) to find the expected completion time of a project floats	
	37	PERT for finding expected duration of an activity and project	
	38	determining the probability of completing a project	
	39	predicting the completion time of project	
	40	Crashing of simple projects.	

12.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book /website /Paper
1	Assignment 1:	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1& 2 of the syllabus	4	Individual Activity.	Books 1, 2 and 3 of the text book list
2	Assignment 2:	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 3,4 & 5 of the syllabus	9	Individual Activity.	Books 1, 2 and 3 of the text book list

13.0 QUESTION BANK

Module 1

1. What is a project?
2. What is project management?
3. What types of constraints are common to most projects?
4. Which deliverable authorizes the project team to move from Selecting & Initiating to Planning?
5. At what stage of a project life cycle are the majority of the "hands-on" tasks completed?
6. What are the five process groups of project management?
7. What are the 10 project management knowledge areas?
8. What two project dimensions are components of project performance?
9. How do you define project success?

10. How do you define project failure?
11. List four common causes of project failure.
12. What are three common ways of classifying projects?
13. List and describe each step in the strategic planning process.
14. Name five things that may be negotiated between a client company and a contractor company
15. What are some common reasons for project failure?

Module 2

1. List three reasons why understanding stake holder is important to successful project management.
2. What is the difference between an internal and external stake holder?
3. Which three criteria should you consider when prioritizing stakeholders?
4. Describe an AGILE "stand-up" meeting.
5. What three tasks comprise the "define scope" process?
6. Why is scope definition important?
7. What are two common causes of scope creep?
8. What does the acronym WBS stand for?
9. What are the advantages of using a WBS?
10. List three ways of organizing a WBS.
11. The lowest level of the WBS is known as?
12. What items are typically included in a work package description?
13. What is rolling wave planning?
14. What is uncontrolled change known as?
15. Why do project teams use change control systems?
16. List the major sections that should be included in a change request form, and tell why each is important.
17. When can the first draft of a project schedule be constructed?
18. What is the difference between an activity and a work package?
19. How can a **Gantt chart** be helpful in project planning?

Module 3

1. In addition to technical skills, what other skill must a project manager have in order to successful resource a project?
2. Why is it important to involve workers in the planning phase of a project when possible?
3. What are two techniques used to compress a project schedule?
4. When crashing a project, what two criteria are considered when deciding which activities to speed up?
5. What type of costs does not depend on the size of a project?
6. During which phase of a project do recurring costs typically occur?
7. What are some examples of expedited costs?
8. What is the purpose of an order of magnitude cost estimate?
9. What is the "time value of money," and why is it relevant to project management?
10. For a routine project, what is a typical percentage of total project costs that should be placed into contingency reserves? For an unusual project?
11. Should a project manager alone identify potential risks for the project? Why or why not?
12. During which stage of a project are most risks typically uncovered?
13. Are both qualitative and quantitative risk analyses used on all projects? Why or why not?
14. What is an example of transferring risk?
15. In the risk register, why should only one person be assigned "owner" of a risk?
16. Identify similarities and differences among TQM,ISO, and Six Sigma. What strengths and weaknesses are inherent in each of these approaches?
17. Discuss the areas of ISO. Which do you feel is most important and why?
18. Describe the process of achieving stake holder satisfaction. Why is it important to consider stakeholder satisfaction?
19. Describe the three outputs of quality control.
20. List the project quality tools you expect to use on your project. Tell where you plan to use each tool and why it is important.

Module 4

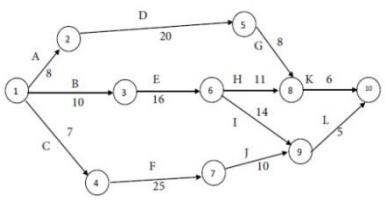
1. Do small businesses often outsource project work? Why or why not?
2. Which is the first of the four processes that make up project procurement management?
3. In supply chain management, what are some other names for the seller? What are some other names for the buyer?
4. List three functional areas that are frequently outsourced by business organizations.
5. What are some potential issues related to outsourcing?
6. What are four potential information sources that organizations can use to identify potential sellers?
7. Describe two methods that can be used to evaluate potential suppliers.
8. What items are generally included in a request for proposal?
9. What is the primary reason for determining project progress and results?
10. Which five aspects of project success are evaluated in the balanced scorecard approach?
11. Give three categories of internal project issues and an example of each.
12. In addition to the WBS, what might trigger project work to be authorized and performed?
13. What is an advantage of letting workers self-control their work?
14. How does one calculate schedule variance?
15. What does cost performance index (CPI) measure?
16. When does a project move into the closing stage?
17. What is validate scope?
18. What is the purpose of a "punch list"?
19. What should a project manager refer back to in order to make sure that all planned work has, in fact, been completed?
20. When might a contract clause be invoked?
21. If an early termination of his project seems likely, what two avenues can a project manager explore to increase the likelihood of being able to continue the project?

Module 5

1. What is network analyses? Write its salient feature.
2. Define following
   i) Pert
   ii) CPM
3. How 20 key project manager actions are organized? Explain.
4. What is material requirement planning (MRP)? define it with suitable example
5. How MRP is a 'push' system while JIT is a 'pull' system? explain it
6. Determine the critical path, the critical activities and the project completion time
   The following details are available regarding a project:

Activity	Predecessor Activity	Duration (Weeks)
A	-	3
B	A	5
C	A	7
D	B	10
E	C	5
F	D,E	4

7. Find out the completion time and the critical activities for the following project:



8. Draw the network diagram and determine the critical path for the following project

Activity	Time estimate (Weeks)
1- 2	5
1- 3	6
1- 4	3
2 -5	5
3 -6	7
3 -7	10
4 -7	4
5 -8	2
6 -8	5
7 -9	6
8 -9	4

9. Develop a network diagram for the project specified below

Activity	Immediate Predecessor Activity
A	-
B	A
C, D	B
E	C
F	D
G	E, F

Preparedby		
Prof. M S Futane	**HOD**	**Principal**
Course coordinator		

Subject Title	Consumer Electronics		
Subject Code	BEC654B	**IA Marks**	50
Number of Lecture Hrs /	03	**Exam Marks**	50
Total Number of Lecture Hrs	40	**Exam Hours**	03
		CREDITS – 03	

FACULTY DETAILS:		
Name: Prof. S. M. Patil	Designation: Asst. Professor	Experience: 2
No. of times course taught: 01	**Specialization:** VLSI & Embedded system	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electronics and Communication Engineering	I / II	Basic Electronics
02	Electronics and Communication Engineering	IV	Principles of Communication System

2.0 Course Objectives

Course Learning Objectives:

- To understand the working principles and classifications of various microphones and loudspeakers, and their roles in audio systems.
- To explore the structure, recording, and playback processes of Audio Compact Disc systems, along with error correction techniques and digital-to-analog conversion.
- To analyse the fundamentals of color television systems, including the transmission of color signals, and to study recent advances in television technology.
- To gain knowledge of modern consumer electronic devices such as mobile phones, home appliances, and computers, focusing on their applications and technological advancements.

3.0 Course Outcomes

Having successfully completed this course, the student will be able to

Course Code	Course Outcome	RBTL	POs
C319.1	Understand the functioning and classification of various types of microphones and loudspeakers	L1,L2	1,2,3,4,5,6 ,7,9,10,12
C319.2	Demonstrate knowledge of the optical recording and playback processes in audio compact disc systems	L1,L2	1,2,3,4,5,6, 7,9,10,12
C319.3	Analyse the principles of colour television and modern display technologies	L1,L2	1,2,3,4,5,6, 7,9,10,12
C319.4	Evaluate the working of cable television systems and miscellaneous consumer devices	L1,L2	1,2,3,4,5,6, 7,9,10,12
C319.5	Explore advancements in consumer electronics, such as mobile phones, computing devices, and home appliances	L1,L2	1,2,3,4,5,6, 7,9,10,12
Total Hours of instruction		**40**	

4.0 Course Content

Module-1:

Microphones: Introduction, Requirements, Quality of Microphones, Classification, Moving Coil Microphone, Ribbon Microphone, Condenser (or Capacitor) Microphone, Crystal Microphone, Carbon Microphone, Electret Microphone.

Loudspeakers: Introduction, Features of Loudspeaker, Moving Coil (Cone Type) Loudspeaker, Electrodynamic Loudspeaker, Horn Loudspeaker, Loudspeaker for High Fidelity Systems. **(8 hours)**

Module -2:

Audio Compact Disc Systems: Introduction, Comparison of CD and Tape, Optical Recording, Details of a Compact Disc, Details of Recording Process, Details of playback Process, Geometry of Audio Disc, Encoding Process and Error Correction, D/A Convertor, Handling of Compact Disc. **(8 hours)**

Module -3:

Colour Television: Introduction, Light Energy, Primary Colours, Tristimulus Values, Trichromatic Coefficients, Colour Triangle, Mixing of Colours, Grassman's Law, Colour Specifications, Bandwidth for Colour Signal Transmission. Chromaticity Diagram, Spectral and Non-Spectral Colours, Colour Circle, Visibility Curve, Digital Television (DTV) and High Definition Television (HDTV), Recent Advances in TV technology, LCD TV, LED TV, Plasma TV

(8 hours)

Module -4:

Cable Television: Introduction, Video Monitor, Closed Circuit Television (CCTV), Cable Television, Cable TV Using Internet.

Miscellaneous Devices: Digital Watch, Calculator, An Electronic Guessing Game, Cordless Telephone.

(8 hours)

Module -5:

Mobile Telephone, Cellular Telephone, UPS, Inverter, Decorative Lighting, Remote Control for TV and VCR, Facsimile (FAX), Pager, Microwave Oven, LCD Timer with Alarm, Electronic Ignition System for Automobiles, Washing Machine, Organisation of Digital computer, Microprocessor, Note Book, Laptop, Tablet PC, Ultrabook, IPAD, Recent Advances in Consumer Electronics. **(8 hours)**

5.0 Relevance to future subjects

Sl. No.	Semester	Subject	Topics
01	VIII	Project work	Communication based projects.

6.0 Relevance to Real World

Sl. No	Real World Mapping
01	Communication based projects.
02	Optical Fiber Communication

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	Tutorial	Android Mobile Application Development
02	NPTEL	Microelectronics: Devices to Circuits

8.0 Books Used and Recommended to Students

Text Books
1. B.R. Gupta, V. Singhal "Consumer Electronics", S.K. Kataria & Sons, 6th edition, 2013, ISBN 978-93-5014-407-7.
2. R.P.Bali, Consumer Electronics, Pearson Education (2008)

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
Web links and Video Lectures: • Android Mobile Application Development: • https://onlinecourses.swayam2.ac.in/nou24_ge66/preview • Microelectronics: Devices to Circuits: https://onlinecourses.nptel.ac.in/noc24_ee139/preview

10.0 Magazines/Journals Used and Recommended to Students

Sl. No	Magazines/Journals	Website
1	IEEE	https://ieeexplore.ieee.org/Xplore/home.jsp
2	PC World	http://www.pcworld.com/article/146957/components/article.html

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together.

Continuous Internal Evaluation:

1. For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.

2. The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered.

3. Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.

4. For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment.

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester-End Examination:

Theory SEE will be conducted by University as per the scheduled time table, with common question papers for the course (**duration 03 hours).**

1. The question paper will have ten questions. Each question is set for 20 marks.
2. There will be 2 questions from each module. Each of the two questions under a module (with a maximum of sub-questions), **should have a mix of topics** under that module.
3. The students have to answer 5 full questions, selecting one full question from each module.
4. Marks scored shall be proportionally reduced to 50 marks

12.0 Course Delivery Plan

Module No.	Lecture No.	Content of Lecturer	% of Portion
1	1	Introduction to microphones	20
	2	Classification of Microphone	
	3	Working of Moving coil, Ribbon and Condenser Microphone	
	4	Working of Crystal, Carbon and Electret Microphone	
	5	Introduction of Loudspeaker	
	6	Features and working of Cone Type Loudspeaker	
	7	Working of Carbon and Electret Microphone	
	8	Loudspeaker for High Fidelity System	
2	9	Introduction to Audio Compact Disc Systems	20
	10	Comparison of CD and Tape	
	11	Optical Recording	
	12	Details of a Compact Disc	
	13	Details of Recording Process	
	14	Details of playback Process	
	15	Geometry of Audio Disc, Encoding Process and Error Correction	
	16	D/A Convertor, Handling of Compact Disc	
3	17	Introduction, Light Energy, Primary Colours, Tristimulus Values	20
	18	Trichromatic Coefficients, Colour Triangle, Mixing of Colours	
	19	Grassman's Law, Colour Specifications	
	20	Bandwidth for Colour Signal Transmission	
	21	Chromaticity Diagram, Spectral and Non-Spectral Colours	
	22	Colour Circle, Visibility Curve, Digital Television (DTV)	
	23	Recent Advances in TV technology, High Definition Television (HDTV),	
	24	LCD TV, LED TV, Plasma TV	

4	25	Introduction of Cable Television	20
	26	Video Monitor	
	27	Closed Circuit Television (CCTV)	
	28	Cable Television	
	29	Cable Television Using Internet	
	30	Digital watch, Calculator	
	31	An Electronic Gueessing Game	
	32	Cordless Telephone	
5	33	Introduction of Mobile Telephone ,Cellular Telephone	20
	34	UPS, Inverter, Decorative Lighting	
	35	Remote Control for TV and VCR, Facsimile(FAX)	
	36	Pager, Microwave Oven, LCD Timer with Alarm	
	37	Electrical Ignition System for Automobiles, Washing Machine	
	38	Organization of Digital Computer, Microprocessor	
	39	Notebook, Laptop, Tablet PC, Ultrabook	
	40	IPAD, Recent Advances in Consumer Electronics	

13.0 Assignments

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 1,2&3 of the syllabus	6	Individual Activity.	Book 1, of the reference list. Website of the Reference list
2	Assignment 2: University Questions	Students study the Topics and write the Answers. Get practice to solve university questions.	Module 4, &5 of the syllabus	10	Individual Activity.	Book 1, 2 of the reference list. Website of the Reference list

14.0 QUESTION BANK

Module-1: Microphone and Loudspeaker

1. Explain the function of a microphone.
2. Working principle of moving coil microphone
3. Working principle of condenser microphone
4. Describe how a ribbon microphone differs from a dynamic microphone
5. Describe the working principle of loudspeaker with the help of labeled diagram
6. Explain the process of loudspeaker in high fidelity system
7. Working principle of Cone and Horn type loudspeaker

Module-2: Audio Compact Disc Systems

1. Explain the process of CD?
2. What is the difference between a tape disk and a compact disk?
3. What are three benefits of the CD over the cassette tape?
4. What is the function of error correction in CD audio playback?
5. Compare the contrast CD-R and CD-RW
6. What is playback and recording?
7. What are recording processes?
8. What are the basic steps in the recording process?
9. What are the three types of error correction?
10. What is the principle of D /A converter?

Module-3: Color Television

1. What is the concept of color TV?
2. What is the principle of color TV?
3. Which type of mixing is used in colour TV?
4. Which color model is used for TV broadcasting?
5. What is the grassman law of color mixing?
6. What is the Grassmann law in consumer electronics?
7. What is the bandwidth for colour signal?
8. What is bandwidth in signal transmission?
9. What is the bandwidth of TV signal for transmission?
10. What is the difference between spectral and non spectral colors?
11. What is spectral Colouring?
12. What is the difference between DTV and HDTV?
13. What is the difference between HDTV and regular TV?
14. How to use DTV on TV?
15. What is the latest technology in LED TV?
16. What is the technology of plasma TV?
17. What is the difference between LED TV and plasma TV?

Module-4: Cable Television

1. What are the disadvantages of plasma TV?
2. What is CCTV (closed circuit television)?
3. What is a CCTV monitoring system?
4. What is cable in CCTV?
5. What Is Cable Internet and How Does It Work?
6. What is the guessing game?
7. What is cordless telephone system?
8. What are the drawbacks of cordless phones?
9. What is the difference between a wireless phone and a cordless phone?

Module-5: Mobile Telephone, UPS, Recent Advances in Consumer Electronics

1. What is the difference between a mobile phone and a cellular phone?
2. What is meant by cellular telephone?
3. Why is the UPS light on in an inverter?
4. Which component is commonly used to generate microwave signals?
5. What is the electronic ignition system in a car?
6. What is the ignition system of an automobile?
7. Which microcontroller is used in a washing machine?
8. What is the microprocessor of a washing machine?
9. Explain the process of microprocessor and IPAD

Prepared by	Checked by		
Prof. S. M. Patil	Prof. S.S..Ittannavar	HOD	Principal

Subject Title	ENERGY MANAGEMENT IN ELECTRIC VEHICLES		
Subject Code	BEE657A	**IA Marks**	50
Number of Lecture Hrs /	1:0:0	**Exam Marks**	50
Total Number of Lecture Hrs	15	**Exam Hours**	02
Credits 01			

FACULTY DETAILS:		
Name: Prof. S. J. Patil	**Designation:** Assistant Professor	**Experience:** 12Years
No. of times course taught: 01	**Specialization:** Industrial Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Students should have the knowledge of basic subjects	1 & 2	IEE, Basic Electronics

2.0 Course Objectives

- To provide a comprehensive understanding of energy management principles and strategies specific to electric vehicles.
- To familiarize students with the various components and systems involved in energy management in electric vehicles.
- To equip students with the knowledge and skills to apply optimization techniques for efficient energy management in electric vehicles.

3.0 Course Outcomes

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

COs	Course Outcome	Cognitive Level	POs
C219.1	Understand the types, advantages, challenges and Energy management of EVs.	L1,L2	1,2,5,6,7,8,10 ,11,12
C219.2	Understand and analyze the energy storage technologies used in electric vehicles	L1,L2	1,2,3,5,6,7,8, 10,11,12
C219.3	Understand the design and implementation of energy management strategies for electric vehicles.	L1,L2	1,2,3,5,6,7,8, 10,11,12
C219.4	Understand optimization techniques and intelligent algorithms to optimize energy management.	L1,L2	1,2,5,6,7,8,10 ,11,12
C219.5	Understand the challenges & strategies for energy management in transportation, wireless charging technology & Vehicle – Vehicle communication for energy optimization.	L1,L2	1,2,3,5,6,7,8, 10,11,12
Total Hours		**15**	

4.0 Course Content

Module-1

Introduction to Electric Vehicles and Energy Management Overview of electric vehicles (EVs) - Types of EVs (Battery Electric Vehicles, Plug-in Hybrid Electric Vehicles); Advantages and challenges of EVs. Introduction to energy management in EVs - Importance of energy management; Key objectives of energy management in EVs. Electric vehicle components and systems- Battery systems; Power electronics and motor drive systems; Regenerative braking systems; Energy storage and management systems. **03 Hours**

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding.

Module-2

Fundamentals of Energy Management Energy storage technologies for EVs - Lithium-ion batteries; Solid-state batteries; Supercapacitors; Fuel cells. Battery charging and discharging techniques - Charging infrastructure for EVs; Charging modes (AC and DC charging); Fast charging vs. slow charging; Battery management systems (BMS). Energy efficiency and energy loss analysis - Losses in power electronics and motor drive systems; Losses in battery systems; Factors affecting energy efficiency in EVs **03 Hours**.

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding.

Module-3

Advanced Energy Management Strategies State-of-charge (SoC) estimation and management - SoC estimation techniques (Coulomb counting, Kalman filtering, etc.); SoC balancing techniques; Impact of SoC on battery life and performance. Power management strategies - Optimal power allocation between different vehicle systems; Dynamic power allocation based on driving conditions; Power flow control in EVs. Regenerative braking and energy recovery - Principles of regenerative braking; Control strategies for regenerative braking; Energy recovery and utilization. **03 Hours**.

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding

Module-4

Optimization Techniques for Energy Management Optimization models for energy management - Linear programming and nonlinear optimization; Model predictive control (MPC) for energy management; Genetic algorithms and other heuristic optimization techniques. Intelligent energy management systems - Artificial intelligence (AI) and machine learning techniques for energy management; Reinforcement learning-based energy management; Data- driven approaches for energy optimization. Realtime energy management algorithms - Real-time optimization algorithms for energy allocation; Adaptive control strategies for energy management; Integration of energy management with navigation systems.

03 Hours

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding.

Module-5

Case Studies and Applications Energy management in electric buses and fleet management - Challenges and strategies for energy management in public transportation; Fleet management and scheduling optimization. Energy management in electric vehicles charging infrastructure - Smart charging stations and grid integration; Demand-side management and load balancing. Emerging trends and future directions in energy management - Wireless charging technologies; Vehicle-to-vehicle (V2V) communication for energy optimization; Advanced energy storage and conversion technologies **03 Hours**

Revised Bloom's Taxonomy Level L1 – Remembering, L2 – Understanding

5.0 Relevance to future subjects

Sl No	Semester	Subject	Topics
01	VII/VIII	Project work	Electric Vehicles

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Analyze different batteries , Charging and Discharging Systems
02	Case study of Energy management in electric buses and Wireless charging system

7.0 Gap Analysis and Mitigation

Sl. No	Delivery Type	Details
01	NPTEL	https://kristujayanti.digimat.in/nptel/courses/video/108106170/L07.html
02	NPTEL	https://www.youtube.com/watch?v=3E1SXG7VkQk

8.0 Books Used and Recommended to Students

Text Books

1. "Electric Vehicle Technology" by H. C. Rai
2. "Electric Vehicle Energy Management System for Efficiency Optimization" by Jingang Han, Linlin Tan, and Xinbo Ruan
3. "Advanced Electric Drive Vehicles" edited by Ali Emadi
4. "Electric Vehicle Technology Explained" by James Larminie and John Lowry

9.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References

1. **http://kcl.digimat.in/nptel/courses/video/108106170/L74.html**
2. **https://digimat.in/nptel/courses/video/108106182/L94.html**

10.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Explorer	https://ieeexplore.ieee.org/document/8421346/
2	International Journal of Science and Technology	https://www.mdpi.com/journal/wevj

11.0 Examination Note

Assessment Details (both CIE and SEE)

The weightage of Continuous Internal Evaluation (CIE) is 50% and for Semester End Exam (SEE) is 50%. The minimum passing mark for the CIE is 40% of the maximum marks (20 marks out of 50) and for the SEE minimum passing mark is 35% of the maximum marks (18 out of 50 marks). The student is declared as a pass in the course if he/she secures a minimum of 40% (40 marks out of 100) in the sum total of the CIE (Continuous Internal Evaluation) and SEE (Semester End Examination) taken together

CIE for the theory component of the IPCC

- For the Assignment component of the CIE, there are 25 marks and for the Internal Assessment Test component, there are 25 marks.
- The first test will be administered after 40-50% of the syllabus has been covered, and the second test will be administered after 85-90% of the syllabus has been covered
- Any two assignment methods mentioned in the 22OB2.4, if an assignment is project-based then only one assignment for the course shall be planned. The teacher should not conduct two assignments at the end of the semester if two assignments are planned.
- For the course, CIE marks will be based on a scaled-down sum of two tests and other methods of assessment

Internal Assessment Test question paper is designed to attain the different levels of Bloom's taxonomy as per the outcome defined for the course.

Semester End Examinations (SEE)

SEE paper shall be set for 50 questions, each of the 01 marks. The pattern of the question paper is MCQ (multiple choice questions). The time allotted for SEE is 01 hour. The student has to secure a minimum of 35% of the maximum marks meant for SEE.

12.0 Course Delivery Plan

Module	Lecture No.	Content of Lecture	% of Portion
1	1.	Types of EVs (Battery Electric Vehicles, Plug-in Hybrid Electric Vehicles); Advantages and challenges of EVs. Introduction to energy management in EVs - Importance of energy management	20
	2.	Key objectives of energy management in EVs. Electric vehicle components and systems- Battery systems	
	3.	Power electronics and motor drive systems; Regenerative braking systems; Energy storage and management systems	
2	4	Lithium-ion batteries; Solid-state batteries; Supercapacitors; Fuel cells. Battery charging and discharging techniques - Charging infrastructure for EVs;	20
	5	Charging modes (AC and DC charging); Fast charging vs. slow charging; Battery management systems (BMS). Energy efficiency and energy loss analysis	
	6	Losses in power electronics and motor drive systems; Losses in battery systems; Factors affecting energy efficiency in EVs.	
3	7	SoC estimation techniques (Coulomb counting, Kalman filtering, etc.); SoC balancing techniques; Impact of SoC on battery life and performance. Power management strategies	20
	8	Optimal power allocation between different vehicle systems; Dynamic power allocation based on driving conditions; Power flow control in EVs. Regenerative braking and energy recovery	
	9	Principles of regenerative braking; Control strategies for regenerative braking; Energy recovery and utilization	
4	10	Linear programming and nonlinear optimization; Model predictive control (MPC) for energy management; Genetic algorithms and other heuristic optimization techniques.	20

	11	Intelligent energy management systems - Artificial intelligence (AI) and machine learning techniques for energy management; Reinforcement learning-based energy management; Data- driven approaches for energy optimization.	
	12	Real time energy management algorithms - Real-time optimization algorithms for energy allocation; Adaptive control strategies for energy management; Integration of energy management with navigation systems.	
5	13	Challenges and strategies for energy management in public transportation; Fleet management and scheduling optimization. Energy management in electric vehicles charging infrastructure.	**20**
	14	Smart charging stations and grid integration; Demand-side management and load balancing. Emerging trends and future directions in energy management.	
	15	Wireless charging technologies; Vehicle-to-vehicle (V2V) communication for energy optimization; Advanced energy storage and conversion technologies.	

13.0 Assignments, Pop Quiz, Mini Project, Seminars

Sl. No.	Title	Outcome expected	Allied study	Week No.	Individual / Group activity	Reference: book/website /Paper
1	Assignment 1: University Questions on Electrical Vehicles.	Students study the Topics and will prepare for Final Exam.	Module-1, 2 & 3 of the syllabus	9	Individual Activity	Text Book 1&4
2	MCQ: University Questions on Energy management and charging system	Students study the Topics and will prepare for Final Exam.	Module-3,4 & 5 of the syllabus	12	Individual Activity.	Text Book 2& Text Book 3

14.0 QUESTION BANK

DESCRIPTIVE QUESTIONS

1.Elaborate on and compare the energy sources for EV and HEV.
2. Draw and explain the configurational block diagram of EV.
3. Draw and explain the architecture of Series and Series -Parallel hybrid electric drive train and explain any one of them.
4. Compare EV, HEV and PHEV technologies.
5. Describe the power flow control in electric drive train topologies for HEV for parallel configuration.
6. Calculate Peukert capacity of a battery of 130Ah with C10(10hr) rating and Peukert coefficient=1.2
7. Describe the concept of "Hybridness" and Classify HEV on basis of hybridness
8. What are the different charging methods used in EV? Elaborate on standards adopted for same worldwide.
9. What is tractive effort? Explain aerodynamic drag in detail.
10. Compare various types of DC and AC machines used for EV applications.
11. What is the need of electric vehicle and hybrid electric vehicle?
12. State and define any five key battery parameters.
13. What are the different types of energy storage devices? Explain any one in detail.
14. A lead acid battery of 240V,120 Ah capacity is used for EV drive, provides average of 240wh/km to motor. Calculate distance covered in single charge. Assume efficiency as 90% and DOD as 50%.
15. Classify energy management strategies used in hybrid electric vehicle.
16. Draw the schematic of general configuration of electrical subsystem of an Electric Vehicle (EV) and a Hybrid Electric Vehicle (HEV).
17. State and define the key battery parameters (i) Battery capacity (ii) C rate (iii) SoC (iv) DoD (v) Specific Energy (vi) Energy Density.
18. Describe the concept of "Hybridness" and classify the HEV based on hybridness.
19. Describe in detail all modes of operation of a series hybrid vehicle
20. Explain the terms rolling resistance and aerodynamic drag in vehicles and derive the expression for vehicle translational speed from fundamentals
21. What is the need and importance of EV and HEV?
22. Explain energy management system in short.

Objective Questions:

1. What is the primary source of propulsion in an electric vehicle?
a) Gasoline
b) Diesel
c) Electric motor
d) Hydrogen fuel cell
Answer: c) Electric motor

2. What is the main component that stores electrical energy in an electric vehicle?
a) Radiator
b) Battery pack
c) Carburetor
d) Exhaust pipe
Answer: b) Battery pack

3. Which type of batter
y is commonly used in modern electric vehicles due to its high energy density and efficiency?
a) Nickel-Cadmium (NiCd)
b) Lead-Acid
c) Lithium-Ion (Li-ion)
d) Alkaline
Answer: c) Lithium-Ion (Li-ion)

4. What feature in electric vehicles converts kinetic energy generated during braking into electrical energy to recharge the battery?
a) Solar panels
b) Regenerative braking
c) Turbocharger
d) Radiator fan
Answer: b) Regenerative braking

5. Where can electric vehicles be charged?
a) Gas stations
b) Charging stations
c) Car wash
d) Traffic signals
Answer: b) Charging stations

6. What does EV stand for in the context of electric vehicles?
a) Electric Voltage
b) Eco-Vehicle
c) Electric Vehicle
d) Efficient Van
Answer: c) Electric Vehicle

7. Which type of electric vehicle has both an electric motor and an internal combustion engine?
a) Battery Electric Vehicle (BEV)
b) Hybrid Electric Vehicle (HEV)
c) Plug-in Hybrid Electric Vehicle (PHEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: c) Plug-in Hybrid Electric Vehicle (PHEV)

8. What is the driving range of an electric vehicle?
a) The top speed it can reach
b) The time it takes to charge the battery
c) The distance it can travel on a single charge
d) The weight of the vehicle
Answer: c) The distance it can travel on a single charge

9. What is the process of charging an electric vehicle at home using a regular electrical outlet called?
a) Fast charging
b) Level 3 charging

c) Level 2 charging
d) Trickle charging
Answer: d) Trickle charging

10. Which component in an electric vehicle allows the driver to control the speed and direction of the vehicle?
a) Battery pack
b) Electric motor
c) Charging port
d) Drive-by-wire system
Answer: d) Drive-by-wire system

11. What is the term used for electric vehicles that have both an electric motor and an internal combustion engine, but the engine is used as a backup to extend range?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: b) Plug-in Hybrid Electric Vehicle (PHEV)

12. Which type of electric vehicle relies solely on electricity and does not have an internal combustion engine?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: a) Battery Electric Vehicle (BEV)

13. What is the term used for the process of supplying electric power to an electric vehicle for charging purposes?
a) Electrification
b) Charging
c) Plugging in
d) Refueling
Answer: b) Charging

14. Which type of electric vehicle uses hydrogen and oxygen to generate electricity and produce water vapor as the only byproduct?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: d) Fuel Cell Electric Vehicle (FCEV)

15. What is the approximate charging time for a fast-charging station to charge an electric vehicle to 80% capacity?
a) 5 minutes
b) 30 minutes
c) 1 hour
d) 8 hours
Answer: b) 30 minutes

16. Which type of electric vehicle uses a combination of an electric motor and a traditional internal combustion engine, where the engine is the primary source of propulsion?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: c) Hybrid Electric Vehicle (HEV)

17. What is the term used for the energy efficiency of an electric vehicle, measured in miles (or kilometers) driven per unit of energy consumed (e.g., miles per kilowatt-hour)?
a) Energy density
b) Energy efficiency
c) Range anxiety
d) Electric vehicle efficiency
Answer: d) Electric vehicle efficiency

18. Which component of an electric vehicle's charging system controls the flow of electricity to the battery during charging?
a) Charging port
b) Charging cable
c) Onboard charging controller
d) Power inverter
Answer: c) Onboard charging controller

19. What is the process called when an electric vehicle uses its own energy to produce electricity and supply it back to the grid during peak demand periods?
a) Vehicle-to-Grid (V2G)
b) Grid-to-Vehicle (G2V)
c) Peak demand charging
d) Grid balancing
Answer: a) Vehicle-to-Grid (V2G)

20. Which type of electric vehicle uses a combination of an electric motor and a traditional internal combustion engine, where the electric motor is the primary source of propulsion?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: b) Plug-in Hybrid Electric Vehicle (PHEV)

21. What is the term used for the process of recharging an electric vehicle at a fast-charging station that provides higher power output than standard charging stations?
a) Level 3 charging
b) Rapid charging
c) Trickle charging
d) Level 2 charging
Answer: a) Level 3 charging

22. Which type of electric vehicle uses a fuel cell to generate electricity from hydrogen to power an electric motor?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: d) Fuel Cell Electric Vehicle (FCEV)

23. Which organization or standard is responsible for establishing the charging interface protocol used in many electric vehicles and charging stations?
a) ISO 9001
b) UL (Underwriters Laboratories)
c) SAE International (Society of Automotive Engineers)
d) IEEE (Institute of Electrical and Electronics Engineers)
Answer: c) SAE International (Society of Automotive Engineers)

24. What is the term used for the fear or anxiety experienced by electric vehicle drivers about running out of battery charge before reaching their destination?
a) Range anxiety
b) Charging stress
c) Battery panic
d) EV worry
Answer: a) Range anxiety

25. Which component of an electric vehicle cools down the electric motor and other components to prevent overheating during operation?
a) Radiator
b) Exhaust pipe
c) Cooling fan
d) Carburetor
Answer: c) Cooling fan

26. What is the term used for the process of transmitting electricity from the power grid to an electric vehicle for charging purposes?
a) Electrification
b) Transmission
c) Grid-to-Vehicle (G2V)
d) Charging
Answer: c) Grid-to-Vehicle (G2V)

27. Which type of electric vehicle uses only an electric motor for propulsion and does not have an internal combustion engine as a backup?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: a) Battery Electric Vehicle (BEV)

28. What is the approximate time for charging an electric vehicle using a Level 2 charging station to reach full battery capacity?
a) 5 minutes
b) 30 minutes
c) 2-8 hours
d) 24 hours
Answer: c) 2-8 hours

29. Which type of electric vehicle is powered by electricity generated by burning fossil fuels in a power plant?
a) Battery Electric Vehicle (BEV)
b) Plug-in Hybrid Electric Vehicle (PHEV)
c) Hybrid Electric Vehicle (HEV)
d) Fuel Cell Electric Vehicle (FCEV)
Answer: d) Fuel Cell Electric Vehicle (FCEV)

30. What is the term used for the process of supplying electricity from an electric vehicle's battery back to the power grid during periods of high demand or emergencies?
a) Grid balancing
b) Vehicle-to-Grid (V2G)
c) Peak demand charging
d) Grid support
Answer: b) Vehicle-to-Grid (V2G)

Prepared by	Checked by		
			
Prof. S. J. Patil	**Dr. M. P. Yenagimath**	**HOD**	**Principal**

Subject Title	**CONTROL SYSTEM LABORATORY**		
Subject Code	BEEL606	**CIE Marks**	50
Number of Practical Hours/Week(L:T:P)	0:02:02	**SEE Marks**	50
Total No of Practical Hrs	48	**Exam Hours**	03
		CREDITS – 01	

FACULTY DETAILS:		
Name: Shri. O. B.Heddurshetti	**Designation:** Asst. Professor	**Experience:** 18 Years
No. of times course taught: 05 Times	**Specialization:** Power Electronics	

1.0 Prerequisite Subjects:

Sl. No	Branch	Semester	Subject
01	Electrical & Electronics Engineering	I/II	Basic Electrical Engineering
02	Electrical & Electronics Engineering	IV	Electric Motors
03	Electrical & Electronics Engineering	VI	Control System

2.0 Course Objectives

- To draw the speed torque characteristics of AC and DC servo motor.
- To determine the time and frequency reposes of a given second order system using discrete components.
- To design and analyze Lead, Lag and Lag – Lead compensators for given specifications.
- To study the feedback control system and to study the effect of P, PI, PD and PID controllerand Lead compensator on the step response of the system.
- To simulate and write a script files to plot root locus, bode plot, to study the stability ofthe system

3.0 Course Outcomes

The student, after successful completion of the course, will be able to

CO	Course Outcome	Cognitive Level	POs
C329.1	Determine the speed – torque characteristics of a D.C. and A.C. servomotor & Synchro pair characteristics.	L3	1,2,3,8,9, 10,12
C329.2	Determine time response characteristics of a second order system using MATLAB and frequency response characteristics of a second order system using MATLAB and experimental setup and evaluate time and frequency domain specifications.	L5	1,2,3,5,8, 9,10,12
C329.3	Design passive RC lead, lag, lead-lag compensating network for given specifications and determine the frequency response characteristics of the same using MATLAB and experimental setup.	L5	1,2,3,5,8, 9,10,12
C329.4	Determine the effect of P, PI, PD and PID controller on the step response of a feedback control system using MATLABand experimental setup.	L5	1,2,3,5,8, 9,10,12
C329.5	Demonstrate a DC position control system by using MATLAB and determine its step response.	L3	1,2,3,5,8, 9,10,12
C329.6	Examine the stability of a system by root locus, bode plot and Nyquistplot methods, verify and compare the same by using MATLAB.	L4	1,2,3,5,8, 9,10,12

4.0 Course Content

Sl. No.	LIST OF EXPERIMENTS
1	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor
2	Experiment to draw synchro pair characteristics
3	Experiment to determine frequency response of a second order system
4	(a) To design a passive RC lead compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response.
5	(a) To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response. (b) To determine experimentally the transfer function of the lag compensating network
6	Experiment to draw the frequency response characteristics of the lag – lead compensator network and determination of its transfer function.
7	To study a second order system and verify the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.
8	(a) To simulate a typical second order system and determine step response and evaluate time response specifications. (b)To evaluate the effect of adding poles and zeros on time response of second order system. (c) To evaluate the effect of pole location on stability.
9	(a) To simulate a D.C. Position control system and obtain its step response. (b)To verify the effect of input waveform, loop gain and system type on steady state errors. (c) To perform trade-off study for lead compensator. (d) To design PI controller and study its effect on steady state error.
10	(a) To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response. (b) To study the effect of open loop gain on transient response of closed loop system using root locus.
11	(a) To study the effect of open loop poles and zeros on root locus contour. (b) Comparative study of Bode, Nyquist and root locus with respect to stability.

5.0 Relevance to future subjects

SL. No	Semester	Subject	Topics / Relevance
01	VII &VIII	Project work	System Control Applications

6.0 Relevance to Real World

SL. No	Real World Mapping
01	Control system has a wide range of applications from the flight and propulsion systems of commercial airliners to the cruise control present in many modern automobiles. In most cases, control engineers utilize feedback while designing control systems. This is often accomplished using a PID controller system

7.0 Books Used and Recommended to Students

Text Books
1. Control Systems by Anand Kumar, 2nd Edition, 2014, PHI.
Reference Books
1. Automatic Control Systems by FaridGolnaraghi, Benjamin C. Kuo, Wiley , 9th Edition, 2010. 2. Control Systems Engineering by Norman S. Nise, 4th Edition, 2004. 3. Modern Control Systems by Richard C Dorf et al, Pearson, 11th Edition, 2008. 4. Control Systems, Principles and Design by M.Gopal ,McGaw Hill, 4th Edition, 2012. 5. Control Systems Engineering by S. Salivahanan et al, Pearson, 1st Edition, 2015.
Additional Study material & e-Books
1. Control Engineering by Ganesh Rao and Chennavenkatesh, Pearson.

8.0 Relevant Websites (Reputed Universities and Others) for Notes/Animation/Videos Recommended

Website and Internet Contents References
1) www.VSSUT.ac.in
2) https://nptel.ac.in/courses/107/106/107106081/
3) www.Smartzworld.com
4) www.Scribd.com

9.0 Magazines/Journals Used and Recommended to Students

Sl.No	Magazines/Journals	website
1	IEEE Xplore: IEEE Control Systems Magazine	www.ieeexplore.ieee.org
2	Journal of Control Theory and Applications, Journal of Real-Time Image Processing etc	www.Springer.com

10.0 Examination Note

Conduct of Practical Examination:

1. All Laboratory experiments are to be included for practical examination
2. Breakup of marks and the instructions printed on the cover page of answer script to be strictly adhered by the examiners.
3. Students can pick one experiment from the questions lot prepared by the examiners.
4. Change of experiment is allowed only once and 15% marks allotted to the procedure part shall be made zero.

Continuous Internal Evaluation (CIE):

CIE marks for the practical course is **50 Marks**.

The split-up of CIE marks for record/ journal and test are in the ratio **60:40**.

- Each experiment to be evaluated for conduction with observation sheet and record write-up. Rubrics for the evaluation of the journal/write-up for hardware/software experiments designed

by the faculty who is handling the laboratory session and is made known to students at the beginning of the practical session.

- Record should contain all the specified experiments in the syllabus and each experiment write-up will be evaluated for 10 marks.
- Total marks scored by the students are scaled downed to 30 marks (60% of maximum marks).
- Weightage to be given for neatness and submission of record/write-up on time.
- Department shall conduct 02 tests for 100 marks, the first test shall be conducted after the 8th week of the semester and the second test shall be conducted after the 14th week of the semester.
- In each test, test write-up, conduction of experiment, acceptable result, and procedural knowledge will
  carry a weightage of 60% and the rest 40% for viva-voce.
- The suitable rubrics can be designed to evaluate each student's performance and learning ability.
- The average of 02 tests is scaled down to **20 marks** (40% of the maximum marks).
- The Sum of scaled-down marks scored in

Semester End Evaluation (SEE):

- SEE marks for the practical course is 50 Marks.
- SEE shall be conducted jointly by the two examiners of the same institute, examiners are appointed by the University
- All laboratory experiments are to be included for practical examination.
- (Rubrics) Breakup of marks and the instructions printed on the cover page of the answer script to be strictly adhered to by the examiners. **OR** based on the course requirement evaluation rubrics shall be decided jointly by examiners.
- Students can pick one question (experiment) from the questions lot prepared by the internal /external examiners jointly.
- Evaluation of test write-up/ conduction procedure and result/viva will be conducted jointly by examiners.
- General rubrics suggested for SEE are mentioned here, writeup-20%, Conduction procedure and result in - 60%, Viva-voce 20% of maximum marks. SEE for practical shall be evaluated for 100 marks and scored marks shall be scaled down to 50 marks (however, based on course type, rubrics shall be decided by the examiners)
- Change of experiment is allowed only once and 15% Marks allotted to the procedure part to be made zero. The duration of SEE is 03 hours

11.0 Course Delivery Plan

Expt No	Lecture / Pract No	Name of the Experiment	% of Portion
1	1	Experiment to draw the speed torque characteristics of (i) AC servo motor (ii) DC servo motor	8.33%
2	2	Experiment to draw synchro pair characteristics	8.33%
3	3	Experiment to determine frequency response of a second order system	8.33%

4	4	a)To design a passive RC lead compensating network for the given specifications, viz, the maximum phase lead and the frequency at which it occurs and to obtain the frequency response. (b) To determine experimentally the transfer function of the lead compensating network.	8.33%
5	5	(a)To design a passive RC lag compensating network for the given specifications, viz, the maximum phase lag and the frequency at which it occurs and to obtain the frequency response. (b) To determine experimentally the transfer function of the lag compensating network	8.33%
6	6	Experiment to draw the frequency response characteristics of the lag – lead compensator network and determination of its transfer function..	8.33%
7	7	(a) To simulate a typical second order system and determine step response and evaluate time response specifications. (b) To evaluate the effect of additional poles and zeros on time response of second order system. (c) To evaluate the effect of pole location on stability (d) To evaluate the effect of loop gain of a negative feedback system on stability.	8.33%
8	8	To simulate a second order system and study the effect of (a) P, (b) PI, (c) PD and (d) PID controller on the step response.	8.33%
9	9	(a) To simulate a D.C. Position control system and obtain its step response. (b) To verify the effect of input waveform, loop gain and system type on steady state errors. (c) To perform trade-off study for lead compensator. (d) To design PI controller and study its effect on steady state error.	8.33%
10	10	(a) To examine the relationship between open-loop frequency response and stability, open-loop frequency and closed loop transient response (b) To study the effect of open loop gain on transient response of closed loop system using root locus.	8.33%
11	11	(a) To study the effect of open loop poles and zeros on root locus contour (b) To estimate the effect of open loop gain on the transient response of closed loop system using root locus. (c) Comparative study of Bode, Nyquist and root locus with respect to stability.	8.33%

12.0 QUESTION BANK

1. What is control System?
2. What is open loop control system?
3. What is open loop control system?
4. Differentiate between open and closed loop control system.
5. What is lead compensating network?
6. What is lag compensating network?
7. What is lead- lag compensating network?
8. What is Servo motor?
9. What are the features does Servo Motors possess?

10. What is the difference between AC servomotor and two phase induction motors?
11. Compare AC servo motor and DC servo motors?
12. Some Applications where Servo motors are used?
13. What is Synchro?
14. What is Synchro pair?
15. What are the applications of Synchro pair?
16. What is Proportional Controller? Advantages and Disadvantages?
17. What is Integral Controller? Advantages and Disadvantages?
18. Why Derivative Controller is not used in isolation like Proportional and Integral?
19. For reducing Steady State error which type of controller is used?
20. Which type of controller anticipates the error?
21. What is order of the system?
22. What is Time response of the control system?
23. How Time response of the system is divided?
24. What are Test signals and their significance?
25. What is Pole of the system?
26. What is Zero of the system?
27. What is gain margin in bode plot?
28. Define phase margin in bode plot.

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Prof. O. B. Heddurshetti	**Prof. H. R. Zinage**	**HOD**	**Principal**