MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act, 1956)

FACULTY OF ENGINEERING & TECHNOLOGY

CURRICULUM
AND
SCHEME OF EXAMINATION

(B. Tech (Hons.) in Electrical & Electronics Engineering with specialization in Microgrid Technologies)
BATCH: 2021-25

FOREWORD

This is to certify that this booklet contains the entire Curriculum and Scheme of Examination of B.Tech-Electrical & Electronics Engineering being offered at Faculty of Engineering & Technology of this University. This has been duly vetted and finally approved by the Academic Council of the University vide its **37th meeting** held on **02.07.2021** and changes, if any deemed appropriate, shall be duly incorporated after the necessary approval by the Academic Council.

This Curriculum and Scheme of Examination of B.Tech-Electrical & Electronics Engineering shall be implemented w.e.f. AY 2021-22.

Prof. (Dr.) Naresh Grover
Date: **Dean-Academics, MRIIRS**

PREAMBLE

Manav Rachna international institute of research & studies has revised the syllabi as per credit-based choice system from third semester onwards from 2018 for B. Tech in Electrical & Electronics Engineering. The Department have formulated Program Educational Objectives (PEO's) of Electrical & Electronics Engineering keeping in view interests of all its stakeholders' i.e. Students, employers, Alumni etc. PEO's are comprehensive statements describing the career and professional accomplishments that the program is preparing the learner for Development of science and technology especially in the last three decades has increased the applications of Electrical & Electronics Engineering in the various fields such as industrial Automation and Internet of things. Therefore, taking into considerations the rapid change in technology, new courses in different emerging areas of Smart grid and Electric Vehicle are introduced to prepare the students to compete internationally.

Some of the courses like AI for Engineers, Introduction to Smart grid, Distributed Generation, Energy storage system, Fundamentals of Electric and hybrid Vehicle, Battery Management System are introduced to meet the requirements of the industry at local, National and global level.

The opinions have been taken from various stakeholders like employers, alumni & parents and the curriculum is revised based on inputs provided by them.

To relive the students from the stress and anxiety, in choice-based credit system additional courses on ethics, professional communications such as Stress Management by Yoga, English language courses and its lab etc. have been incorporated in the syllabi. The students can explore their talents by opting the courses related to their interest in the fields like media, photography, journalism, health care, hotel management etc.

The curriculum is designed to provide positive impact on every aspect of life, including Environmental Sustainability, Gender Sensitization, Professional and Human Values.

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FACULTY OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF ELECTRICAL & ELECTRONICS ENGINEERING

VISION

The vision of the department is to produce comprehensively trained, socially responsible, innovative engineers and researchers of highest quality to enable India's excellence in the field of Electrical Engineering.

MISSION

- To offer the students with the skills, knowledge and attitude that will allow the graduates to succeed as engineers and leaders.
- To maintain a vital, state-of-the art research enterprise, which provides its students and faculty with opportunities to create, interpret, apply and disseminate knowledge.
- To prepare graduates for the high technology field by undertaking collaborative projects which offer opportunities for long-term interaction with academia and industry.
- To pursue excellence in scholarly research at the frontiers of electrical engineering
- To inculcate ethical values and professionalism.

About the Department

The Department commenced its activities in 2007. This Department has adopted a teaching programme to develop in each student the mastery of fundamentals, motivation for learning, intellectual efficacy and self-reliance which provide the best foundation for continuing professional achievement. This shall prepare the students to deal constructively with issues and problems anticipated in the coming decades relevant to the technological development of our country in general and power/ energy sectors in particular.

The department has highly qualified and experienced faculty drawn from both industry and academia. The department has up to date laboratory facilities. The major laboratories are: Electrical Machines, Instrumentation, Power Electronics, Network Theory, Control Systems, Power System, Simulation and Project Lab.

The department has entered into the collaboration with Mitsubishi Electric India, a global leader in Electric equipment. An Advanced Automation (Factory Automation) lab has been set up in the department to train the students & faculty on Automation. Infineon Centre of Excellence has also been established at the campus involving projects and world-class training in semi-conductor technology with internships for select students.

Programme Educational Objectives

PEO's of B.Tech Program in Electrical & Electronics Engineering are:

1. To prepare students for successful careers in relevant industry that meets the needs of PSUs as well as multinational companies.
2. To clear the fundamentals in mathematical, scientific and engineering necessary for modeling, analyzing and solve engineering problems.
3. To provide practical concept in designing, modeling and analyzing of existing as well as new technology.
4. To impart technical knowledge for professional development, ethical values for good human development of the student to solve the complex problems and to develop a good and conducive for social benefits.
5. To provide training in soft skills via English language, communication, verbal, logical, analytical, comprehension, team building, inter personal relationship, group discussion etc for placement.
6. To provide multi-disciplinary ambience to the student for job orientation and career progress.

Programme Outcomes/Program Specific Outcomes

1) Apply the knowledge of mathematics, science, engineering fundamentals, and Engineering specialization to the solution of complex engineering problems.
2) Identify, formulate, research literature, and analyze engineering problems to arrive at substantiated conclusions using first principles of mathematics, natural, and engineering sciences.
3) Design solutions for complex engineering problems and design system components, processes to meet the specifications with consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4) Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5) 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) 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) Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8) Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9) Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.
10) Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.
11) Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.
12) 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.

Programme Specific Outcomes (PSO)

1) Endowed to analyze, design, implement and evaluate electrical based systems process, component, or program and deal with the rapid pace of industrial innovations and developments.
2) Skillful to use application and control techniques to conventional and non-conventional energy systems.
3) Ability to stimulate opportunities by providing multi-disciplinary ambience for successful career in relevant industry, PSUs or to be a thriving entrepreneur.
4) Empower with an in-depth understanding of research orientation in the domain with a strategy to improve quality by inculcating a desire for continuous learning and creativity, with emerging tools and technology.

Mapping of PEO's with PO's and PSO's

PEO/PO's& PSO's	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
PEO1	3	3	3	2	2	3	2	2	2	3	3	2	3	2	1	2
PEO2	3	3	3	2	2	3	2	2	2	3	3	2	3	2	1	3
PEO3	2	2	2	2	2	3	3	3	3	3	3	2	3	2	1	3
PEO4	2	3	2	1	3	3	3	3	3	3	3	2	3	1	1	3
PEO5	2	3	2	1	3	2	3	3	3	3	3	2	3	1	1	3
PEO6	2	3	1	2	3	2	3	3	3	3	3	2	2	2	1	3

Semester System and Choice Based Credit System

Credit based system of study and student's performance/progress is measured by the number of credits that he/she has earned, i.e., completed satisfactorily. Based on the course credits and grade obtained by the student, grade point average is calculated

(a) Course credits assignment

Each course has a certain number of credits assigned to it depending upon its duration in periods for lecture, tutorial and laboratory/clinical practice in a week. A few courses/activities are without credit (s) and are referred to as Audit Pass Courses (APC) but are mandatory to pass as a partial fulfillment of award of degree.

(b)Earning of credits

At the end of every course, a letter "Grade" shall be awarded in each course for which a student has registered. On obtaining a minimum Pass Grade, student shall accumulate the course credits as Earned Credits. A student's performance shall be measured by the number of credits that he/she has earned and by the weighted grade point average. Grades obtained in the audit courses shall not be counted for computation of grade point average, however shall be mandatory to pass as a partial fulfillment of award of degree.

For Award of Degree of a programme **B. Tech in Electrical and Electronics Engineering**, he/she has to earn minimum **162 credits** during the **4-year duration** of the programme **in 8 semesters**.

The total credits required to be earned have been further classified under two baskets of courses: "Compulsory Courses Basket", and "Elective Courses Basket". The **total 123 credits required** to be earned under "Compulsory Courses Basket" and remaining under "Elective Courses Basket".

All courses under "Compulsory Courses Basket", are required to be qualified and cleared/pass by each and every student enrolled under the programme and are semester-wise listed in the study scheme along with credits assigned to each course.

Under Elective Courses Basket, there will be three types of courses:

- Semester-wise courses offered by the department itself
- Open/Inter-disciplinary courses offered at the Institute/University level notified from the office of Dean-Academics.
- Massive Open Online Courses (MOOCs) available on SWAYAM Platform or any other platform as recommended by UGC/AICTE and notified from the office of Dean-Academics.

Each course shall have credits assigned to it. Student shall be required to register courses every semester for as many courses/credits specified under "Elective Courses Basket" depending upon his/her interest, capability/pace of learning and availability of time slot (without any clash in time table) so as to earn all required total credits under the "Elective Courses Basket" during the entire programme duration.

However, for registration of courses [including courses under "Compulsory Courses Basket", "Elective Courses Basket" and Previous Semester Courses (wherein he/she was declared in-eligible on the basis of attendance or he/she could not clear the course within permissible given chances)], if any, the maximum limit in a semester shall be 30 credits.

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FACULTY OF ENGINEERING & TECHNOLOGY
STUDY SCHEME FOR FIRST YEAR B.TECH 2021-25 BATCH
First year (Common for All B.Tech. Programmes)

Semester I													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Continuous Evaluation**	**End Sem.**	**Total**		
Compulsory Courses													
BSC	BPH-106	Physics for Engineers (Group A)	NA	NA	3+1#	0	0	4	100	100	200	3 hrs	3
BSC	BCH-106	Chemistry for Engineers (Group B)	NA	NA	2+1 #	0	0	3	100	100	200	3 hrs	2
BSC	BMA-101/BMA-102/BMA-103	Mathematics-I(For CSE only)/ Mathematics- 1(All Branches except CSE & BT)/ Mathematics for Biotechnology-I (For BT only)	NA	NA	3+1#	1	0	5	100	100	200	3 hrs	4
ESC	BEE-101A/BCS-101A	Basic Electrical Engineering (Group A)/Programming for Problem Solving (Group B)	NA	NA	3	0	0	3	100	100	200	3 hrs	3
ESC	BCS-100	AI For Engineers	NA	NA	2	0	0	2	100	100	200	3 hrs	2
ESC	BME-101A/ BME-102	Engineering Graphics & Design(Group A)/ Workshop/Manufacturing Practices(Group B)	NA	NA	0	0	4	4	100	100	200	3 hrs	2
ESC	BPH-151A/ BCH-151A	Physics lab (Group A)/ Chemistry lab (Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BEE-151A/ BCS-151A	Basic Electrical Engineering lab(Gp A)/ Programming for Problem Solving lab (Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BHM-201A	English	NA	NA	2	0	0	2	50	50	100	3 hrs	2
BSC	BHM-MC-001/ BCH-MC-002	Constitution of India* (Group A)/Environmental Science** (Group B)	NA	NA	1*	1**	0	1	50	50	100	2 hrs	AP
		Total (Group A/ Group B)							**700**	**700**	**1400**		**18/16**

SEMESTER-II

Course Type	Subject Code	Subject	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Sem.	Total		
Compulsory Courses													
BSC	BPH-106	Physics for Engineers (Group B)	NA	NA	3+1#	0	0	4	100	100	200	3 hrs	3
BSC	BCH-106	Chemistry for Engineers (Group A)	NA	NA	2+1 #	0	0	3	100	100	200	3 hrs	2
BSC	BMA-201/BMA-202/BMA-203	Mathematics-2(For CSE only) /Mathematics- 2(All Branches except CSE & BT)/Mathematics for Biotechnology-II (For BT only)	NA	NA	3	1	0	4	100	100	200	3 hrs	4
ESC	BEE-101A/ BCS-101A	Basic Electrical Engineering (Group B)/Programming for Problem Solving (Group A)	NA	NA	3	0	0	3	100	100	200	3 hrs	3
ESC	BME-101A/ BME-102	Engineering Graphics & Design(Group A)/ Workshop/Manufacturing Practices(Group B)	NA	NA	0	0	4	4	100	100	200	3 hrs	2
BSC	BBT-100	Biology for Engineers	NA	NA	2	0	0	2	100	100	200	3 hrs	2
BSC	BCH-151A/BPH-151A	Chemistry lab (Group A)/ Physics lab (Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
ESC	BCS-151A/BEE-151A	Programming for Problem Solving lab (Group A)/ Basic Electrical Engineering lab(Group B)	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	BHM-151	English lab	NA	NA	0	0	2	2	50	50	100	2 hrs	1
HSMC	BHM-MC-001/ BCH-MC-002	Environmental Science** (Group A)/Constitution of India* (Group B)	NA	NA	1*	1**	0	1	50	50	100	2 hrs	AP
		Total (Group A/ Group B)							**700**	**700**	**1400**		**16/18**
# NOTE: Contact hours per week have been increased due to bridge course.													

SEMESTER-III

Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Sem.	Total		
Compulsory Courses													
CORE	BEE-DS-301	Electrical Circuit Analysis	Basic Electrical Engineering	BEE-101A	3	1	0	4	100	100	200	3 Hrs	4
CORE	BEE-DS-302	Electrical Machines – I	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BEC-DS-321	Analog Electronics	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BEC-DS-302	Digital Electronics	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BEE-DS-351	Electrical Circuit Analysis Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BEE-DS-352	Electrical Machines – I Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BEC-DS-361	Analog Electronics Lab	Analog Electronics	BEC-DS-321	0	0	2	2	50	50	100	2 hrs	1
CORE	BEC-DS-352	Digital Electronics Lab	Digital Electronics	BEC-DS-302	0	0	2	2	50	50	100	2 Hrs	1
BSC	BMA-308	Mathematics-3	Mathematics 1 & 2	BSC-MA-102 & BSC-MA-202	2	0	0	2	100	100	200	3Hrs	2
HSMC	BHM-320	Universal Human Values	NIL		1	2	0	3	50	50	100	3Hrs	2
HSMC	DTI-300	Design, Thinking and Innovation – I	NIL		1	0	0	1	50		50		1
PROJ	Proj-EE-300A*	Summer Internship –I	NA	NA	(2 WEEKS minimum)				50		50		1
HSMC	BHM-MC-004	Quantitative Aptitude	NA	NA			2	2	50	50	100	2 hrs	AP
Total					**17**	**4**	**10**	**30**	**900**	**800**	**1700**	**0**	**24**

*** Under Inter Disciplinary Elective/open Elective Courses the student should attain 24 credits with a minimum of 3 credits starting from 2nd semester.**

***Training undertaken by students during the Summer vacation after second Semester(4 weeks minimum) will be evaluated as a III Semester subject.**

SEMESTER-IV

Course	Course Code	Title of Course	Pre-requisite Course, if any	Periods/Week	Marks	Duration	Credits

Type			Title	Code	L	T	P	Total	Continuous Evaluation	End Sem.	Total	of Exam	
Compulsory Courses													
CORE	BEE-DS-401	Electrical Machines – II	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BEE-DS-402A	Power Systems-I	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BEC-DS-401A	Communication Engineering	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BEC-DS-403	Microprocessor & Microcontrollers	Digital Electronics	BEC-DS-302	3	0	0	3	100	100	200	3Hrs	3
CORE	BEE-DS-451	Electrical Machines – II Lab	NIL		0	0	2	2	50	50	100	2Hrs	1
CORE	BEE-DS-452	Power Systems -I Lab	NIL		0	0	2	2	50	50	100	2Hrs	1
CORE	BEC-DS-453	Microprocessor & Microcontrollers Lab	Microprocessor & Microcontrollers	BEC-DS-403	0	0	2	2	50	50	100	2 Hrs	1
HSMC	DTI-400	Design, Thinking and Innovation – II	Design, Thinking and Innovation – I	DTI-300	1	0	0	1	50		50		1
HSMC	BHM-MC-002	Sports and Yoga	NIL		1	2	0	3	100		100	1 hr	AP
HSMC	BHM-MC-006	Quantitative Aptitude and Personality Development-I	NIL		2	0	0	2	50	50	100	2 hrs	AP
Total					**16**	**5**	**6**	**27**	**700**	**650**	**1350**	**0**	**19**
Disciplinary Elective Courses *													
Domain Specific Elective	BEE-DS-525	Power System Protection	NIL		3	##	0	3	100	100	200	3Hrs	3
Domain Specific Elective	BEE-DS-523A	Measurements and Instrumentation	NIL		3	0	0	3	100	100	200	3Hrs	3
Domain Specific Elective	BEC-DS-404A	Electromagnetic Waves	BPH-106		3	##	0	3	100	100	200	3Hrs	3
B Tech in Electrical and Electronics Engineering with Hon/Minor In Micro grid Technologies													

Domain Specific Elective	BEE-DS-624	Renewable Energy Systems			3	0	0	3	100	100	200	3Hrs	3
Domain Specific Elective	BEE-DS-654	Renewable Energy Systems Lab			2	0	0	2	50	50	100	2 Hrs	1

*** Under Disciplinary Elective Courses the student should attain 15 credits with a minimum of 3 credits starting from 4th semester.**

*** Under Inter Disciplinary Elective/open Elective Courses the student should attain 24 credits with a minimum of 3 credits starting from 2nd semester.**

SEMESTER-V

Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Sem.	Total		
Compulsory Courses													
CORE	BEE-DS-501A	Power Electronics	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BEE-DS-502	Control Systems	NIL		3	1	0	4	100	100	200	3Hrs	4
CORE	BEE-DS-551	Power Electronics Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BEE-DS-552	Control System Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
PROJ	PROJ-EE-500	Summer Internship-II	NIL		(Minimum 4 Weeks)				100		100	2 hrs	2
HSMC	BHM-520	Entrepreneurship and Startups	NIL		2	0	0	2	100	100	200	2 Hrs	2
HSMC	DTI-500	Design, Thinking and Innovation – III	Design, Thinking and Innovation – II	DTI-400	1			1	50		50		1
HSMC	BHM-MC-008	Quantitative Aptitude and Personality Development-II	NIL		0	0	2	2	50	50	100	2 hrs	AP
Total					**10**	**2**	**6**	**18**	**600**	**450**	**1050**		**14**
Disciplinary Elective Courses *													

Domain Specific	BEE-DS-521A	Electrical Machine Design	Electrical Machines I Electrical Machines -II	BEE-DS-302 BEE-DS-401	3	0	0	3	100	100	200	3Hrs	3
Domain Specific	BEE-DS-522	Electrical Energy Conservation and Auditing	NIL		3	##	0	3	100	100	200	3Hrs	3
Domain Specific	BEC-DS-501A	Digital Signal Processing and it Applications	NIL		3	0	0	3	100	100	200	3 hrs	3
B Tech in Electrical and Electronics Engineering with Hon/Minor In Micro grid Technologies													
Domain Specific	BEE-DS-527	Introduction to Smart grid			3	0	0	3	100	100	200	3Hrs	3
Domain Specific	BEE-DS-528	Distributed Generation			3	0	0	3	100	100	200	3Hrs	3
Generic Elective -I													
	HM-506	French I			2	0	0	2	50	50	100	1.5 hrs	2
	HM-507	German I			2	0	0	2	50	50	100	1.5 hrs	2
	HM-508	Spanish I			2	0	0	2	50	50	100	1.5 hrs	2

*** Under Disciplinary Elective Courses the student should attain 15 credits with a minimum of 3 credits starting from 4th semester.**

*** Under Inter Disciplinary Elective/open Elective Courses the student should attain 24 credits with a minimum of 3 credits starting from 2nd semester.**

***Training undertaken by students during the Summer vacation after fourth Semester(4 weeks minimum) will be evaluated as a V Semester subject.**

SEMESTER-VI

Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Sem.	Total		
Compulsory Courses													
CORE	BEE-DS-601A	Power System-II	Power System-I	BEE-DS-502	3	1	0	4	100	100	200	3Hrs	4

CORE	BEE-DS-602	Programmable Logic Controllers & SCADA	NIL		3	0	0	3	100	100	200	3Hrs	3
CORE	BEE-DS-625A	Electric Drives	Power Electronics	BEE-DS-501A	3	0	0	3	100	100	200	3Hrs	3
CORE	BEE-DS-651	Power System-II Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BEE-DS-652	Programmable Logic Controllers & SCADA Lab	NIL		0	0	2	2	50	50	100	2 Hrs	1
CORE	BEE-DS-653	Electric Drives Lab	NIL		0	0	2	2	50	50	100	2Hrs	1
PROJ	PROJ-EE-600	Project Phase - I	NIL		0	0	2	2	50	0	50		1
HSMC	BHM-MC-009	Quantitative Aptitude and Personality Development-III	NIL		0	0	2	2	50	50	100	2 hrs	AP
Total					**9**	**1**	**10**	**20**	**550**	**500**	**1050**		**14**
Disciplinary Elective Courses *													
Domain Specific	BEE-DS-621	Industrial Electrical systems	NIL		3	0	0	3	100	100	200	3Hrs	3
Domain Specific	BEE-DS-622	Power Quality and FACTS	NIL		3	0	0	3	100	100	200	3Hrs	3
Domain Specific	BEE-DS-623	Advanced Control System	Control Systems	BEE-DS-502	3	0	0	3	100	100	200	3Hrs	**3**

B Tech in Electrical and Electronics Engineering with Hon/Minor In Micro grid Technologies													
Domain Specific Elective	BEE-DS-628	Communication in smart grid			3	0	0	3	100	100	200	3Hrs	3
Domain Specific Elective	BEE-DS-629	Energy Storage Systems			3	0	0	3	100	100	200	3Hrs	3
Generic Elective -II													
	HM 606	French II			2	0	0	2	50	50	100	1.5 hrs	2
	HM 607	German II			2	0	0	2	50	50	100	1.5 hrs	2
	HM 608	Spanish II			2	0	0	2	50	50	100	1.5 hrs	2
*** Under Disciplinary Elective Courses the student should attain 15 credits with a minimum of 3 credits starting from 4th semester.**													
*** Under Inter Disciplinary Elective/open Elective Courses the student should attain 24 credits with a minimum of 3 credits starting from 2nd semester.**													
***Training undertaken by students during the Summer vacation after Sixth Semester(4 weeks minimum) will be evaluated as a VII Semester subject.**													
SEMESTER-VII													

Course Type	Course Code	Title of Course	Pre-requisite Course, if any		Periods/Week				Marks			Duration of Exam	Credits
			Title	Code	L	T	P	Total	Continuous Evaluation	End Sem.	Total		
Compulsory Courses													
PROJ	PROJ-EE-710	Summer Internship-III			(Minimum 4 Weeks)				100		100	2 hrs	2
PROJ	Proj-EE-700A	Project Phase - II/Industrial Project			0	0	10	10	200	100	300	2 hrs	5
PROJ	GP-EE-700	General Proficiency (Grade will be given)											AP
Total													**7**
Disciplinary Elective Courses *													
Domain Specific	BEE-DS-722	Power System Dynamics and Control	NIL		3	0	0	3	100	100	200	3Hrs	3
Domain Specific	BEE-DS-626A	Electric Power Applications and Traction	NIL		3	0	0	3	100	100	200	3Hrs	**3**
Domain Specific	BEE-DS-726A	Robotics and Automation	NIL		3	0	0	3	100	100	200	3Hrs	**3**
Inter-Disciplinary Elective Courses * List given at the last sheet													
B Tech in Electrical and Electronics Engineering with Hon/Minor In Micro grid Technologies													
Domain Specific	BEE-DS-729	Optimization and control of Microgrids			3	0	0	3	100	100	200	3 Hrs	3
Domain Specific	BEE-DS-752	Simulation of Microgrid lab			2	0	0	2	50	50	100	2Hrs	1
*** Under Disciplinary Elective Courses the student should attain 15 credits with a minimum of 3 credits starting from 4th semester.**													
*** Under Inter Disciplinary Elective/open Elective Courses the student should attain 24 credits with a minimum of 3 credits starting from 2nd semester.**													
SEMESTER-VIII													
Course Type	**Course Code**	**Title of Course**	**Pre-requisite Course, if any**		**Periods/Week**				**Marks**			**Duration of Exam**	**Credits**
			Title	**Code**	**L**	**T**	**P**	**Total**	**Continuous Evaluation**	**End Sem.**	**Total**		
Compulsory Courses													
PROJ	Proj-EE-800A	Internship –III (20 - 24 weeks Training)			20 - 24 Weeks				200	100	300	2 hrs	10
Total													**10**

For B	Minimum Credits required for award of degree	162

Tech Normal Students	Total credits required under compulsory basket :	123
For Lateral Entry Students	Minimum credits required for award of Degree	128
	Total credits required under compulsory basket :	89

Semester	**BSC/ESC/ HUM/Lan**	**Core/Proj/Internship**	**Disciplinary Elective**	**Inter Disciplinary/ Open Elective**	TOTAL
sem1	18				18
sem2	16				19
sem3	4	20			24
sem4		19			25
sem5	2	12			24
sem6		14			23
sem7		7			17
Sem 8		10			10
Total	**40**	**82**	**15**	**25**	**162**

B. Tech in Electrical and Electronics Engineering with Hons./Minor in Micro grid Technologies

Semester	**Course Code**	**Course Title**	**L**	**T**	**P**	**Total**	**Continuous Evaluation**	**End Sem.**	**Total**	**D.of Exam**	**Credits**
IV	BEE-DS-624	Renewable Energy Systems	3	0	0	3	100	100	200	3Hrs	3
IV	BEE-DS-654	Renewable Energy Systems Lab	0	0	2	2	50	50	100	2Hrs	1
V	BEE-DS-527	Introduction to Smart grid	3	0	0	3	100	100	200	3Hrs	3
V	BEE-DS-528	Distributed Generation	3	0	0	3	100	100	200	3Hrs	3
VI	BEE-DS-628	Communication in smart grid	3	0	0	3	100	100	200	3Hrs	3
VI	BEE-DS-629	Energy Storage Systems	3	0	0	3	100	100	200	3Hrs	3
VII	BEE-DS-729	Optimization and control of Micro grids	3	0	0	3	100	100	200	3Hrs	3
VII	BEE-DS-752	Simulation of Micro grid lab	0	0	2	2	50	50	100	2Hrs	1
		Total									20

I Semester

BPH-106: PHYSICS FOR ENGINEERS

Periods/week	Credits		
L: 3	T:0	3	
Duration of Examination: 3 Hrs			

Max. Marks	: 200
Continuous Evaluation	: 100
End Term Examination	: 100

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Basic Sciences

Course Outcomes: The students will be able to:
BPH-106.1 discuss and explain the key concepts and principles of quantum physics, lasers and optical fibres
BPH-106.2 apply the basic concepts of semiconductors and devices based on them
BPH-106.3 analyze the structure, characterization techniques and applications of advanced material.
BPH-106.4 recall the basic concept of electromagnetism and understand their applications to the theoryof electromagnetic waves.

Unit-1 Lasers and Optical Fibres (8 Lectures)
Introduction to laser, Spontaneous and stimulated emissions of radiations, Einstein's coefficients and relation among them, Population inversion and laser pumping, Characteristics of lasers, Components of laser, He-Ne laser, Semiconductor laser, Applications of laser.
Introduction to optical fibres, Acceptance angle and acceptance cone, Numerical aperture, Classification of fibres, Attenuation, Losses associated with optical fibres, Merits and applications of optical fibres.

Unit-2 Quantum Physics (8 Lectures)
Limitations of classical physics, Black-body radiations, Planck's hypothesis, Photo-electric effect, Compton effect, Uncertainty principle, Matter waves, Phase and group velocity, Schrodinger's equations (time dependent and independent), Particle in a box (motion in one dimension), Basics of quantum statistics.

Unit-3 Semiconductors (8 Lectures)
Physical properties of semiconductors, direct and indirect band gap semiconductors, compound semiconductors, organic and inorganic semiconductors, Fermi level and Fermi energy, occupation probability, concentration of charge carriers, generation and recombination, carrier transport: drift and diffusion, energy band diagram of unbiased and biased P N Junction, Light Emitting Diode, Photodetectors - p-n photodiode, PIN, Photoconductivity, Effect of impurity & Traps, Photovoltaic effect and Solar cell.

UNIT 4: Advance Material and Synthesis (6 Lectures)
Introduction to nanomaterials, Nano-science and nano-technology, Two main approaches in nanotechnology, Bottom up technique, Top down technique, Quantum dot and graphene, Methods to produce Nanomaterials, Chemical vapour deposition, Sol-gel process, Molecular beam epitaxy, Physical and chemical properties of nanomaterials, Carbon nanotubes: single and multi-walled nanotubes, Synthesis of Nanotubes: carbon arc method, Laser evaporation method, Sputtering, applications of advanced materials.

UNIT 5: Investigating Techniques (6 Lectures)
Properties of X-Ray,Braggs' Law, Bragg's Spectrometer, Rutherford Back Scattering, Raman effect and Raman spectroscopy, Hall effect, Vander Pauw measurements for carrier density, resistivity, Hot-point probe measurement, AFM, SEM, photoluminescence spectroscopy, band gap by UV-Vis spectroscopy.

Unit-6 Electrodynamics (8 Lectures)
Divergence and curl of electrostatic field, Laplace's and Poisson's equations for electrostatic potential. Solutions of Laplace equation in one dimension, Dielectric Polarization and Dielectric constant, Piezoelectricity, Bio-Savart law and Ampere's circuital theorem, Continuity equation for current densities, Displacement current, Maxwell's equations, Electromagnetic energy – Flow of energy and Poynting vector, The wave equation; Plane electromagnetic waves in vacuum, their transverse nature, Energy carried by electromagnetic waves.

Text Books/ Reference Books:

1. P. Bhattacharya,2017, Semiconductor Optoelectronic Devices, Pearson education.
2. D.J Griffiths, 2015, Introduction to Electrodynamics, Pearson education.
3. Avadhanulu and Kshirsagar,2014, A textbook of Engineering Physics S. Chand.
4. S.P. Taneja,2018, Modern Physics for Engineers, R. Chand & Co.
5. Mark Ratner and Daniel Ratner, 2003,Nanotechnology, Pearson.
6. M.N.O. Sadiku, 2015, Elements of Electromagnetics, Asian Edition, Oxford Higher Education.

Distribution of Continuous Evaluation:

Sessional-I	30%
Sessional-II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus. Action verbs should be used from Bloom's Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO 11	PO 12	PS O 1	PS O 2	PS O3	PS O4
BPH-106.1	2	2	1	2	3	-	-	-	-	-	2	3	1	-	-	1
BPH-106.2	3	1	3	-	2	1	1	-	-	-	-	3	1	1	-	1
BPH-106.3	3	2	2	-	2	2	1	-	-	-	-	2	-	-	1	
BPH-106.4	3	3	3	1	1	3	1	-	-	-	-	3	1	-	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BMA-102: MATHEMATICS-1
(Calculus and Linear Algebra)

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 1	4	Continuos Evaluation:	100
Duration of Examination: 3 Hrs			
End Semester Exam	: 100		

Pre-requisites: The students must have the knowledge of mathematical concepts of Intermediate level.
Course Type: Basic Sciences

Course Outcomes:

The objective of this course is to familiarize the prospective engineers with techniques in calculus, multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advanced level that will serve them well towards tackling more advanced level of mathematics and applications that they would find useful in their disciplines. More precisely, the outcomes are:

BMA-102.1	Students will be able to understand the role of mathematics in engineering.
BMA-102.2	Students will be able to define the terminology of Integration, Differentiation, Matrices and Infinite Series. Students will be able to explain improper integrals, power series, and linear system of equations, convergence of series and physical interpretation of vector function.
BMA-102.3	Students will be able to demonstrate the knowledge of evolutes and involutes, rank of matrices, expansion of functions and diagonalization.
BMA-102.4	Students will be able to interpret the concepts of integration, differentiation, matrices and series to solve real life problems.
BMA-102.5	Students will be able to correlate the surface area, maxima and minima, eigen vectors.

PART-A

Unit 1: Integral Calculus

Evolutes and involutes, Evaluation of definite and improper integrals, Beta and Gamma functions and their properties, Applications of definite integrals to evaluate surface areas and volumes of revolutions.

Unit 2: Differential Calculus

Rolle's Theorem, Mean value theorems, Taylor's and Maclaurin theorems with remainders; indeterminate forms and L'Hospital's rule, Maxima and minima.

Unit 3: Sequences and Series

Convergence of sequence and series, tests for convergence, Power series, Taylor's series, series for exponential, trigonometric and logarithm functions, Fourier series: Half range sine and cosine series, Parseval's theorem.

PART-B

Unit 4: Multivariable Calculus (Differentiation)

Limit, continuity and partial derivatives, directional derivatives, total derivative, Tangent plane and normal line, Maxima, minima and saddle points, Method of Lagrange multipliers, gradient, curl and divergence.

Unit 5: Matrices

Inverse and rank of a matrix, rank-nullity theorem, System of linear equations, Symmetric, skew-symmetric and orthogonal matrices, Determinants, Eigenvalues and Eigenvectors, Diagonalization of matrices, Cayley-Hamilton theorem and Orthogonal transformation.

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney, 2002, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint.

2. Erwin Kreyszig, 2006, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
3. T. Veerarajan 2008, Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi.
4. B.V Ramana B.V.,2010, Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint.
5. D. Poole, 2005, Linear Algebra: A Modern Introduction, 2nd Edition, Brooks/Cole.
6. N.P. Bali and Manish Goyal, 2008, A text book of Engineering Mathematics, Laxmi Publications, Reprint.
7. B.S. Grewal, 2010, Higher Engineering Mathematics, Khanna Publishers, 36th Edition.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous evaluation table

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials.
Sessional tests.
Surprise questions during lectures/Class Performance.
End Term Examination.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BMA-102.1	3	3	1	2	2	--	--	--	--	--	--	2	2	--	--	--
BMA-102.2	3	3	1	2	2	--	--	--	--	--	--	1	1	--	--	--
BMA-102.3	3	3	2	2	3	--	--	--	--	--	--	2	1	--	--	--
BMA-102.4	3	3	1	1	2	--	--	--	--	--	--	1	1	--	--	--
BMA-102.5	3	3	2	2	3	--	--	--	--	--	--	2	1	--	--	--

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BEE-101A: BASIC ELECTRICAL ENGINEERING

Periods/week Credits	Max. Marks : 200
L: 3 T: 3	Continuous Evaluation : 100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre-requisites
Course Type: Engineering Science

Course Outcomes: After completion of this course the students will be able to
BEE-101A.1 understand the components of electrical network, low voltage electrical installation, earthing and working of batteries.
BEE-101A.2 apply the basic theorems and laws for solving both dc and ac networks.
BEE-101A.3 differentiate between single phase series and parallel circuits and three phase system.
BEE-101A.4 explain the construction and working of transformers, electrical machines and power converters

Unit 1: DC CIRCUITS (8 hours)
1.1 Electrical circuit elements (R, L and C), voltage and current sources,
1,2Kirchoff Voltage and Current Laws,
1.3 Analysis of simple circuits (two loops) with dc excitation ,
1.4 Superposition Theorem,
1.5 Thevenin's Theorem,
1.6 Norton's Theorem,
1.7 Time domain analysis of first order system- RL circuit,
1.8 Time domain analysis of first order system- RC circuit.

Unit 2: AC CIRCUITS (8 hours)
2.1 Single Phase-AC Generation,
2.2 Sinusoidal Waveform- peak value average and rms values
2.3 Phasor representation, L, C, RL, RC circuit
2.4 RLC Series Circuits
2.5 Power factor, Real power, Reactive power and Apparent power
2.6 RLC parallel circuits
2.7 Resonance
2.8 Three Phase Emf Generation, Delta and Star Connections
2.9 Voltage and current relation in star and delta connections

Unit 3: TRANSFORMERS (6 hours)
3.1Magnetic materials
3.2 BH characteristics,
3.3 Working Principle and Emf Equation of transformer,
3.4 Ideal and Practical transformer,
3.5 Equivalent circuit Losses in transformer,
3.6 Efficiency and regulation of transformer
3.7 Auto transformer
3.8 Three phase transformer connections.

Unit 4: DC MACHINES (5 hours)
4.1 Construction and working of DC motor,
4.2 Torque-speed characteristic and speed control of separately excited dc motor,
4.3 Construction and working of DC generator,
4.4 EMF equation of DC generator,
4.5 Introduction to power converters/power switching devices.

Unit 5: AC MACHINES (6 hours)

5.1 Generation of rotating magnetic fields,
5.2 Construction and working of a three-phase induction motor
5.3 Significance of torque-slip characteristic,
5.4 Loss components and efficiency of three phase induction motor
5.5 Starting and speed control of induction motor,
5.6 Single-phase induction motor working and types
5.7 Construction and working of synchronous generators.

Unit 6: ELECTRICAL INSTALLATIONS (6hours)

6.1Components of LT Switchgear: Switch Fuse Unit (SFU), MCB, ELCB, MCCB,
6.2 Types of Wires and Cables,
6.3 Earthing,
6.4 Types of Batteries, Important Characteristics for Batteries,
6.5 Elementary calculations for energy consumption,
6.6 Power factor improvement and battery backup.

Text Books/ Reference Books:

1. I. J. Nagrath, D. P. Kothari ,2007, Basic Electrical Engineering, TMH.
2. S. NathChakrabarti, C. K. Chanda , 2009, Basic Electrical Engineering, TMH,2009.
3. B. L. Thereja , 2005, Electrical Technology Vol.1, S Chand.
4. V. N. Mittal, Aravind Mittal, 2007, Basic Electrical Engineering,TMH 2007.
5. S N Singh , 2011, Basic Electrical Engineering, PHI.
6. D. C. Kulshreshtha , 2009, Basic Electrical Engineering, McGrawHill.
7. Leonard S Bobrow,2011,Fundamentals of Electrical Engineering, 2nd edition, Oxford University Press.
8. E. Hughes ,2010, Basic Electrical Engineering, Pearson.
9. S K Sahadev ,2015, Basic Electrical Engineering, Pearson India.

Software required/Weblinks

http://nptel.ac.in/courses/108105053/
https://nptel.ac.in/courses/108108076/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-101A.1	3	3	2	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-101A.2	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-101A.3	3	3	3	1	1	-	-	-	-	-	-	2	3	3	1	1
BEE-101A.4	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1

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NAAC 'A' Grade University

BCS-100 : ARTIFICIAL INTELLIGENCE FOR ENGINEERS

Periods/week Credits
L :2 T: 0 2.0
Duration of Exam: 3 Hrs
Pre-Requisite: Basic Knowledge of Computers
Course Type: Engineering Science Course

Max. Marks: 200
Continuous Evaluation: 100
End Term Examination:100

Course Outcomes: The students will be able to-
BCS-100.1 Understand the evolution and various approaches of AI
BCS-100.2 Familiarize with the role of data, data storage, processing, algorithm, visualization, regression, classification and clustering.
BCS-100.3 Identify the Natural Language Processing in designing AI models.
BCS-100.4 Illustrate the use of various concepts of neural network and its applications.
BCS-100.5 Recognize the applications of AI and its domains in real-life applications.

Unit 1: An overview to AI
- 1.1 The evolution of AI to the present
- 1.2 Various approaches to AI
- 1.3 What should all engineers know about AI?
- 1.4 Other emerging technologies
- 1.5 AI and ethical concerns

Unit 2: Data & Algorithms
- 2.1 History of Data
- 2.2 Data Storage and Importance of Data and its Acquisition
- 2.3 The Stages of data processing
- 2.4 Data Visualization
- 2.5 Regression, Prediction & Classification
- 2.6 Clustering & Recommender Systems

Unit 3: Natural Language Processing
- 3.1 Speech recognition
- 3.2 Natural language understanding
- 3.3 Natural language generation
- 3.4 Chatbots
- 3.5 Machine Translation

Unit 4: Artificial Neural Networks
- 4.1 Deep Learning
- 4.2 Recurrent Neural Networks
- 4.3 Convolution Neural Networks
- 4.4 The Universal Approximation Theorem
- 4.5 Generative Adversarial Networks

Unit 5: Applications
- 5.1 Image and face recognition
- 5.2 Object recognition
- 5.3 Speech Recognition besides Computer Vision
- 5.4 Robots
- 5.5 Applications

Text Books / Reference Books:

1. ElaineRich,KevinKnight,& Shivashankar BNair,Artificial Intelligence,Third Edition, McGrawHill.
2. Stuart J. Russell and Peter Norvig, Artificial Intelligence: A Modern Approach, Third Edition, Pearson.
3. Deepika M, Vijay Cuddapah, Amitendra Srivastava, Srinivas Mahankali, AI & ML - Powering the Agents of Automation, BPB Publication
4. Lasse Rouhiainen, Artificial Intelligence: 101 Things You Must Know Today About Our Future.
5. Oliver Theobald, Machine Learning for Absolute Beginners, Second Edition,
6. John Paul Mueller, and Luca Massaron, Artificial Intelligence For Dummies

Software required/Weblinks:

https://onlinecourses.nptel.ac.in/noc21_ge20/preview
https://www.tutorialspoint.com/artificial_intelligence/index.htm
https://nptel.ac.in/courses/106/102/106102220/
https://nptel.ac.in/courses/106/105/106105158/https://www.tutorialspoint.com/artificial_intelligence/index.htm
https://www.youtube.com/watch?v=0rrDqBIP2qU&list=PL-JvKqOx2AtfQ8cGyKsFE7Tj2FyB1yCkd

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX:

CO Statement (BCS-100)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BCS-100.1	3	2	-	-	-	-	-	-	-	-	-	3	1	1	1	1
BCS-100.2	3	-	3	2	-	-	-	-	-	-	-	3	2	3	3	2
BCS-100.3	3	3	3	-	-	-	-	-	-	-	-	3	2	3	3	2
BCS-100.4	3	-	-	-	-	-	-	-	-	-	-	3	2	3	3	1
BCS-100.5	3	2	2	-	-	-	-	-	-	-	-	3	3	3	3	2

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BME-101A: ENGINEERING GRAPHICS & DESIGN

Periods/week Credits	Max. Marks : 200
L: 0 T: 0 P: 4 2	Internal/Continuous Assessment : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Prerequisites:
Course Type: Engineering Science Course
Course Coordinator / Co-Coordinator:

Course Outcomes: **After completion of this course the students will be able to**

BME-101A.1	understand the role and importance of Engineering Graphics, design/drafting in cognitive development.
BME-101A.2	conceptualize engineering drawing and descriptive geometry to understand different components and machineries.
BME-101A.3	visualize objects with the help of engineering principles, projection theories including their applications to solve problems related to engineering and production.
BME-101A.4	develop capability of understanding engineering drawing problems and implementation of respective solution.
BME-101A.5	develop capability of selection of solutions for a given design problem.
BME-101A.6	develop of capability of designing a product or assembly with its various components with a systematic design approach

Theory (Detailed Content)

Traditional Engineering Graphics:
Principles o f Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

(**Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory**)

Part-A

Unit 1: Introduction to Engineering Drawing, Orthographic Projections
Principles of Engineering Graphics and their significance, usage of drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales; Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes;

Unit 2: Projections of Regular Solids & Sections and Sectional Views of Right Angular Solids
Inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.
Prism, Cylinder, Pyramid, Cone – Auxiliary Views; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone; draw the sectional orthographic views of geometrical solids, objects from industry and dwellings (foundation to slab only).

Unit 3: Isometric Projections
Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric
Views to Orthographic Views and Vice-versa, Conventions;

Theory (Detailed Content)
Computer Graphics

Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM)

(**Except the basic essential concepts, most of the teaching part can happen concurrently in the laboratory**)

Part-B

Unit 4: Overview of Computer Graphics, Customization & CAD Drawing

Listing the computer technologies that impact on graphical communication, Demonstrating knowledge of the theory of CAD software [such as: The Menu System, Toolbars (Standard, Object Properties, Draw, Modify and Dimension), Drawing Area (Background, Crosshairs, Coordinate System), Dialog boxes and windows, Shortcut menus (Button Bars), The Command Line (where applicable), The Status Bar, Different methods of zoom as used in CAD, Select and erase objects.; Isometric Views of lines, Planes, Simple and compound Solids; consisting of set up of the drawing page and the printer, including scale settings, Setting up of units and drawing limits; ISO and ANSI standards for coordinate dimensioning and tolerancing; Orthographic constraints, Snap to objects manually and automatically; Producing drawings by using various coordinate input entry methods to draw straight lines, Applying various ways of drawing circles;

Unit 5: Annotations, layering, other functions

Applying dimensions to objects, applying annotations to drawings; Setting up and use of Layers, layers to create drawings, Create, edit and use customized layers; Changing line lengths through modifying existing lines (extend/lengthen); Printing documents to paper using the print command; orthographic projection techniques; Drawing sectional views of composite right regular geometric solids and project the true shape of the sectioned surface; Drawing annotation, Computer-aided design (CAD) software modeling of parts and assemblies. Parametric and non-parametric solid, surface, and wireframe models. Part editing and two-dimensional documentation of models. Planar projection theory, including sketching of perspective, isometric, multiview, auxiliary, and section views. Spatial visualization exercises. Dimensioning guidelines, tolerancing techniques; dimensioning and scale multi views of dwelling;

Unit 6: Demonstration of a simple team design project

Geometry and topology of engineered components: creation of engineering models and their presentation in standard 2D blueprint form and as 3D wire-frame and shaded solids; meshed topologies for engineering analysis and tool-path generation for component manufacture; geometric dimensioning and tolerancing; Use of solid-modeling software for creating associative models at the component and assembly levels; floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc. Applying color coding according to building drawing practice; Drawing sectional elevation showing foundation to ceiling; Introduction to Building Information Modelling (BIM).

Text Books:

1. Bhatt N.D., Panchal V.M. & Ingle P.R., (2014), Engineering Drawing, Charotar Publishing House
2. Shah, M.B. & Rana B.C. (2008), Engineering Drawing and Computer Graphics, Pearson Education
3. (Corresponding set of) CAD Software Theory and User Manuals

Reference Books:

1. Agrawal B. & Agrawal C. M. (2012), Engineering Graphics, TMH Publication
2. Narayana, K.L. & P Kannaiah (2008), Text book on Engineering Drawing, Scitech Publishers

Weblinks:

https://nptel.ac.in/courses/112103019/
https://nptel.ac.in/courses/112104172/

Assessment Tools:
Surprise questions during lab/Class Performance
Term end examination/viva

Course Articulation Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BME-101A.1	2	1	1	1	1	2	1	2	1	1	2	3	3	3	2	2
BME-101A.2	2	2	3	1	1	2	2	2	2	2	3	2	3	2	2	3
BME-101A.3	2	2	2	2	2	1	2	1	3	2	2	2	3	2	1	2
BME-101A.4	3	3	2	3	2	1	2	2	1	1	2	1	3	2	2	3
BME-101A.5	3	3	2	3	2	1	2	1	1	1	2	1	3	2	2	3
BME-101A.6	2	1	3	2	3	2	2	2	3	2	2	1	3	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

NAAC 'A' Grade University

BPH-151A: PHYSICS LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal	: 50
Duration of Examination: 2 Hrs		External	: 50

Pre-requisite: Basic knowledge of 10+2 level Physics
Course Type: Basic Sciences Courses

Course Outcomes: The students will be able to:

BPH-151A.1 calculate zero error, least count, maximum percentage error, percentage error and understand their importance
BPH-151A.2 understand the principle, concept and working of the experiments
BPH-151A.3 rearrange/assemble the different components of a device or a circuit
BPH-151A.4 describe the methodology of science and the relationship between observation and theory

List of Experiments:

1. To calculate the hysteresis loss and magnetic susceptibility by tracingB- H curve.
2. To determine the value of Planck's constant h by a photo cell.
3. To determine the grating element of a given grating by using LASER.
4. To study Hall Effect in a semiconductor and to find (i) Hall voltage and Hall coefficient (ii) number of charge carriers per unit volume (iii) mobility.
5. To draw the characteristics of a solar cell and to find the fill factor.
6. To find the band gap of an intrinsic semiconductor using four probe method.
7. To draw the V-I characteristics of a PIN diode.
8. To determine numerical aperture of an optical fibre.
9. To determine the volume magnetic susceptibility of manganese sulphate solution at different concentrations.
10. To find the charge to mass (e/m) ratio of an electron.
11. To study the resonance phenomena in LCR circuits.
12. To study the variation of magnetic field from Helmholtz coil.
13. To determine the moment of inertia of a flywheel.
14. To determine the Young's modulus of the material of a given beam supported on two knife-edges and loaded at the middle point.
15. To determine the Modulus of Rigidity of a wire by Maxwell's Needle.

Text Books/References:

1. S. L. Gupta & V. Kumar, Practical Physics, 2018, Pragati Prakashan.
2. S.L. Arora, B.SC, Practical Physics, 2010, S. Chand.
3. NPTEL video lectures for Experimental Physics.

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Assessment Tools:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	20%

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PS O 4
BPH-151A.1	3	1		1				1	1	1		3	2	1		1
BPH-151A.2	2		2		2				1	1		2	1	1		
BPH-151A.3	2	3	2	3	3				3		1	3	2		2	1
BPH-151A.4	3	1	2		1		1	1	1	1		3	1	1		

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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NAAC 'A' Grade University

BEE-151A: BASIC ELECTRICAL ENGINEERING LAB

Periods/week Credits	Max. Marks : 100
P: 2 1	Internal/Continuous Evaluation: 50
Duration of Examination: 2 Hours	End Semester Exam : 50

Course Outcomes

After completion of this course the students will be able to

BEE-151A.1 familiarize with the measuring instruments, breadboard, CRO, components of LT installation

BEE-151A.2 understand the transformers connection both single and three phase.

BEE-151A.3 study the working principles of electric machines and power converters

BEE-151A.4design a simple PCB with software.

LIST OF EXPERIMENTS:

1. Introduction and use of measuring instruments – voltmeter, ammeter, multi-meter, oscilloscope. Real-life resistors, capacitors and inductors and verification of basic laws.
2. To measure the steady-state and transient time-response of R-L/R-L circuits to a step change in voltage (transient may be observed on a storage oscilloscope).
3. To examine sinusoidal steady state response of R-L, and R-C circuits – impedance calculation and verification. Observation of phase differences between current and voltage.
4. To find the resonance frequency inR-L-C circuits..
5. To observe the no-load current waveform of transformer on an oscilloscope (non- sinusoidal wave-shape due to B-H curve nonlinearity should be shown along with a discussion about harmonics).
6. To perform Load test on a transformer: measurement of primary and secondary voltages and currents, and power.
7. To connect Three-phase transformers in Star and Delta and verify voltage and current relationships (line-line voltage, phase-to-neutral voltage, line and phase currents). Phase-shifts between the primary and secondary side and to measure three-phase power in balanced three-phase circuits.
8. Identification of various types of Printed Circuit Boards (PCB) and soldering techniques.
9. Introduction to PCB design software.
10. PCB Lab a) Artwork & printing of simple PCB b) Etching & drilling of PCB.
11. Demonstration of cut-out sections of machines: dc machine (commutator-brush arrangement), induction machine (squirrel cage rotor), synchronous machine (field winding - slip ring arrangement) and single-phase induction machine.
12. To draw Torque -Speed Characteristic of dc motor.
13. To find Synchronous speed of two and four-pole three-phase induction motors, check Direction reversal by change of phase-sequence of connections and to draw Torque-Slip Characteristic of an induction motor.
14. To Study components of LT, switchgear- MCB, ELCB, MCCB.
15. To Study DC-DC Converter.

Text Books:

Dr. N K Jain ,2010, A text book of Practicals in Electrical Engineering, Dhanpatrai Publishing Co.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

CO Statement (BEE-151A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BEE-151A.1	3	3	2	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-151A.2	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1
BEE-151A.3	3	3	3	1	1	-	-	-	-	-	-	2	3	3	1	1
BEE-151A.4	3	3	3	1	1	-	-	-	-	-	-	2	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
BHM-201A: English

Periods/week	Credits	Max. Marks: 100
L: 2 T:0 P:0	2	Continuous Evaluation: 50
Duration of Exam: 2 Hours		External (Written): 50

Prerequisites:
Students are expected to have an inclination towards understanding the need for life skills required to succeed in their career and should know Basic English.

Course Type: Program Core

Course Outcomes: The students would be able to-
BHM 201.1. Speak in English confidently
BHM 201.2. Acquire proficiency in reading and writing skills
BHM 201.3. Communicate in grammatically correct English.
BHM 201.4. Create and deliver presentations confidently.
BHM 201.5 Understand the meaning of professional communication.

Unit 1. Vocabulary Building
1.1 The concept of Word Formation
1.2 Root words from foreign languages and their use in English
1.3 Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4 Synonyms, antonyms, and standard abbreviations.

Unit 2. Basic Writing Skills
2.1 Sentence Structures
2.2 Use of phrases and clauses in sentences
2.3 Importance of proper punctuation
2.4 Creating coherence
2.5 Organizing principles of paragraphs in documents
2.6 Techniques for writing precisely

Unit 3. Identifying Common Errors in Writing
3.1 Subject-verb agreement
3.2 Noun-pronoun agreement
3.3 Misplaced modifiers
3.4 Articles
3.5 Prepositions
3.6 Redundancies
3.7 Clichés

Unit 4. Nature and Style of sensible Writing
4.1 Describing
4.2 Defining
4.3 Classifying
4.4 Providing examples or evidence
4.5 Writing introduction and conclusion

Unit 5. Writing Practices
5.1 Email Writing
5.2 Cover Letter
5.3 Essay

Unit 6. Oral Communication

6.1Listening Comprehension
6.2 Pronunciation, Intonation, Stress and Rhythm
6.3Common Everyday Situations: Conversations and Dialogues
6.4 Communication at Workplace
6.5Interviews
6.6Formal Presentations

Text Books/Reference Books:

- F.T. Wood.2007, Remedial English Grammar. Macmillan.
- William Zinsser,2001, On Writing Well, Harper Resource Book.
- Liz Hamp-Lyons and Ben Heasly. 2006, Study Writing. Cambridge University Press.
- Sanjay Kumar and PushpLata, 2011, Communication Skills. Oxford University Press.

Web links:

- https://www.mindtools.com/
- https://www.slideshare.net/
- http://ndl.iitkgp.ac.in
- hbx.hbs.edu

Distribution of Continuous Evaluation:

Sessional 1	15%
Sessional 2	15%
Assignment	10%
Class Performance	5%
Attendance	5%
End Term Exam	50%

Instructions for Paper Setting:

- **Section A- MCQ's- 30 marks**
- **Section B- 2 short questions- 10 marks**
- **Section C- 2 short questions, 10 marks**

Assessment Tools:

- **Assessment of sessional 1 through In Class Presentations.**
- **Continuous evaluation**
- **Assignments**
- **Attendance**
- **Marks for Behavior and soft skills displayed in the class**

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BHM 201.1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1
BHM 201.2	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	1
BHM 201.3	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-
BHM 201.4	-	-	-	-	-	-	-	-	2	-	1	-	-	-	1	1
BHM 201.5	-	-	-	-	-	-	-	1	1	-	2	-	-	-	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BHM-MC-001: CONSTITUTION OF INDIA

Periods/week Credits	Max. Marks : 100
L :0 T: 1 AP	Continuous Evaluation: 50
Duration of Exam: 2 Hrs	End Semester Exam : 50

Pre-Requisite: Nil
Course Type: HSMC

Unit-1: Background:
India's struggle for independence, Formation of the Constituent Assembly, The Union and its Territory : Nomenclature, Formation of New States and Alteration of Areas, Citizenship : Citizenship at the Commencement of the Constitution, Rights of Citizenship of certain persons, Rights of Citizenship of certain persons of Indian origin residing outside India, Continuance of the rights of Citizenship, Parliament to regulate the right of the Citizenship by law.

Unit-2: Fundamental Rights and Directive Principles :
Definition, Laws inconsistent with or in derogation of the Fundamental Rights, Equality before law, Prohibition of discrimination on grounds of religion, race, caste, sex or place of birth, Equality of opportunity in matters of public employment, Abolition of untouchability, Abolition of Titles- Right to Freedom, Right against Exploitation, Right to freedom of religion, Cultural and Educational rights, Right to constitutional remedies, Directive principles of State Policy : Definition, Right to work, Right to education and to public assistance in certain cases, provisions for just and humane condition of work and maternity relief, uniform civil code for the citizens, protection and improvement of environment and safeguarding of forests and wildlife, protection of monuments and places and objects of national importance, separation of judiciary from executive, promotion of international peace and security and Fundamental Duties.

Unit-3: The Union:
The executive, The President and Vice President of India, Council of Ministers, Attorney General for India, Parliament, Legislative procedure, The Union Judiciary: Establishment and constitution of Supreme Court, Powers and Functions of Supreme Court, Original Jurisdiction of the Supreme Court, The States : Definition, The Governor, Council of Ministers, The Advocate General for the State, The State Legislature, Legislative Procedure, High Courts in the State, The Union Territories, The Panchayats, Municipalities, Relations between the Union and the States.

Unit-4:Services under the Union and the States:
Services, Public Service Commissions, Elections: Election Commission of India, Emergency Provisions : Proclamation of Emergency, Amendment of the Constitution, Temporary, Transitional and Special Provisions, Schedules : First to Tenth Schedule and Miscellaneous.

Text books/reference books:

1. R. Bhargava, (2008) 'Introduction: Outline of a Political Theory of the Indian Constitution', in R. Bhargava (ed.) Politics and Ethics of the Indian Constitution, New Delhi: Oxford University Press, pp. 1-40.
2. G. Austin, (2000) 'The Social Revolution and the First Amendment', in Working a Democratic Constitution, New Delhi: Oxford University Press, pp. 69-98.
3. A. Sibal, (2010) 'From Niti to Nyaya,' Seminar, Issue 615, pp 28-34.
4. B. Shankar and V. Rodrigues, (2011) 'The Changing Conception of Representation: Issues, Concerns and Institutions', in The Indian Parliament: A Democracy at Work, New Delhi: Oxford University Press, pp. 105-173.
5. V. Hewitt and S. Rai, (2010) 'Parliament', in P. Mehta and N. Jayal (eds.) The Oxford Companion to Politics in India, New Delhi: Oxford University Press, pp. 28-42.
6. J. Manor, (2005) 'The Presidency', in D. Kapur and P. Mehta P. (eds.) Public Institutions in India, New Delhi: Oxford University Press, pp.105-127.
7. J. Manor, (1994) 'The Prime Minister and the President', in B. Dua and J. Manor (eds.) Nehru to the Nineties: The Changing Office of the Prime Minister in India, Vancouver: University of British Columbia Press, pp. 20-47.
8. U. Baxi, (2010) 'The Judiciary as a Resource for Indian Democracy', Seminar, Issue 615, pp. 61-67.
   R. Ramachandran, (2006) 'The Supreme Court and the Basic Structure Doctrine' in B. Kirpal et.al (eds.)

Supreme but not Infallible: Essays in Honour of the Supreme Court of India, New Delhi: Oxford University Press, pp. 107-133.
9. M. Singh, and R. Saxena (eds.), (2011) 'Towards Greater Federalization,' in Indian Politics: Constitutional Foundations and Institutional Functioning, Delhi: PHI Learning Private Ltd., pp. 166-195.
10. V. Marwah, (1995) 'Use and Abuse of Emergency Powers: The Indian Experience', in B. Arora and D. Verney (eds.) Multiple Identities in a Single State: Indian Federalism in a Comparative Perspective, Delhi: Konark, pp. 136-159.
11. B. Sharma, (2010) 'The 1990s: Great Expectations'; 'The 2000s: Disillusionment Unfathomable', in Unbroken History of Broken Promises: Indian State and Tribal People, Delhi: Freedom Press and Sahyog Pustak Kuteer, pp. 64-91.
12. P. deSouza, (2002) 'Decentralization and Local Government: The Second Wind of Democracy in India', in Z. Hasan, E. Sridharan and R. Sudarshan (eds.) India's Living Constitution: Ideas, Practices and Controversies, New Delhi: Permanent Black, pp. 370-404.
13. M. John, (2007) 'Women in Power? Gender, Caste and Politics of Local Urban Governance', in Economic and Political Weekly, Vol. 42(39), pp. 3986-3993

Distribution of Continuous evaluation table

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

2nd Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University
BCH-106: CHEMISTRY FOR ENGINEERS

Periods/week	Credits	Max. Marks	: 200
L: 2 T: 0	2	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Term Examination	: 100

Pre-requisite: Basic knowledge of 10+2 level Chemistry
Course Type: Basic Sciences

Course Outcomes: The course will enable the student to-
BCH-106.1. Apply fundamental principles to predict the structure, stereochemistry, bonding and general properties of materials.
BCH-106.2.Predict potential applications and practical utility of chemistry in different areas and propose suitable analytical techniques for practical applications.
BCH-106.3. Develop the understanding of water treatment techniques, electrochemical cells and combustion technology.

Unit 1: Water Treatment Chemistry (5 Lectures)
Impurities in water, Drinking Water quality standards, Hardness, types and its determination by EDTA method, Alkalinity and its determination, numerical problems based on hardness & alkalinity, Water softening methods: zeolite, ion-exchange process, Desalination of water: Reverse osmosis (RO) & Electro-dialysis process

Unit 2: Electrochemical cells and Fuels (5 Lectures)
Basic concepts of cells, Primary cells, Secondary cells and batteries, Fuel cells, Fuels and their types, Combustion technology

Unit 3: Phase Rule and its applications (4 Lectures)
3.1 Terminology of Gibb's phase rule and problems based on phase rule equation, One component system (water), Two component Eutectic system (Pb-Ag), Industrial applications of phase diagrams

Unit 4: Atomic and molecular structure (5 Lectures)
Limitations of classical mechanics in treating atomic and molecular phenomena, Schrodinger equation, Particle in a box solution and their applications for conjugated molecules and nanoparticles, Molecular orbital treatment for homo-nuclear diatomic molecules, Bonding in Coordination Compounds: Crystal field theory

Unit-5: Stereochemistry (4 Lectures)
Structural isomers and stereoisomers, Representations of 3 dimensional structures, Enantiomers, diastereomers, Absolute configurations and conformational analysis

Unit6: Analytical Techniques(5 Lectures)
Basic Principles of spectroscopy, UV- VIS spectroscopy and its applications, IR spectroscopy and its applications, Principle and analytical applications of Atomic Absorption spectroscopy, brief overview of Inductively coupled plasma mass spectrometry

Text Books/ Reference books/Web references:

1. P. C. Jain and Monica Jain, Engineering Chemistry, 2017, Dhanpat Rai Publishing Company.
2. Prasanta Rath, Subhendu Chakroborty, Chemistry, 2018, Cengage Learning Publishers.
3. B. H. Mahan,2010, University Chemistry, Pearson Education.
4. C. N. Banwell, 2008, Fundamentals of Molecular Spectroscopy, McGraw Hill Education India.
5. Gourkrishna Dasmohapatra, 2019, Chemistry-I, Vikas Publishing.
6. https://nptel.ac.in/courses/103/108/103108138/
7. https://nptel.ac.in/courses/122/101/122101001/

Distribution of Continuous Evaluation:

Sessional-I	30%
Sessional-II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Evaluation Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Assignments, Sessional and End Semester Examination paper will consist of various difficulty levels to accommodate the different capabilities of students. Assessment should cover all course outcomes and upper limit for lower order skills will be 40% (for knowledge-oriented questions). However, weightage for different cognitive levels in the question papers can vary.

Instructions for paper setting: The paper setter must ensure the coverage of entire syllabus while setting the question papers and mention the learning outcomes across each section to be measured by the examination. Weightage of the sections may vary as per the number of respective lecture hours mentioned in the syllabus.Action verbs should be used from Bloom's Taxonomy while designing question papers.

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3	PS O4
BCH-106.1	3	3	1	-	1	-	-	-	-	-	-	2	1	-	-	-
BCH-106.2	3	3	2	-	2	2	2	-	-	-	-	2	-	1	-	-
BCH-106.3	3	3	2	-	2	2	2	-	-	-	-	2	1	-	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BMA-202: MATHEMATICS-2
(Calculus, ordinary Differential Equations and Complex variables)

Periods/week Credits	Max. Marks : 200
L: 3 T: 1 4	Continuous Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites: The students must have the knowledge of mathematical concepts of Intermediate level and Mathematics-1.
Course Type: Basic Sciences

Course Outcomes: The objective of this course is to familiarize the prospective engineers with techniques in multivariate integration, ordinary and partial differential equations and complex variables. It aims to equip the students to deal with advanced level of mathematics and applications that would be essential for their disciplines. More precisely, the outcomes are:

BMA-202.1 Students will be able to recognize the application of mathematics in engineering.
BMA-202.2 Students will be able to describe the knowledge of multiple Integration and Differentiation in the field of complex functions.
BMA-202.3 Students will be able to demonstrate the concepts of differential equations of higher order.
BMA-202.4 Students will be able to distinguish between real and complex functions.
BMA-202.5 Students will be able to interpret the concept of complex integration for those functions which are not defined on real line.
BMA-202.6 Students will be able to evaluate improper integrals using complex integration.

PART-A

Unit 1: Multivariable Calculus (Integration)
Multiple Integration: Double integrals (Cartesian), change of order of integration in double integrals, Change of variables (Cartesian to polar), Applications: areas and volumes, Center of mass and Gravity (constant and variable densities), Triple integrals (Cartesian), orthogonal curvilinear coordinates, Simple applications involving cubes, sphere and rectangular parallelepipeds, Scalar line integrals, vector line integrals, scalar surface integrals, vector surface integrals, theorems of Green, Gauss and Stokes.

Unit 2: First Order Ordinary Differential Equations
Exact, linear and Bernoulli's equations, Euler's equations, Equations not of first degree: equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type.

Unit 3: Ordinary Differential Equations of Higher Orders
Second order linear differential equations with variable coefficients, method of variation of parameters, Cauchy-Euler equation, Power series solutions; Legendre polynomials, Bessel functions of the first kind and their properties.

PART-B

Unit 4: Complex Variable – Differentiation
Differentiation, Cauchy-Riemann equations, analytic functions, harmonic functions, finding harmonic conjugate, elementary analytic functions (exponential, trigonometric, logarithm) and their properties, Conformal mappings, Mobius transformations and their properties.

Unit 5: Complex Variable – Integration
Contour integrals, Cauchy-Goursat theorem (without proof), Cauchy Integral formula (without proof), Liouville's theorem and Maximum-Modulus theorem (without proof), Taylor's series, zeros of analytic functions, singularities, Laurent's series, Residues, Cauchy Residue theorem (without proof), Evaluation of definite integral involving sine and cosine, Evaluation of certain improper integrals using the Bromwich contour.

Suggested Text/Reference Books

1. G.B. Thomas and R.L. Finney,2002, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint.
2. Erwin kreyszig, 2006, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons.
3. W. E. Boyce and R. C. DiPrima, 2009, Elementary Differential Equations and Boundary Value Problems, 9th Edn., Wiley India.
4. S. L. Ross, 1984, Differential Equations, 3rd Ed., Wiley India.
5. E. A. Coddington, 1995, An Introduction to Ordinary Differential Equations, Prentice Hall India.
6. E. L. Ince, 1958, Ordinary Differential Equations, Dover Publications.
7. J. W. Brown and R. V. Churchill, 2004, Complex Variables and Applications, 7th Ed., Mc-Graw Hill.
8. N.P. Bali and Manish Goyal, 2008, A text book of Engineering Mathematics, Laxmi Publications, Reprint.
9. B.S. Grewal, 2010, Higher Engineering Mathematics, Khanna Publishers, 36th Edition.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B. Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous evaluation table

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials.
Sessional Tests.
Surprise questions during lectures/Class Performance.
End Term Examination.

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BMA-202.1	3	3	2	2	2	--	--	--	--	--	--	2	3	--	--	--
BMA-202.2	3	3	2	2	2	--	--	--	--	--	--	1	2	--	--	--
BMA-202.3	3	3	2	2	3	--	--	--	--	--	--	2	2	--	--	--
BMA-202.4	2	2	3	1	2	--	--	--	--	--	--	1	2-	--	--	--
BMA-202.5	3	3	2	2	3	--	--	--	--	--	--	2	2	--	--	--

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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NAAC 'A' Grade University

BCS-101A: PROGRAMMING FOR PROBLEM SOLVING

Periods/week	Credits	Max. Marks : 200
L :3 T: 0	3.0	Continuous Evaluation : 100
Duration of Exam: 3 Hrs		End Term Examination : 100

Pre-Requisite: Basic Knowledge of Computers

Course Type: Program Core

Course Outcomes: The students will be able to-

BCS-101A.1 Formulate simple algorithms for arithmetic and logical problems with correct logic.

BCS-101A.2 Implement the conditional statement and ietration with understanding of concepts.

BCS-101A.3 Decompose a problem into functions and able to understand use of functions.

BCS-101A.4Apply advance C programming techniques such as arrays, pointers, dynamic memory allocation, structures to develop solutions for particular problems.

PART- A

Unit-1: Introduction to Programming

1.1 Introduction to programming

1.2 Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.)

1.3 Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/ Pseudo code with examples.

1.4 From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

1.5 Expressions, Precedence and Associatively, Expression Evaluation, Type conversions

Unit-2: Loops and Conditional Statements

2.1 Arithmetic expressions and precedence

2.2 Conditional Branching; Writing and evaluation of conditionals and consequent branching

2.3 Iteration and loops

Unit-3: Arrays and Structures

3.1 Arrays (1-D, 2-D):1 D array and function–Passing individual array elements to a function, passing individual array elements address to a function, passing whole 1d array to a function, 2D array and function, Passing individual array elements to a function, passing individual array elements address to a function, passing whole 2d array to a function

3.2 Character Arrays and Strings

3.3 Structures; Defining Structures

3.4 Array of Structures

PART –B

Unit-4: Functions

4.1 Functions (including using built in libraries)

4.2 Parameter passing in functions

4.3 call by value.

4.4 Passing arrays to functions: idea of call by reference

4.5 Recursion, as a different way of solving problems.

4.6 Example programs, such as Finding Factorial, Fibonacci series.

Unit-5: Basic Algorithms

5.1 Iterative Searching (Linear and Binary Search)

5.2 Basic Sorting Algorithms with implementation (Bubble, Insertion and Selection)

5.3 Finding roots of equations

5.4 Notion of order of complexity through example programs (no formal definition required)

Unit-6: Pointers and File Handling

6.1 Idea of pointers, Defining pointers, Pointer to an array, Array of pointers, Pointers and two dimensional arrays

6.2 Use of Pointers in self-referential structures

6.3 Notion of linked list (no implementation)

6.4 File Handling :Working with text files and Binary Files, File operations using std. library and system calls–File management I/O functions

Text Books / Reference Books:

1. Byron Gottfried, 2015, Schaum's Outline of Programming with C: 2nd Ed., McGraw-Hill.
2. E. Balaguruswamy, 1998, Programming in ANSI C: 2nd Ed., Tata McGraw-Hill.
3. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language:, 2nd Ed., PHI.

Software required/Weblinks:

Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Evaluation Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX :

CO Statement (BCS-101A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BCS-101A.1	2	3	2	-	2	-	-	-	-	-	-	3	1	1	-	1
BCS-101A.2	2	1	2	1	3	-	-	-	-	-	-	-	-	1	1	2
BCS-101A.3	-	1	2	-	1	2	-	-	-	-	-	1	3	2	1	1
BCS-101A.4	3	3	1	3	2	-	-	-	-	-	-	-	3	1	2	1

BME-102: WORKSHOP/MANUFACTURING PRACTICES

Periods/weekCredits	Max. Marks :200
L: 0 T: 0P:4 2	Continuous Assessment :100
Duration of Examination:3Hrs	End Semester Exam :100

Prerequisites: basic knowledge of Science and Mathematics Course
Type: Engineering Science Course

Course Outcomes:
After completion of this course the students will be able to

BME-102.1	Learn the basic manufacturing/fabrication processes and develop skills to fabricate with their own hand.
BME-102.2	Understand how to operate various traditional and modern machine tools used inindustries.
BME-102.3	Apply knowledge of the dimensional accuracies and dimensional tolerances, basics of various measuring instruments, hand tools and cuttingtools.
BME-102.4	Acquire knowledge of safetymeasurements
BME-102.5	Understand the impact of manufacturing engineering solution.
BME-102.6	Assemble different mechanicalcomponent/parts

Lectures & Videos (10 Hrs)

(i) Detailed Content

1. Manufacturing Methods- casting, forming, machining, joining, advanced manufacturing methods (3lectures).
2. CNC machining, Additive manufacturing (1lecture)
3. Fitting operations & power tools (1lecture)
4. Electrical &Electronics (1lecture)
5. Carpentry (1lecture)
6. Plastic moulding, glass cutting (1lecture)
7. Metal casting (1lecture)
8. Welding (arc welding & gas welding), brazing (1lecture)

(ii) Workshop Practice: (60hours)

1. Machine shop (10hours)
2. Fitting shop (8hours)
3. Carpentry (6 hours)
4. Electrical & Electronics (8 hours)
5. Welding shop (8 hours) (Arc welding 4 hrs + gas welding 4hrs)
6. Casting (8hours)
7. Smithy (6hours)
8. Plastic moulding & Glass Cutting (6hours)

Students Project Fabrication

Students have to fabricate product from the assigned list with their own hands. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different workshop processes. The final product should be assembly of different components fabricated by different workshop practices.
For e.g. Tack-hammer; Project Display Stand; Pen stand, Screw Driver, Variable size Spanner, Electrical Extension Board with electronic circuits or any other product which should involve multiple workshop practices to fabricate a single product.
Each student will be issued the drawings of the product assembly along with the drawing of the sub-

part assembly, mentioning the dimensions, tolerance, sub-products used.
Students should follow the process planning sheet of the product and get involved in different workshop practices to complete the jobs for final submission.
Note: Each student should do more than one product to get hands on experience of all the workshop practices.

Text Books:

1. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., Elements of Workshop Technology Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited,Mumbai.
2. Kalpakjian S. And StevenS. Schmid, Manufacturing Engineeringand Technology 4th edition, Pearson Education India Edition,2002.
3. Gowri P. Hariharan and A. Suresh Babu, ManufacturingTechnology I PearsonEducation, 2008.

Reference Books:

1. Roy A. Lindberg, " Processes and Materials of Manufacture" , 4th edition, Prentice Hall India, 1998.
2. Rao P.N., " Manufacturing Technology" , Vol. I and Vol. II, Tata McGrawHill House, 2017.

Weblinks:

https://nptel.ac.in/noc/courses/noc17/SEM2/noc17-me21/

Instructions for setting of Paper Seven questions are to set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each part A and part B (one from each unit). Student needs to attempt two questions out of three questions from each part. Each question will be of 20 marks.

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BME-102.1	3	3	3	3	2	1	1	2	2	2	2	3	3	3	3	3
BME-102.2	3	3	3	3	3	2	1	2	2	2	2	2	2	2	2	2
BME-102.3	3	3	3	3	3	2	2	1	2	2	1	2	2	2	2	2
BME-102.4	2	2	2	2	3	2	1	1	2	1	2	2	3	2	2	2
BME-102.5	3	2	2	2	2	3	3	2	2	2	2	2	3	2	2	2
BME-102.6	3	3	3	2	2	1	2	2	2	3	2	2	2	2	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BBT-100 BIOLOGY FOR ENGINEERS

Periods/week	Credits	Max. Marks	: 200
L: 2 T: 0 P:0	02	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Semester Examination:	100

Pre-requisites: Knowledge of 10+2 Science
Course Type: Basic Sciences

Course Outcomes:
The students will be able to-

BBT-100.1 describe the taxonomic diversity of life forms and their functions.
BBT-100.2 assess the role of biomolecules in physiology and genetics.
BBT-100.3 illustrate the structural and functional organization of the human body.
BBT-100. 4 apply the principles of biology for sustenance.

PART-A

Unit 1: The Living World
1.1 What is living World?
1.2 Diversity in the living world
1.3 Taxonomy and Biological Classification
1.4 Structural organization in plants and animals
1.5 Cell- The unit of Life

Unit 2: Microbiology
2.1 Microbial diversity, Ecology and Population dynamics, Microbial growth on surfaces Environmental effect on microbial growth.
2.2 Bioremediation, examples of bioremediation, Acid mine drainage, Enhanced metal recovery, Wastewater microbiology
2.3 Solid waste microbiology, Landfills, Leachate, Anaerobic degradation phases.
2.4 Antimicrobial resistance

PART-B

Unit 3: Biochemistry
3.1 Carbohydrates- monosaccharides, disaccharides and Polysaccharides,
3.2 Lipids- fatty acids, fats and oils, lipids of biological importance
3.3 Amino acids – essential and non-essential amino acids, peptide bond formation
3.4 Proteins- overview of proteins synthesis, structural organization, functions of proteins
3.5 Nucleic acids- structure and functions of DNA and RNA.
3.6 Enzymes: role as biological catalysts, Mechanism of enzyme action, Industrial applications of enzymes

Unit 4: Human Anatomy
4.1 General Anatomy- Basic terms in anatomy- Anterior, posterior, lateral, medial, Elementary tissues of the human body
4.2 Cardiovascular system, Respiratory System
4.3 Gastrointestinal System, Genito-urinary system
4.4 Musculoskeletal system, Nervous system & Sense organs

4.5 Endocrine System

Unit 5: Human Physiology
5.1 Body fluids and salts, composition and functions of blood, Blood groups, blood clotting
5.2 Cardiac cycle and heart sounds, Electrocardiogram (ECG), Blood pressure, Hypertension, Hypotension, Arteriosclerosis, Atherosclerosis, Angina, Myocardial infarction, Congestive heart failure and cardiac arrhythmias
5.3 Respiratory volumes and capacities, Hypoxia, Asphyxia
5.4 Disorders of GIT, Endocrine disorders
5.5 Microbial infections, Cancer

Unit 6: Genetics & Computational Approach to Biology
6.1 Genetics- DNA as a blueprint and RNA as a messenger, from DNA sequence to Genes (From alphabets to words), Mendelian Inheritance
6.2 DNA to Chromosomes- Genes and Mutations, Information pathways – Replication, Transcription and Translation, Epigenetic Modifications.
6.3 Computational Approach to Biology- Finding a needle in the haystack – Making sense of the Big Data,Types of Biological Datasets.
6.4 The "Omics" Approach, Introduction to Network Biology - Basics of Graph and Network Theory, Cellular Networks.

Text/ Reference Books:
1) Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd
2) Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons
3) Principles of Biochemistry (V Edition), By Nelson, D. L.; and Cox, M. M.W.H. Freeman and Company
4) Molecular Genetics (Second edition), Stent, G. S.; and Calender, R.W.H. Freeman and company, Distributed by Satish Kumar Jain for CBS Publisher
5) Microbiology, Prescott, L.M J.P. Harley and C.A. Klein 1995. 2nd edition Wm, C. Brown Publishers.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering the entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each Unit). Students need to attempt two questions out of three from each part. Each question will be of 20 marks.

Continuous Evaluation:
Sessional-I 30%
Sessional-II 30%
Assignment/Tutorial 20%
Class Work/ Quiz 20%

Course Articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BBT-100.1	2	1	1	-	-	1	1	-	-	-	3	2	1	2	-	1
BBT-100.2	3	2	2	-	-	2	2	-	-	-	3	3	2	0	-	1
BBT-100.3	3	3	3	-	-	3	3	-	-	-	3	3	1	1	-	1
BBT-100.4	3	3	3	-	-	3	3	-	-	-	3	3	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

BCH-151A: CHEMISTRY LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Term Examination	: 50

Pre-requisite: Basic knowledge of 10+2 level Chemistry
Course Type: Basic Sciences Courses

Course Outcomes: The students will be able to:
BCH-151A.1. analyze the need and utility of the experiments.
BCH-151A.2. do precise quantitative measurements using volumetric glassware, analytical balance, and prepare standards solutions independently.
BCH-151A.3. carry out experiments to check the hardness, alkalinity and chloride content of different water samples and interpret the results.
BCH-151A.4. employ the basic methods/techniques to measure surface tension, viscosity, conductance, emf, saponification value of different samples.

List of Experiments:

1. Preparation and standardization of volumetric solutions.
2. Determination of viscosity using Ostwald Viscometer.
3. Determination of hardness of water by EDTA method.
4. Determination of alkalinity of water.
5. Determination of strength of solution by Conductometric titration.
6. Determination of Ferrous ion concentration using Potentiometer.
7. Determine the percentage composition of given mixture of sodium hydroxide and sodium chloride.
8. Determination of viscosity of lubricating oils using Redwood viscometers.
9. Determination of chloride content of water.
10. Determination of surface tension using Stalagmometer.
11. Determination of saponification value of oils.
12. Determination of the partition coefficient of a substance between two immiscible liquids.

Text Books/ Reference books/Web references:
1, Sunita Rattan, 2011, **Experiments in Applied Chemistry**, S.K.Kataria & sons.
2. Shailendra K.Sinha,2014, Physical Chemistry A Laboratory Manual, Alpha Science International Limited.
3. https://vlab.amrita.edu/index.php?sub=2&brch=190
4.https://vlab.amrita.edu/index.php?sub=2&brch=193&sim=575&cnt=1

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Distribution of Continuous Evaluation:

Viva-I	30%
Viva-II	30%
File/Records	20%
Class Work/ Performance	20%

Evaluation Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
BCH-151A.1	3	3	2	1	1	-	1	1	1	1	-	2	2	1	2	1
BCH-151A.2	3	3	2	1	2	-	1	1	1	1	-	2	2	-	1	-
BCH-151A.3	3	3	2	1	2	-	2	1	1	1	-	2	2	1	-	2
BCH-151A.4	3	3	2	1	1	-	1	1	1	1	-	2	2	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University
BCS-151A: PROGRAMMING FOR PROBLEM SOLVING LAB

Periods/week Credits	Max. Marks :100
P :2 1.0	Continuous Evaluation : 50
Duration of Exam: 2 Hrs	End Term Examination : 50

Co-Requisite: Programming for problem solving (BCS-101A)
Course Type: Program Core

Course Outcomes: Students will be able to-

BCS-151A.1 Formulate the algorithms for simple problems in C language.
BCS-151A.2 Understanding of syntax errors as reported by the compilers as well as logical errors.
BCS-151A.3 Write iterative as well as recursive programs, implementing of arrays, strings and structures and various graph traversing algorithms.
BCS-101A.4 Declare pointers of different types and able to understand the concept of file handling.

NOTE: The laboratory should be preceded or followed by a tutorial to explain the approach or algorithm to be implemented for the problem given.

List of Practicals:
Tutorial 1: Problem solving using computers:
Lab1: Familiarization with programming environment
Tutorial 2: Variable types and type conversions:
Lab 2: Simple computational problems using arithmetic expressions
Tutorial 3: Branching and logical expressions:
Lab 3: Problems involving if-then-else structures
Tutorial 4: Loops, while and for loops:
Lab 4: Iterative problems e.g., sum of series
Tutorial 5: 1D Arrays: searching, sorting:
Lab 5: 1D Array manipulation
Tutorial 6: 2D arrays and Strings
Lab 6: Matrix problems, String operations
Tutorial 7: Functions, call by value,call by refrence
Lab 7: Simple functions
Tutorial 8: Recursion, structure of recursive calls
Lab 8: Recursive functions
Tutorial 9: Numerical methods (Root finding, numerical differentiation, numerical integration):
Lab 9: Programming for solving Numerical methods problems
Tutorial 10: Pointers, structures and dynamic memory allocation
Lab 10: Pointers and structures
Tutorial 11: File handling
Lab 11: File operations

Software required/Weblinks:
Turbo C
www.tutorialpoint.com
www.nptel.com
www.w3schools.com

Note: At least 5 more exercises to be given by the teacher concerned.

Distribution of Continuous Evaluation:

Viva- I	30%
Viva- II	30%
File/Records	20%
Class Work/ Performance	20%

Evaluation Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Exam

COURSE ARTICULATION MATRIX :

CO Statement (BCS-151A)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BCS-151A.1	2	1	2	2	-	-	-	-	-	-	2	1	2	-	1	1
BCS-151A.2	3	-	-	3	2	-	-	-	-	-	-	-	2	3	3	2
BCS-151A.3	3	1	2	3	-	1	-	-	-	-	-	-	1	2	-	-
BCS-151A.4	2	3	1	2	3	-	-	-	-	-	1	1	3	2	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BHM-151: ENGLISH LAB
(Humanities and Social Sciences including Management Courses)

Periods/week	Credits	Max. Marks	: 50
L: 0 T:0 P:2	1	Continuous Evaluation: 25	
		End Semester Exam (Written)	: 25

Prerequisites:
Basic knowledge of English language

Course Type: Program Core

Course Outcomes:

BHM-151.1. Students would be able to speak in English confidently.
BHM-151.2. To develop the understanding of correct pronunciation and intonation.
BHM-151.3. Students would be able to communicate professionally in a corporate environment.

List of Activities

1. Listening exercises for correct pronunciation and intonation
2. Role plays for speaking confidently
3. Group Discussions
4. Extempore
5. Mock Interviews
6. In Class Presentations
7. JAM Sessions
8. Theatre activity

Text Books/Reference Books:

- Liz Hamp-Lyons and Ben Heasly. 2006, Study Writing. Cambridge University Press.
- Sanjay Kumar and PushpLata 2011, Communication Skills, Oxford University Press.
- CIEFL, Hyderabad ,Exercises in Spoken English. Parts. I-III, Oxford University Press.

Distribution of Continuous evaluation table

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
BHM-151.1	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	1
BHM-151.2	-	-	-	-	-	-	-	-	-	2	-	-	1	-	-	-
BHM-151.3	-	-	-	-	-	-	-	1	1	-	2	-	-	1	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BCH-MC-002: Environmental Science

Periods/week **Max. Marks : 100**
T: 1 Internal : 50
External : 50

Pre-requisite: Basic knowledge of Environment related issues
Course Type: Mandatory

Course Outcomes : The students will be able to

BCH-MC-002.1: comprehend various environmental issues through various activities.
BCH-MC-002.2: understand that each and every action of ours reflects on the environment and collaborate in groups to suggest innovative ways to protect environment through project work/report writing.

Activities:
i) Small group meetings about conservation and management of natural resources, conservation of biodiversity, solid waste management and *environmental remediation*
ii) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
iii) Expert talk
iv) Slogan writing /Poster making event
v) Cycle rally to create awareness on issues like pollution control, cleanliness, and waste management.
vi) Plantation activity
vii) Cleanliness drive
viii) Drive for segregation of waste
ix) Visit to an area to document environmental assets: river/ forest/ flora/fauna, etc.
x) Environment protection related efforts

The break-up for marks
Internal Marks
Evaluation based on participation in activities: 50 marks
External Marks
Field work, Report writing & Viva: 20+20+10 = 50 marks

Course Articulation Matrix

CO Statement (BCH-MC-002**)**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BCH-MC-002.1	1	2	1	-	-	2	3	2	1	-	-	1	1	-	1	-
BCH-MC-002.2	1	2	1	-	-	2	3	2	1	-	-	1	1	-	1	-

3rd SEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-301: ELECTRICAL CIRCUIT ANALYSIS

Periods/week Credits	Max. Marks : 200
L: 3T: 1 4	Continuous Evaluation: 100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre Requisite: Basic Electrical Engineering
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-301.1 Solve electrical networks using different theorems and Graph theory.
BEE-DS-301.2 Analyze the transient and steady state behavior of electrical circuits.
BEE-DS-301.3 Analyze the effect of location of poles and zeros on time domain behavior and calculate the two-port network functions and parameters.
BEE-DS-301.4 Design the Constant-K passive filters.

Unit 1: NETWORK THEOREMS (8 Hours)
1.1 Superposition theorem, Thevenin theorem
1.2 Norton theorem, Maximum power transfer theorem, Compensation theorem.
1.3 Analysis with independent and dependent current and voltage sources.
1.4 Node and Mesh Analysis.
1.5 Concept of duality and dual networks.

Unit 2: ELECTRICAL CIRCUIT ANALYSIS USING LAPLACE TRANSFORMS (7 HOURS)
2.1 Review of Laplace Transform, inverse Laplace transform
2.2 Circuit representation in s-domain,
2.3 Types of signals
2.4 Wave form synthesis
2.5 Analysis of electrical circuits (RL, RC, RLC) using Laplace Transform for standard inputs.

Unit 3: NETWORK FUNCTIONS (7 HOURS)
3.1 Network Functions, terminal pairs or ports
3.2 Network functions for one-port and two-port networks
3.3 Transfer function- impedance and admittance function
3.4 Poles and zeros of Network functions
3.5 Restrictions on pole and zero locations for driving point functions and transfer functions
3.6 Effect of Pole-Zero location on Time domain behavior.

Unit 4: TWO PORT NETWORK PARAMETERS (6 HOURS)
4.1 Relationship of two-port variables short-circuit admittance parameters
4.2 Open circuit impedance parameters
4.3 Transmission parameters, Hybrid parameters
4.4 Relationships between parameter sets
4.5 Theorem and condition of reciprocity & symmetry
4.6 Inter-connection of two port networks.

Unit 5: FILTERS (6 HOURS)
5.1 Image Parameters and characteristics impedance
5.2 Filter fundamentals

5.3 Analysis of k derived high-pass, low-pass, band-pass and band-reject filters
5.4 Design of constant k low pass and high pass filters
5.5 Analysis of m -derived low pass and high pass filters.

Unit 6: GRAPH THEORY (6 HOURS)
6.1 Graph of a network definitions
6.2 Incidence matrix, Reduced Incidence matrix
6.3 Loop matrix, cut set matrix
6.4 Interrelation among various matrices
6.5 Mesh and Nodal solutions from tie set & cut set matrix.

Text Books/ Reference Books:

1. A Chakrabarti, 2018, Circuit Theory Analysis and Synthesis, DhanpatRai&Co.
2. Ashfaq Husain, 2015, Networks and Systems, Khanna Publishers.
3. D. Roy Choudhary, 2013, Networks and Systems, New Age International Publications.
4. M Nahvi , Joseph Edminister, K Rao,2017, Electric Circuits, (Schaum's Outline Series), McGraw Hill Education.
5. Samarajit Gosh,2005, Network Theory- Analysis and Synthesis, PHI learning.
6. W. H. Hayt and J. E. Kemmerly, 2013, Engineering Circuit Analysis, McGraw Hill Education.

Software required/Weblinks:
MATLAB
http://nptel.ac.in/courses/10810242/2
https://www.tutorialspoint.com/gate.../pdf/gate

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-301.1	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-
BEE-DS-301.2	2	2	3	2	-	-	-	-	1	-	-	1	2	-	1	2
BEE-DS-301.3	2	-	2	-	1	-	-	-	-	-	-		2	-	1	-
BEE-DS-301.4	2	2	3	-	-	1	-	-	-	-	-	1	3	-	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-302: ELECTRICAL MACHINES –I

Periods/week Credits	Max. Marks : 200
L: 3 T: 1 4	Continuous Evaluation : 100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre requisites: Nil
Course Type: Program Core
Course Outcomes:After completion of this course the students will be able to
BEE-DS-302.1 explain the concepts of magnetic circuits and electromechanical energy conversion.
BEE-DS-302.2. analyze the differences in operation of different dc machine configurations.
BEE-DS-302.3.analyze the constructional details, principle of operation, testing and applications of different types of transformers.
BEE-DS-302.4.demonstrate construction and working of special electrical machines.

Unit 1 Magnetic fields and magnetic circuits (6 Hours)
4.1 Review of magnetic circuits – MMF, flux, reluctance, inductance
4.2 Influence of highly permeable materials on the magnetic flux lines;B-H curve of magnetic materials
4.3 Basic laws of electro magnetism
4.4 Energy stored in the magnetic circuit
4.5 Force as a partial derivative of stored energy with respect to position of a moving element;
4.6 Torque as a partial derivative of stored energy with respect to angular position of a rotating element.

Unit 2 DC machines (8 Hours)
2.1 Basic construction of a DC machine, magnetic structure – stator yoke, stator poles, pole-faces or shoes, air gap and armature core,
2.2 Visualization of magnetic field produced by the field winding excitation with armature winding open, air gap flux density distribution, flux per pole, induced EMF in an armature coil.
2.3 Armature winding and commutation – Elementary armature coil and commutator,
2.4 Lap and wave windings,
2.5 Construction of commutator, linear commutation
2.6 Derivation of back EMF equation, armature MMF wave,
2.7 Derivation of torque equation,
2.8 Armature reaction, air gap flux density distribution with armature reaction

Unit 3 DC machine – motoring and generation (7 Hours)
3.1 Armature circuit equation for motoring and generation,
3.2 Types of field excitations – separately excited, shunt and series.
3.3 Open circuit characteristic of separately excited DC generator,
3.4 Back EMF with armature reaction,
3.5 Voltage build-up in a shunt generator, critical field resistance and critical speed.
3.6 V-I characteristics and torque-speed characteristics of separately excited, shunt and series motors.
3.7 Speed control of DC motors.
3.8 Losses, load testing and back-to-back testing of DC machines

Unit 4 Transformers (6 Hours)
4.1 Principle, construction and operation of single-phase transformers,
4.2 Magnetizing current, effect of nonlinear B-H curve of magnetic core material
4.3Testing – open circuit and short circuit tests, polarity test, back-to-back test,
4.4 Separation of hysteresis and eddy current losses
4.5 Equivalent circuit, phasor diagram of Single Phase Transformers

4.6 Voltage regulation, losses and efficiency

Unit 5 Three Phase Transformers (6 Hours)
5.1 Three-phase transformer – construction, types of connection and their comparative features,
5.2 Parallel operation of single-phase and three-phase transformers
5.3 Autotransformers – construction, principle
5.4 Applications and comparison with two winding transformer
5.5 Phase conversion – Scott connection, three-phase to six-phase conversion
5.6 Tap-changing transformers – No-load and on-load tap-changing of transformers

Unit 6 Special Electrical Machines (5 Hours)
6.1 Types and constructional features of Permanent Magnet Brushless Motors (PMBLDC);
6.2 Principle of operation – phasor diagram, Torque Equation;
6.3 Stepper Motor. Reluctance motors;

Text Books/ Reference Books:

1. P. S. Bimbhra, 2011, Electrical Machinery, Khanna Publishers.
2. A.Chakrabarti , S,Nath, 2017, Electrical Machines, Macgraw Hill.
3. I. J. Nagrath and D. P. Kothari,2010,Electric Machines, McGraw Hill Education.
4. G C Garg ,2002, A text book of Electrical Machines, KhannaPubhishers.
5. E. G.Janardanan, 2014, Special Electrical Machines, PHI.
6. A. E. Fitzgerald and C. Kingsley, 2013, Electric Machinery, New York, McGraw Hill Education.

Software required / Web links:
nptel.ac.in/courses/108105017/
http://nptel.ac.in/courses/108105017

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-302.1	3	3	3	1	3	-	-	1	1	2	3	3	3	1	3	1
BEE-DS-302.2	3	1	3	3	2	-	-	1	2	2	3	3	3	1	3	1
BEE-DS-302.3	3	3	2	1	2	1	1	2	1	2	3	3	3	-	3	1
BEE-DS-302.4	1	2	1	2	-	-	-	2	-	2	-	1	-	1	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BEC-DS-321: ANALOG ELECTRONICS

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 0	3	Internal	: 100
Duration of Examination: 3 Hrs		External	: 100

Pre-requisites: Nil
Course Type: Program Core

Course Outcomes: The student will be able to

BEC-DS-321.1. discuss the working & basic application of semiconductor devices.
BEC-DS-321.2. understand the basic working principle of oscillator and design the same.
BEC-DS-321.3. list and implement various differential amplifiers.
BEC-DS-321.4.implement linear and non-linear applications of operational amplifiers.

Unit 1: Diode circuits
1.1 P-N junction diode, I-V characteristics of a diode
1.2 Review of half-wave and full-wave rectifiers
1.3 Zener diodes
1.4 Clamping and clipping circuits.

Unit 2: BJT circuits
2.1 Structure and I-V characteristics of a BJT
2.2 BJT as a switch, BJT as an amplifier: small-signal model
2.3 Biasing circuits, current mirror
2.4 Common-emitter, common-base and common collector amplifiers

Unit 3: MOSFET circuits
3.1 MOSFET structure and I-V characteristics
3.2 MOSFET as a switch, MOSFET as an amplifier: small-signal model
3.3 Biasing circuits, common-source, common-gate and common-drain amplifiers
3.4 Small signal equivalent circuits - gain, input and output impedances, transconductance

Unit 4: Differential, multi-stage and operational amplifiers
4.1 Differential amplifier, power amplifier
4.2 Direct coupled multi-stage amplifier
4.3 Internal structure of an operational amplifier, ideal op-amp
4.4 Non-idealities in an op-amp (Output offset voltage, input bias current, input offset current, slew rate, gain bandwidth product)

Unit 5: Linear applications of op-amp
5.1 Idealized analysis of op-amp circuits
5.2 Inverting and non-inverting amplifier, differential amplifier
5.3 Instrumentation amplifier, integrator, active filter
5.4 P, PI and PID controllers and lead/lag compensator using an op-amp
5.5 Voltage regulator, oscillators (Wein bridge and phase shift)
5.6 Analog to Digital Conversion

Unit 6: Nonlinear applications of op-amp
6.1 Hysteretic Comparator, Zero Crossing Detector

6.2 Square-wave and triangular-wave generators
6.3 Precision rectifier, peak detector
6.4 Monoshot

Text Books/Reference Books:

1. Microelectronic Circuits : A. S. Sedra and K. C. Smith, New York, Oxford University Press, 1998.
2. Introduction to Operational Amplifier theory and applications :J. V. Wait, L. P. Huelsman and G. A. Korn, McGraw Hill U. S., 1992.
3. Microelectronics : J. Millman and A. Grabel, McGraw Hill Education, 1988.
4. The Art of Electronics : P. Horowitz and W. Hill, Cambridge University Press, 1989.
5. Analysis and Design of Analog Integrated Circuits :P. R. Gray, R. G. Meyer and S. Lewis, John Wiley & Sons, 2001.

Software Required/Weblinks:

https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-002-circuits-and-electronics-spring-2007
nptel.ac.in/courses/117103063/31
nptel.ac.in/courses/117103063/30

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BEC-DS-321)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BEC-DS-321.1	3	3	2	2	2	-	-	-	-	-	-	2	2	-	1	-
BEC-DS-321.2	3	3	2	2	2	-	-	-	-	-	-	2	2	-	-	-
BEC-DS-321.3	3	3	3	2	2	-	-	-	-	-	-	2	1	-	1	-
BEC-DS-321.4	3	3	3	2	2	-	-	-	-	-	-	2	1	-	2	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BEC-DS-302: DIGITAL ELECTRONICS

Periods/week	Credits	Max. Marks: 200
L: 3 T: 0	3	Continuous Assessment : 100
Duration of Examination: 3 Hrs		End Semester Examination: 100

Course Type: Program Core

Course Outcomes The students will be able to:
BEC-DS-302.1. Explain the fundamentals of digital electronics such as logic gates, coding techniques etc.
BEC-DS-302.2. Optimize the combinational logic circuits by applying different minimization techniques.
BEC-DS-302.3. Design various combinational and sequential logics by using fundamentals of digital electronics.
BEC-DS-302.4. Compare various A/D and D/A conversion techniques by analyzing their performance parameters fordifferent applications.
BEC-DS-302.5. Classify various logic families and implement basic logic gates based on these logic families.

Unit 1: Fundamentals of Digital Logic Circuits
1.1 Digital Signal, Number System, Conversion of Bases
1.2 Codes: BCD code, Excess-3 code, Gray code and Alpha-numeric code
1.3 Binary & BCD Arithmetic, Boolean algebra
1.4 Logic Gates, Concept of Universal Gates
1.5 Error Detection and Correction: Parity Method, Hamming Code Method

Unit 2: Logic Simplification and Combinational Logic Design
2.1 Review of Boolean Algebra and De Morgan's Theorem,
2.2 SOP & POS forms, Canonical forms,
2.3 Boolean expression minimization techniques: K-Map(up to 6 variables), QuineMccluskey Method
2.4 Design of Combinational Circuits using ROM, PAL ,PLA and FPGA

Unit 3: MSI Devices
3.1 Digital Comparator, Multiplexer, De-multiplexer, Encoder, Decoder
3.2 Half and Full Adders, Subtractors, Serial and Parallel Adders,
3.3 BCD Adder, Barrel shifter and ALU
3.2 Driver and multiplexed display

Unit 4: Sequential Logic Design
4.1 Combinational v/s Sequential Circuit, Latch v/s Flip-Flop
4.2 Types of Flip-Flops: S-R, J-K, D & T, Excitation Table of Flip Flops, Toggling & Race around Condition
4.3 Master Slave Flip-Flop
4.4 Shift Registers & Types: SISO, SIPO, PISO and PIPO
4.5 Bidirectional Shift Register, Universal Shift Register
4.6 Counter & Types: Ripple Counter, Decade Counter, Ring and Johnson Counter

Unit 5: A/D and D/A Converters
5.1 Requirement and Specification of A/D and D/A Converters
5.2 Digital-to-analog converters (DAC): Weighted resistor, R-2R ladder, resistorstring etc.
5.3 Analog-to-digital converters (ADC): Single slope, dual slope, successive approximation, flash etc.

5.4 Switched capacitor circuits: Basic concept, practical configurations, application in amplifier, integrator, ADC etc.

Unit 6: Digital Logic Families

6.1 Unipolar and Bipolar Logic Families, Characteristics of Digital ICs
6.2 Bipolar Logic Families: Tristate TTL and ECL
6.3 Unipolar Logic Families: NMOS, PMOS, CMOS
6.4 Interfacing between TTL and CMOS
6.5 Memory elements

Text Books/ Reference Books:

1. William H. Gothmann, 2006, Digital Electronics: An Introduction To Theory And Practice: , 2nd Edition, PHI Learning.
2.M. Morris Mano, Michael D Ciletti, 2008, Digital Design , 4th Edition, Pearson.
3. Thomas L. Floyd, R. P. Jain, 2005, Digital Fundamentals:, 8th Edition, Pearson.
4.D.V. Hall , 1989, Digital Circuits and Systems, Tata McGraw Hill.
5. John Morris, 1992, Digital Electronics, 1stEdition ,Routledge.
6. Digital Systems: Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss,2009, 10thEdition, Pearson.

Software required/Weblinks:

nptel.ac.in/courses/117101055

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks

Distribution of Continuous Assessment:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BEC-DS-302)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BEC-DS-302.1	2	1	1	-	1	1	-	-	-	-	-	1	3	1	3	1
BEC-DS-302.2	3	2	3	1	2	2	-	-	-	-	-	1	3	2	3	1
BEC-DS-302.3	3	1	3	1	2	2	-	-	-	-	-	1	3	2	3	1
BEC-DS-302.4	3	1	2	-	1	1	-	-	-	-	-	-	3	2	3	1
BEC-DS-302.5	3	1	2	-	1	1	-	-	-	-	-	-	3	2	3	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
BEE-DS-351: ELECTRICAL CIRCUIT ANALYSIS LAB

Periods/week Credits	Max. Marks : 100
P: 2 1	Internal/Continuous Evaluation: 50
Duration of Examination: 2 Hours	End Semester Exam : 50

Pre-requisite :NIL
Course Type: Program Core

Course Outcomes:
After completion of this course the students will be able to
BEE-DS-351.1 design circuit on bread board and learn the concepts of basic elements used in the circuits.
BEE-DS-351.2 implement the basic electrical laws, theorems and their applications to the D.C networks.
BEE-DS-351.3 calculate different parameters for two port networks.
BEE-DS-351.4 determine the frequency response and the half power frequencies of filters.

LIST OF EXPERIMENTS:
1. To verify KVL and KCL in electrical circuits.
2. To verify the Superposition theorem.
3. To verify the maximum power transfer theorem.
4. To determine the 'Z' parameters of a two port network.
5. To determine the 'Y' parameters of a two port network.
6. To determine the ABCD parameters of a two port network.
7. To determine the 'H' parameters of a two port network.
8. Equivalent parameter of parallel connection of two –port network.
9. To Study the frequency response of a low-pass filter and to determine half power frequency.
10. To Study the frequency response of a High–pass filter and to determine half power frequency.
11. To Study the frequency response of a Band-pass filter and to determine half power frequency.
12. To Study the frequency response of a Band–stop filter and to determine half power frequency.

Text Books:
L. Robert, Gabriel Kousourou, 1987, Experiments in Circuit Analysis, 5th Edition, Merrill Pub Co.
Software required/Weblinks:
http://www.ece.ucf.edu/labs/EEL3123/experiments/
Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-351.1	1	-	1	-	-	-	-	-	-	-	-	-	1	-	1	-
BEE-DS-351.2	2	2	3	2								1	2		1	2
BEE-DS-351.3	2	-	2		1								2		1	
BEE-DS-351.4	1	1	2			1						1	3			2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-352: ELECTRICAL MACHINES-I LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hours		End Semester Exam	: 50

Pre requisite: NIL
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-352.1. describe the basic working of transformers and dc machines.
BEE-DS-352.2. conduct various tests and analyze the parameters of transformers
BEE-DS-352.3. demonstrate parallel operation of transformers
BEE-DS-352.4. analyze the speed control of dc motors.
BEE-DS-352.5. apply different connection schemes on transformers and to convert single phase supply to multi phase.

LIST OF EXPERIMENTS:
1. To find turns ratio and polarity of a single-phase transformer.
2. To perform open and short circuit tests on a single-phase transformer.
3. To perform Sumpner's Back to back test on single-phase transformers.
4. Parallel operation of two single -phase transformers.
5. To convert three phase to 2-phase by Scott-connection.
6. To obtain open circuit characteristics of dc shunt generator
7. To perform load test on DC shunt generator.
8. To perform load test on DC series motor.
9. To perform load test on DC shunt motor.
10. Speed control of DC shunt motor.
11. Swinburne's test of DC shunt motor.
12. Hopkinson's test of DC shunt machines.
13. Separation of losses of DC machines
14. Ward Leonard method of speed control.

Text Books:
D. P. Kothari, B. S. Umre, 2017, Laboratory Manual for Electrical Machines,IK International Publishing House Pvt. Ltd.
Software required/Weblinks:

https://studylib.net/doc/18791581/electrical-machines-laboratory

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:

Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-352.1	3	3	3	2	2	-	-	-	-	-	3	2	2	2	1	2
BEE-DS-352.2	3	3	3	2	2	-	-	-	-	-	3	2	2	2	1	3
BEE-DS-352.3	2	2	2	2	2	-	-	-	-	-	3	2	3	2	1	3
BEE-DS-352.4	2	3	2	1	3	-	-	-	-	-	3	2	2	1	1	3
BEE-DS-352.5	2	3	2	1	3	-	-	-	-	-	3	2	2	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BEC-DS-361: ANALOG ELECTRONICS LAB

Periods/week	Credit	Max. Marks	: 100
P: 2	1	Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Semester Exam	: 50

Co- requisites: BEC-DS-321: Analog Electronics
Course Type: Engineering Science

Course Outcomes
The students will be able to:

BEC-DS-361.1. Analyze V-I characteristics and applications of diode.
BEC-DS-361.2. Measure various parameters of BJT, FET and MOSFET.
BEC-DS-361.3. Design the basic application of operational amplifier.
BEC-DS-361.4. Demonstrate the operation of astable and mono stable multivibrator using IC 555 timer.
BEC-DS-361.5. Describe the linear and nonlinear applications of Operational Amplifier along with the basic filter.

LIST OF EXPERIMENTS:

1. To verify the V-I Characteristics of Semiconductor Diode.
2. To verify the V-I characteristics of Zener diode & its application as Voltage regulator.
3. To design a rectifier circuit using diode and calculate ripple factor, efficiency and regulation.
4. To design a clipper circuit using diode.
5. To design a buffer using transistor in Common Collector configuration.
6. To plot the V-I characteristics of JFET and to find its parameters (dynamic resistance (r_d), transconductance (g_m), amplification factor(μ).
7. To Design and measure the frequency response of an RC coupled amplifier using discrete components.
8. To Design and verify IC voltage regulator.
9. To measure the op-amp parameters (Open Loop Gain, Input offset voltage CMMR, Slew rate).
10. To analyze the frequency response of Op-amp.
11. To verify Op-amp as comparator &Schmitt trigger.
12. To study Op-amp as an integrator &differentiator.
13. To verify Astable&Monostable operation using 555 Timer.
14. To design and verify first Order Active High Pass & Low pass filter.

PROJECTS BASED ON ABOVE EXPERIMENTS:

1. Design a VCO.
2. Design a V to I converter.
3. Design a Function Generator (Square wave and Triangular wave).
4. Design AstableMultivibrator.
5. Design of RC Coupled Amplifier.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%

Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEC-DS-361.1	2	1	2	1	-	-	-	-	-	-	-	1	2	1	1	-
BEC-DS-361.2	3	3	3	3	-	-	-	1	-	1	2	2	1	2	-	1
BEC-DS-361.3	-	-	1	-	-	-	-	-	-	-	-	-	3	-	1	2
BEC-DS-361.4	3	1	3	2	-	-	-	1	-	-	1	3	1	1	-	-
BEC-DS-361.5	1	-	-	2	-	-	-	-	-	-	1	1	-	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

BEC-DS-352: DIGITAL ELECTRONICS LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Semester Exam	: 50

Co-requisites: BEC-DS-302: Digital Electronics
Course Type: Program Core

Course Outcomes: The Students will be able to:
BEC-DS-352.1. Demonstrate the operations of various TTL gates.
BEC-DS-352.2. Apply K map minimizing procedures for circuit realization and compare the original and minimized circuits.
BEC-DS-352.3. Interpret the functioning of different combinational circuits and flip-flops by relating the outputs of these IC's with the truth tables.
BEC-DS-352.4. Build various sequential circuits such as shift registers, counters with the help of flip-flops.
BEC-DS-352.5. Describe the functioning of logic gates based on extensively used CMOS logic family.

List of Experiments:

1. To verify the truth tables of TTL gates AND, OR, NOT, NAND, NOR, EX-OR, EX-NOR.
2. To design and realize a given function using K maps & using its performance.
3. To verify the operation of multiplexer and demultiplexer.
4. To verify the operation of comparator.
5. To verify the truth tables of S-R, J-K, T and D type flip flops.
6. To verify the operation of bi-directional shift register.
7. To design and verify the operation of 3 bit synchronous counter.
8. To design the operation of a ring counter.
9. To design the operation of a Johnson counter.
10. To design and verify the operation of a- synchronous UP / DOWN decade counter using J-K Flip flops.
11. To design and verify the operation of synchronous UP / DOWN decade counter using J-K Flip flops.
12. To design and realize a sequence generator for a given sequence using J-K flip flops.
13.To understand the working of CMOS NAND & NOR gates & interfacing between TTL and CMOS gates.
14. Design a 4-bit shift register and verify its operation.

PROJECTS BASED ON ABOVE EXPERIMENTS:

1. Design various logic gates using transistor
2. Design and verify the operation of 2 bit synchronous counter using JK flip flops
3. Design a binary to gray code converter using gates
4. Design visitor counter using BCD to 7 segment Display
5. Design and verify the operation of logic gates using Multiplexer

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEC-DS-352.1	1	1	3	1	1	-	-	-	-	-	-	2	1	-	2	-
BEC-DS-352.2	3	2	2	3	2	-	-	-	-	-	-	1	2	-	1	-
BEC-DS-352.3	2	2	2	3	2	-	-	-	-	-	-	2	3	2	-	2
BEC-DS-352.4	1	1	3	2	2	-	-	-	-	-	-	3	-	-	-	1
BEC-DS-352.5	2	1	2	2	2	-	-	-	-	-	-	2	-	-	-	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)
NAAC 'A' Grade University

BMA-308: MATHEMATICS-3 TRANSFORM AND STATISTICS

Periods/week Credits	Max. Marks : 200
L: 2 T: 0 2	Continuous Evaluation: 100
Duration of Examination: 3 Hrs	End Term Examination: 100

Pre-requisite: Knowledge of basic concepts of probability of Intermediate level
Course Type: Basic Sciences

Course Outcomes: The course will enable the student to-

BMA-308.1 Understand the role of transformation in engineering.
BMA-308.2 Define wavelet and Z- transforms.
BMA-308.3 Apply the statistical tools to engineering problems.
BMA-308.4 To analyze small and large samples by using various statistical tests.

Unit 1: Transform Calculus-1(7 Lectures)
Laplace Transform, Laplace transform of periodic functions, inverse laplace transform by different methods, convolution theorem. Evaluation of integrals by Laplace transform, solving ODEs and PDEs by Laplace Transform method. Fourier Transform, Fourier sine and cosine transform, Fourier finite transform, Solution of differential equation by Fourier transform.

Unit 2: Transform Calculus-2(6 Lectures)
Z-transform and Wavelet transforms: properties, methods, inverses and their applications.

Unit 3: Applied Statistics(8 Lectures)
Probability distributions: Binomial, Poisson and Normal, evaluation of statistical parameters for these three distributions, Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas and more general curves.

Unit 4: Sampling Theory(6 Lectures)
Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations, Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials

Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix:

CO statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BMA-308.1	3	3	1	2	2	-	-	-	-	-	-	2	2	1	1	1
BMA-308.2	3	3	1	2	2	-	-	-	-	-	-	1	2	-	-	1
BMA-308.3	3	3	2	2	3	-	-	-	-	-	-	2	2	2	2	-
BMA-308.4	3	3	1	1	2	-	-	-	-	-	-	1	2	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BHM-320: UNIVERSAL HUMAN VALUES

Periods/week	Credits		Max. Marks	: 100
L: 1	T: 1	2	Continuous Evaluation	: 50
Duration of Examination: 2Hrs			End Term Examination	: 50

Pre-requisite: None
Course Type: Humanities & Social Science

Course Outcomes: The course will enable the student to-
BHM-320.1. Develop a holistic perspective based on self-exploration about themselves(humanbeing), family, society and nature/existence.
BHM-320.2. Understand harmony in the human being, family, society and nature/existence
BHM-320.3. Strengthen the self-reflection, develop commitment and courage to act.

Unit 1: Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation(5 Lectures)
Purpose and motivation for the course,Self-Exploration–what is it? - Its content and process; 'Natural Acceptance'andExperiential Validation- astheprocessforself-exploration, Continuous Happiness and Prosperity- A look at basic Human Aspirations, Rightunderstanding,RelationshipandPhysicalFacility-thebasic requirements for fulfillment of aspirations of every human being with their correctpriority, Understanding Happiness and Prosperity correctly- A critical appraisal of thecurrentscenario, Method to fulfill the above human aspirations: understanding and living inharmonyatvariouslevels.

Unit2:UnderstandingHarmonyintheHumanBeing-HarmonyinMyself!(5 Lectures)
Understanding human being as a co-existence of the sentient 'I' and thematerial'Body' , Understanding the needs of Self ('I') and 'Body' - happiness and physicalfacility, Understanding the Body as an instrument of 'I' (I being the doer, seer andenjoyer),Understandingthecharacteristicsandactivitiesof 'I'andharmonyin'I', Understanding the harmony of I with the Body: Sanyam and Health; correctappraisalofPhysicalneeds,meaningofProsperityindetail, ProgramstoensureSanyamandHealth.

Unit 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship(7 Lectures)

Understanding values in human-human relationship; meaning of Justice (nineuniversal values in relationships) and program for its fulfillment to ensure mutualhappiness;TrustandRespectasthefoundationalvaluesofrelationship, Understanding the meaning of Trust; Difference between intention andcompetence, Understanding the meaning of Respect, Difference between respect anddifferentiation;theother salient values inrelationship
Understanding the harmony in the society (society being an extension offamily): Resolution, Prosperity, fearlessness (trust) and co-existence ascomprehensive Human Goals,Visualizing a universal harmonious order in society- Undivided Society,Universal Order-from familytoworldfamily.

Unit 4: Understanding Harmony in the Nature and Existence - Whole existence asCoexistence(6 Lectures)

UnderstandingtheharmonyintheNature, Interconnectedness and mutual fulfillment among the four orders of nature-recyclabilityand self-regulation in nature, Understanding Existence as Co-existence of mutually interacting units in all-pervasive space Holisticperceptionofharmonyatalllevelsofexistence.
Include practice sessions to discuss human being as cause of imbalance innature (film "Home" can be used), pollution, depletion of resources and role oftechnology etc.

Unit 5: Implications of the above Holistic Understanding of Harmony onProfessionalEthics(5 Lectures)

Naturalacceptanceofhumanvalues, DefinitivenessofEthicalHumanConduct, Basis for Humanistic Education, Humanistic Constitution and HumanisticUniversal Order, Competence in professional ethics, Case studies of typical holistic technologies, management models andproductionsystems, Strategy for transition from the present state to Universal Human Order: a. Atthe level of individual: as socially and ecologically responsible engineers,technologists and managers b. At the level of society: as mutually enrichinginstitutionsand organizations,

Text and ReferenceBooks

1. R R Gaur, R Sangal, G P Bagaria, 2010, Human Values and Professional Ethics,Excel Books, New Delhi
2. A.N. Tripathi, 2019, Human Values, New age International Publishers.
3. E G Seebauer& Robert L.Berry, 2000, Fundamentals of Ethics for Scientists & Engineers, Oxford University Press.

Note:
Lecture's hours are to be used for interactive discussion, placing the proposalsabout the topics at hand and motivating students to reflect, explore and verifythem.
Tutorialhoursaretobeusedforpracticesessions.

Evaluation Tools:
Assessment by faculty mentor: 10 marksSelf-assessment:10marks
Assessmentbypeers:10marks
Socially relevant project/Group Activities/Assignments: 20 marks
SemesterEndExamination: 50 marks

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3	PS O4
BHM-320.1	-	-	2	-	-	3	1	3	2	-	-	2	1	-	-	1
BHM-320.2	-	-	2	-	-	3	1	3	2	-	-	2	1	-	1	-
BHM-320.3	-	-	2	-	-	3	1	3	2	-	-	2	1	1	-	1

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DTI-300: DESIGN, THINKING AND INNOVATION – I

Periods/week	Credits		
P: 1	1.0	Max. Marks	: 50
		Continuous Assessment	: 50

Pre-requisites: Nil
Course Type: Research & Training
Course Coordinator: Research Mentor

Course Outcomes:
RIC 300.1. To explore different sources for generating ideas for Research.
RIC 300.2. To understand the problem classification based on domain specific resources.
RIC 300.3. To realize the design thinking stages.
RIC 300.4. Topresent critical analysis of literature survey.

Activity 1: Motivation
- 1.1 Divergent thinking and brain storming
- 1.2 Creative process

Activity 2: Introduction to Design Thinking
- 2.1 Empathize Mode
  - 2.1.1 Discussions and deliberations
- 2.2 Define Mode
- 2.3 Ideate Mode
  - 2.3.1Contemporary Relevance.
  - 2.3.2 Tools and techniques for generating ideas
  - 2.3.3 Idea Challenges

Activity 3: Problem Classification
- 3.1 Domain Classification.
- 3.2 Identification of Mentors

Activity 4: Problem identification
- 4.1 Literature survey and option analysis.
- 4.2 Feasibility study.
- 4.3 Formulation of problem statement.
- 4.4Expected Outcome / Model of the problem.
- 4.5 Planning Matrix

Activity5: Presenting the Ideation
- 5.1 Structuring and preparation of PPT
- 5.2 Review on presentation skills and content delivered
- 5.3 Incorporating the review comments.

Course Articulation Matrix:

CO Statement (RIC-300)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
DTI-300.1	2	2	2	3	1	1	2	1	1	3	2	1	2	3	2	3
DTI-300.2	2	3	2	3	3	2	1	1	2	3	2	2	3	2	2	2
DTI-300.3	2	2	2	2	1	1	1	1	2	2	2	1	3	2	2	2
DTI-300.4	1	1		1	2	1	1	2	2	2	2	1	2	2	3	2

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No:	Parameters	Description	Marks	
1.	**Attendance**	Percentage of classes attended by the students	**5**	**5**
2.	**Continuous Performance**	Group participation and response of the students to a given task:		**15**
		Judge individual student in the group	**5**	
		Meeting timelines as per activity plan	**10**	
3.	**Literature Review**	Student interaction with faculty mentors	**5**	**15**
		Relevance of the topic	**3**	
		Usage of Scientific Literature Databases. e.g., Scopus/ Web of Science/ etc.	**2**	
		Number of relevant papers / design referred for the given topic	**5**	
4.	**PPT & Report**	Report structure and Slide sequence	**5**	**15**
		Contribution of individual group member towards the presentation and report	**5**	
		Scientific/Technical writing	**5**	
		Max. Marks	**50**	**50**

References:

1. http://nptel.ac.in/courses/121106007/
2. http://public.wsu.edu/~taflinge/research.html

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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PROJ-EE-300A: SUMMER INTERNSHIP –I

Periods/week	Credits	Max. Marks	: 50
2 weeks Minimum	1.0	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs			

Pre-Requisite: Nil
Course Type: Projects

Course Outcomes: After completion of this course the students will be able to
Proj-EE-300A.1. actually face challenges of real field work.
Proj-EE-300A.2. apply their learning skills to solve real life problem.
Proj-EE-300A.3. Show the research capability.
Proj-EE-300A.4. enhance their Innovative skills.
Proj-EE-300A.5. develop solutions.
Proj-EE-300A.6. build technology for new areas.

Every student will have to undergo Industrial Training for 6 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after 4th semester. Respective Head of Department will approve the Industry/Organization for training. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the training, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:

1. Evaluation by the Supervisor in the Industry	:	25 marks
2. Evaluation by Faculty Mentor during training visit	:	10 marks
3. Continuous Evaluation: seminar/ Presentation	:	15 marks
Total Marks	:	**50**

End Semester Exam : Evaluation after training:

1. Project Report	:	10 marks
2. Seminar/Presentation	:	20 marks
3. Viva	:	20 marks

Total marks		**50**

Total Credits : 2

COURSE ARTICULATION MATRIX :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
Proj-EE-300A.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3	2
Proj-EE-300A.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3	3
Proj-EE-300A.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3	3
Proj-EE-300A.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2	2
Proj-EE-300A.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3	3
Proj-EE-300A.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BHM-MC-004: QUANTITATIVE APTITUDE

Periods/week	Credits	Max. Marks	: 100
P :2		Internal/Continuous Evaluation : 50	
Duration of Exam: 2 Hrs		End Semester Exam	: 50

Pre-Requisite: Nil
Course Type: HSMC

Course Outcomes: After completion of this course the students will be able to
BHM-MC-004.1. recognize problems based on arithmetic & number system.
BHM-MC-004.2. solve problems based on verbal reasoning & simplification.
BHM-MC-004.3.calculate the correct answers to the problems within given time.
BHM-MC-004.4. plan their career meticulously by setting their time oriented goals.
BHM-MC-004.5. introspect and enhance their personality.
BHM-MC-004.6. develop cultural sensitivity and communicate respectfully across cultures.

PART – A

Unit 1: Number System 1
1.1 Vedic Mathematics
1.1.1 Basic of mathematics
1.1.2 Addition and subtraction using Vedic Mathematics
1.1.3 Multiplication of two and three numbers.
1.2 Simplification
1.2.1 BODMAS rule
1.2.2 Fractions and recurring decimals
1.2.3 Surds and indices
1.3 Numbers
1.3.1 Types of numbers and number tree
1.3.2 Divisibility Rule
1.3.3 HCF & LCM

Unit 2: Verbal Reasoning 1
2.1 Direction Sense Test
2.2 Blood Relation Test

Unit 3: Arithmetic 1
3.1 Problem on Ages
3.2 Problem on Numbers
3.3 Averages

PART – B

Unit 4: Career Planning
4.1 **Career planning Process** - Self Assessment, Research, Decision Making, Action and Employability
4.2 **Goal Setting:** Relevance, SMART goals, The Dos & Don'ts

Unit 5: Personality Enhancement
5.1 **Emotional Intelligence:** Emotional Self -Awareness, Self- Control, Emotional Management

5.2 **Stress Management:** What is Stress, Types of Stress, Stress Response Example, Vulnerability to Stress, Why do we Stress out, Stress Warning Symbols, Suggestions for Reducing Stress,

5.3 **Time Management:** Setting Priorities, Managing Time, Four Quadrants of Time Management

5.4. **Team Building:** Definition –Team, Characteristics of effective Teams, Competence, Clear and Compelling goal, Supportive Environment, Alignment, Designing the Team, Identifying Roles and Responsibilities, Determining Reward, Troubleshooting Guide, Good Team member

Unit 6: Effective Communication

6.1 **Courtesy in Communication:** Being Polite, Self -Discipline, Respecting Others and understanding other's perspective in communication

6.2 **Inter cultural Communication:** Breaking Stereotypes, Diversity Inclusion and Cultural Sensivity

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company Pvt Ltd.
2. R S Aggarwal , 2018 , Modern Approach to Verbal& Non Verbal Reasoning:, S Chand & Company PvtLtd.
3. Mark A Griffin,2015, College to Career: The Student Guide to Career and Life Navigation,Createspace Independent Pub.
4. Anthony Gutierez, 2017, Effective Communication in the Workplace ,CreateSpace Independent Publishing .

Instructions for paper setting: Fifty MCQ will be set in total. TwentyFiveMCQwill be set from Part A and Twenty Five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BHM-MC-004.1	1	-	-	2	-	-	-	-	-	-	-	-	-	-	1	1
BHM-MC-004.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-004.3	1	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1
BHM-MC-004.4	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	1
BHM-MC-004.5	-	-	-	-	-	-	-	1	3	3	-	1	-	-	-	1
BHM-MC-004.6	-	-	-	-	-	-	-	1	2	3	-	1	-	-	-	1

4th SEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BEE-DS-401: ELECTRICAL MACHINES - II

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 1	4	Continuos Evaluation	: 100
Duration of Examination: 3 Hours		End Semester Exam	: 100

Pre Requisite:

Course Type: Program Core

Course outcomes: After completion of this course the students will be able to

BEE-DS-401.1.explain the fundamentals of AC machine windings.

BEE-DS-401.2.interpret the concepts of rotating magnetic fields.

BEE-DS-401.3.explicate the operation of ac machines.

BEE-DS-401.4.analyze the performance characteristics of synchronous machines

BEE-DS-401.5.evaluate and analyze the performance characteristics of synchronous machines

PART – A

Unit 1 Fundamentals of AC machine windings (8 Hours)

1.1 Physical arrangement of windings in stator and cylindrical rotor;

1.2 Slots for windings; single turn coil - active portion and overhang; full-pitch coils, concentrated winding, distributed winding, winding axis,

1.3 3D visualization of the above winding types,

1.4 Air-gap MMF distribution with fixed current through winding - concentrated and distributed,

1.5 Sinusoidally distributed winding, winding distribution factor.

Unit 2 Pulsating and revolving magnetic fields (4 Hours)

2.1 Constant magnetic field, pulsating magnetic field - alternating current in windings with spatial displacement

2.2 Magnetic field produced by a single winding - fixed current and alternating current Pulsating fields produced by spatially displaced windings

2.3 Windings spatially shifted by 90 degrees

2.4 Addition of pulsating magnetic fields

2.5 Three windings spatially shifted by 120 degrees (carrying three-phase balanced currents), revolving magnetic field.

Unit 3 Induction Machines (12 Hours)

3.1 Construction, Types (squirrel cage and slip-ring)

3.2 Torque Slip Characteristics

3.3 Starting and Maximum Torque.

3.4 Equivalent circuit. Phasor Diagram

3.5 Losses and Efficiency.

3.6 Effect of parameter variation on torque speed characteristics (variation of rotor and stator resistances, stator voltage, and frequency).

3.7 Methods of starting, braking and speed control for induction motors.

3.8 Generator operation, Self-excitation.

3.9 Doubly-Fed Induction Machines.

PART - B

Unit 4 Single-phase induction motors (6 Hours)

4.1 Constructional features double revolving field theory

4.2 Equivalent circuit of Single-Phase Induction Motors determination of parameters.

4.3 Types of Single Phase Motors

4.4 Starting methods and applications

Unit 5 Synchronous machines (5 Hours)

5.1 Constructional features
5.2 Cylindrical rotor synchronous machine - generated EMF,
5.3 Equivalent circuit and phasor diagram,
5.4 Armature reaction, synchronous impedance
5.5 Voltage regulation.

Unit 6 Synchronous machines Characteristics and operation (5 Hours)

6.1 Operating characteristics of synchronous machines
6.2 V-curves, Salient pole machine - two reaction theory
6.3 Analysis of phasor diagram
6.4 Power angle characteristics.
6.5 Parallel operation of alternators - synchronization and load division

Text Books/ Reference Books:

1. P. S. Bimbhra,2011,Electrical Machinery, Khanna Publishers.
2. A.Chakrabarti , S, Nath 2017, Electrical Machines, Macgraw Hill.
3. J. Nagrath and D. P. Kothari, 2010, Electric Machines, McGraw Hill Education.
4. G C Garg ,2002, A text book of Electrical Machines, KhannaPubhishers.
5. P.Purkait, I. Bandyopadhyay, 2017, Electrical Machines, Oxford University Press.
6. P. C. Sen, 2007, Principles of Electric Machines and Power Electronics, John Wiley & Sons.

Software required / Web links:

MATLAB
nptel.ac.in/courses/108106072

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-401.1	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-401.2	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-401.3	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-401.4	1	3	2	2	2	-	-	-	-	2	1	2	2	1	2	2
BEE-DS-401.5	1	2	2	2	3	-	-	-	-	2	1	1	2	1	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BEE-DS-402A: POWER SYSTEMS-I

Periods/week Credits :3	Max. Mark : 200
L: 3 T: 1	Continuos Evaluation :100
Duration of Examination: 3 Hours	End Semester Exam :100

Prerequisite:

Course Type: Program Core

Course outcomes: After completion of this course the students will be able to

BEE-DS-402A.1 explicate the construction & working of power plants

BEE-DS-402A.2 estimate the tariffs and depreciation economics in power systems

BEE-DS-402A.3evaluate the transmission line parameters

BEE-DS-402A.4 describe the generation of over-voltages and earthing requirements in power system

BEE-DS-402A.5 summarize the concepts renewable energy generation

PART-A

Unit 1 : Conventional Power Plants(7 Hours)

1.1 Thermal power plant

1.2 Hydroelectric power plant

1.3 Diesel power plants

1.4 Nuclear power plants

Unit 2: Power Plant Economics (7 Hours)

2.1 Load forecasting

2.2 Load curves, Load duration curve

2.3 Connected Load, Maximum demand, Demand factor, Group diversity factor

2.4 Load factor, Significance of load factor

2.5 Plant factor, Capacity factor

2.6 Selection of unit size, No. of Units reserves.

2.7 Cost of power generation, Tariffs

2.8 Depreciation

Unit 3: Power System Components (7 hours)

3.1 Overhead Transmission Lines and Cables: Electrical and Magnetic Fields around conductors,

3.2 Sag & Tension

3.3 Corona.

3.4 Parameters of lines and cables-Capacitance and Inductance calculations for simple configurations.

3.5 Travelling-wave Equations.

3.6 Sinusoidal Steady state representation of Lines: Short, medium and long lines.

3.7 Power Transfer, Voltage profile and Reactive Power.

3.8 Characteristics of transmission lines, Surge Impedance Loading.

3.9 Series and Shunt Compensation of transmission lines.

PART-B

Unit 4Distribution Systems (8 Hours)

4.1 Classification and arrangement of distribution systems

4.2 Distribution substation layout and arrangement

4.3 Economic loading of distribution transformers

4.4 Kelvin's law

4.5 Radial, ring mains and network distribution system

4.6 Comparison of various types of ac and dc systems.

.**Unit 5: Protection against overvoltage's &Earthing(6 hours)**

5.1 Generation of Over-voltages: Lightning and Switching Surges.

5.2 Protection against Overvoltage's

5.3 Insulation Coordination.

5.4 Propagation of Surges.
5.5 Voltages produced by traveling surges. Bewley Diagrams
5.6 Earthing & earthing methods

Unit 6: Renewable Energy Sources (8 hours)

6.1 Solar Photo Voltaic system.
6.2 VI & PV Characteristics
6.3 Wind Energy Sources
6.4 Tidal Energy Sources
6.5 Fixed and variable speed turbines.
6.6 Permanent Magnetic Synchronous Generators and Induction Generators.

Text/References:

1. A. Ambikapathy, 2013, Power System Analysis, Khanna Publishers.
2. O. I. Elgerd, 2001, Electric Energy Systems Theory An Introduction, McGraw Hill Education.
3. C L Wadhwa,2008, Electrical Power System ,New Age International.
4. Harish C. Rai&ShipraRai ,2017,Power Plant Engineering ,I.K International Publishers.
5. D. P. Kothari and I. J. Nagrath, 2004, Power System Engineering,McGraw Hill Education.
6. Soni, Gupta and Bhatnagar, 1996, A Course in Electrical Power: DhanpatRai and Sons.
7. B R Gupta, 2017, Generation of Electrical Energy,S Chand & Co Ltd.
8. B R Gupta, 2005, Power System Analysis and Design, S Chand&Co Ltd.
9. H. Muhammad Rashid , 2015, Electric Renewable Energy Systems, Academic Press.

Software required / Web links:

nptel.ac.in/courses/108105017/
http://nptel.ac.in/courses/108105017

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Evaluation Table

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

CO Statement (BEE-DS-402A)	PO1	PO2	PO3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PS O3	PSO 4
BEE-DS-402A.1	2	1	-	-	-	-	-	-	-	1	2	-	2	-	-	1
BEE-DS-402A.2	2	2	1	1	-	-	-	-	-	-	2	1	3	-	-	1
BEE-DS-402A.3	2	1	-	-	-	-	-	-	-	1	2	1	2	1	-	1
BEE-DS-402A.4	2	1	-	1	-	-	-	-	-	1	2	2	2	-	2	1
BEE-DS-402A.5	2	1	1	-	-	-	-	-	-	1	2	-	3	-	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEC-DS-401A: COMMUNICATION ENGINEERING

Periods/week Credits	Max. Marks : 200
L: 3 T: 1 4	Continuous Assessment : 100
Duration of Examination: 3 Hrs	End Semester Examination : 100

Course Type: Program Core

Course Outcomes

The students will be able to:

BEC-DS-401A.1: Describe the basic concepts of Communication systems.

BEC-DS-401A.2: Explain the models of Communication systems.

BEC-DS-401A.3: Study basics of modulation and demodulation, various approaches in analog systems

BEC-DS-401A.4 Analyze the modulation and demodulation for various digital systems

BEC-DS-401A.5: Enrich their understanding about noise interference in Communication systems

Unit 1: Introduction to Communication Systems

1.1 Elements of Communication system & its fundamental Limitations
1.2 Frequency spectrum of EM waves, Need for modulation
1.3 Types of modulation
1.4 Bandwidth and information capacity
1.5 Types and Applications of Communication Systems

Unit 2: Amplitude Modulation Systems

2.1 Basics of Amplitude modulation
2.2 Power relations in the AM
2.3 Square law modulator, Switching modulator, Square law demodulator, Envelope Detector
2.4 Double side band suppressed carrier modulation, Balanced and Ring Modulators
2.5 Coherent demodulator, Single side band modulation,
2.6 Frequency Discrimination and Phase Discrimination modulators
2.7 Coherent detection of SSB, VSB modulation & demodulation

Unit 3: Angle Modulation Systems

3.1 Basics of Frequency and phase modulation
3.2 Single tone and multi tone frequency modulation, NBFM, WBFM
3.3 Transmission bandwidth of FM wave
3.4 Indirect and direct methods of FM generation
3.5 Frequency Discriminator
3.6 Phase Locked Loop demodulator
3.7 Ratio Detector

Unit 4: Pulse Modulation

4.1 Sampling theorem, aliasing,
4.2 Aperture effect, type of pulse analog modulation: PAM, PWM and PPM
4.3 Generation and demodulation, comparison of PAM, PWM and PPM.
4.4 PCM, quantization process, companding
4.5 Probability of error for PCM systems
4.6 DPCM, delta, adaptive delta modulation.

Unit 5: Digital Modulation Techniques

5.1 Basic digital band pass modulation schemes
5.2 ASK, PSK, QAM, FSK schemes
5.3 M-ary PSK modulation and demodulation
5.4 Differential PSK modulation and demodulation,
5.5 Spread-spectrum communication system, direct sequence SS system,
5.6 Frequency hopped SS system, applications of SS system, PN sequence.

Unit 6: Noise

6.4 Introduction to noise
6.5 Types, internal and external sources of noise
6.6 Thermal noise, short noise, noise figure
6.7 Noise temperature, equivalent noise bandwidth
6.8 Calculation of noise for cascaded networks.

Text Books/ Reference Books:

1. Simon Haykin , 2004, Communication Systems, 4th Edition, John Wiley & Sons.
2. B.P.Lathi, 2009, Modern Digital and Analog Communication Systems, 4th Edition, Oxford University Press.
3. Herbert Taub, GoutamSaha and Donald L. Schilling, 2015, Principles of Communication Systems , 3rd Edition, Tata McGraw Hill.
4. Wayne Tomasi, 2004, Electronic Communications Systems, Fundamentals Through Advanced, 5th Edition, Pearson Education.
5. George Kennedy, 2012, Electronic Communication Systems, 5th Edition, Tata McGraw Hill.
6. John G.Proakis , 2001, Communication Systems Engineering, 2nd Edition, Pearson

Software Required/Weblinks:

MATLAB
http://nptel.ac.in/courses/117102059/
http://nptel.ac.in/courses/117105077/
http://www.nptelvideos.in/2012/11/communication-engineering.html
http://textofvideo.nptel.iitm.ac.in/117102059/lec12.pdf

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Assessment:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BEC-DS-401A)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
BEC-DS-401A.1	3	3	2	2	1	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-401A.2	3	3	2	2	2	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-401A.3	3	3	2	2	3	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-401A.4	3	3	2	2	3	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-401A.5	3	3	2	2	3	-	-	-	-	-	-	2	3	1	1	-

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEC-DS-403: MICROPROCESSOR & MICROCONTROLLERS

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3	Continuos Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites: BEC-DS-302 Digital Electronics
Course Type: Program Core

Course Outcomes: The students will be able to
BEC-DS-403.1. Identify the main function and application of microprocessor and microcomputers.
BEC-DS-403.2. Describe the architecture of 8 bit, 16 bit microprocessor and 8051 microcontroller.
BEC-DS-403.3. Demonstrate the concept of memory and Peripherals Interfacing with microprocessor and microcontroller.
BEC-DS-403.4. Apply Instruction set to develop microprocessor and microcontroller based applications
BEC-DS-403.5. Illustrate the functioning of various timers and Interrupts of 8051 microcontroller.

Unit 1: Introduction to 8085 Microprocessors
1.1 Evolution of Microprocessors, Comparison of microprocessors and microcontrollers
1.2 Architecture of 8085 microprocessor, Pin configuration, Signal description and De-multiplexing of address data lines, Addressing modes, Instruction set, Timing diagram of MOV, MVI, IN and OUT Instructions
1.3 Interrupt structures

Unit 2: 8086 Architecture
2.1 Architecture of 8086 microprocessor
2.2 Concept of BIU and EU, Pin configuration, Signal description and De multiplexing of address data lines
2.3 Pipelining, Memory segmentation and Memory banking
2.4 Minimum mode and Maximum mode configurations, Interrupt structure
2.5 Introduction to Co-processor 8087

Unit 3: Instruction Set and Assembly Language Programming
3.1 Addressing modes of 8086 microprocessor, Instruction format
3.2 Instructions of 8086 microprocessor: Data transfer Instructions, Arithmetic Instructions, Logical Instructions
3.3 String Manipulation Instructions, Control Transfer Instructions, Processor control Instructions, BCD Instructions
3.4 Programming examples, Assembler directives and operators, Timing diagrams

Unit 4: Introduction to 8051
4.1 Introduction to 8051 microcontroller
4.2 Architecture
4.3 Addressing modes
4.4Instruction set of 8051

Unit 5: Timers& Interrupts
5.1 Various timers and registers of 8051 microcontroller
5.2 Various modes of operation of timers
5.3 Various interrupt codes of 8051

5.4 Simple programming examples

Unit 6: Serial Interface
6.1 Introduction to serial interface
6.2 SCON and SBUF registers, generation of control word
6.3 Various modes of operation of serial interface
6.4 Serial port baud rates
6.5 Use of Timer1 as baud rate clock generator
6.6 Simple programming examples like interfacing with LCD. QMS,

Text Books/ Reference Books:

1. S. Ramesh,Gaonker, 2011, Microprocessor Architecture, Programming & Applications with 8085, 5th, Edition, Wiley.
2. B. Barry, Brey, 2009, The Intel Microprocessors 8086/Pentium Processors, 8th Edition, Pearson Prentice Hall.
3. M. Ali, Janice GillispieMazidi and RolinMcKinlay, 2007, 8051 Microcontroller and Embedded Systems Using Assembly and C, 2nd Edition, Pearson Education.
4. I. Scott Mackenzie and Raphael C. W. Phan, 2008, The 8051 Microcontroller, 4th Edition, Pearson Education.

Software required/Weblinks:
8085 Simulator
EMU-8086
Keil µVision 4
nptel.ac.in/courses/117104072
http://nptel.ac.in/downloads/106108100/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Assessment:

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	0%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEC-DS-403.1	1	1	1	1	2	-	-	-	-	-	-	2	1	-	1	-
BEC-DS-403.2	1	1	2	1	3	-	-	-	-	-	-	2	1	-	-	-
BEC-DS-403.3	1	2	3	3	3	-	-	-	-	-	-	3	1	-	1	-
BEC-DS-403.4	2	2	3	3	3	-	-	-	-	-	-	3	-	1	-	1
BEC-DS-403.5	1	2	2	3	3	-	-	-	-	-	-	2	2	-	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-451: ELECTRICAL MACHINES - II LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hours		End Semester Exam	: 50

Pre Requisite:
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-451.1**.** demonstratedifferent tests on AC machines.
BEE-DS-451.2**.** illustrate performance characteristics of AC Machines.
BEE-DS-451.3**.** explicate the synchronization operation on AC Machines.
BEE-DS-451.4**.** analyze theoretical & practical parameters of AC Machines.

LIST OF EXPERIMENTS:
1. To perform the open circuit test and block rotor test on three phase induction motor and draw the circle diagram.
2. Speed control of induction motor by rotor resistance control.
3. To conduct the load test to determine the performance characteristics of the induction motor.
4. To compute the torque versus speed characteristics for various stator voltages.
5. To perform the open circuit test and block rotor test on single-phase induction motor and determine equivalent circuit parameters.
6. To perform load test on a universal motor and determine the performance with dc/ac supply voltage.
7. To perform load test on alternator and draw the load characteristics.
8. To perform O.C. test on synchronous generator and determine the full load regulation of a three phase synchronous generator by synchronous impedance method.
9. Determination of direct axis and quadrature axis reactances of synchronous machines.
10. To plot V- Curve of synchronous motor.
11. To study the parallel operation of synchronous generators.
12. Determination of sequence impedances of synchronous machine for various stator voltages.

PROJECTS BASED ON ABOVE EXPERIMENTS:

1. To find efficiency of induction motor for different values of load.
2. To find temperature rise in case of induction motors for various duty cycles.
3. To find efficiency of single phase induction motor.
4. To study synchronous motor as condenser to improve power factor.
5. To study load sharing between two alternators connected in parallel.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-451.1	3	3	3	2	2	-	-	-	-	-	3	2	2	2	1	2
BEE-DS-451.2	3	3	3	2	2	-	-	-	-	-	3	2	2	2	1	3
BEE-DS-451.3	2	2	2	2	2	-	-	-	-	-	3	2	3	2	1	3
BEE-DS-451.4	2	3	2	1	3	-	-	-	-	-	3	2	2	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-452:POWER SYSTEMS -I Lab

Periods/week Credits	Max. Marks : 100
P: 2 1	Internal/Continuous Evaluation: 50
Duration of Examination: 2 Hours	End Semester Exam : 50

Pre requisite:
Course Type: Program Core

Course Outcomes : After completion of this course the students will be able to
BEE-DS-452.1. explain construction and operation of different types of relays for various apparatus in protection of power system.
BEE-DS-452.2. describe the Ferranti effect on transmission lines and simulate it on matlab
BEE-DS-452.3. calculate fault current for line to line fault on long transmission line.
BEE-DS-452.4. find ABCD parameters for long transmission line.

LIST OF EXPERIMENTS

1. To draw the operating characteristics of IDMT relay.
2. To draw the operating characteristics of differential relay.
3. To study Buchholz relay.
4. Testing of transformer oil.
5. To find ABCD parameters of a model of transmission line.
6. To observe the Ferranti effect in a model of transmission line.
7. To study the plain impedance relay and plot its tripping characteristics.
8. To study the Mho relay and plot its tripping characteristics.
9. To study the power control by phase shifting transformer.
10. To Calculate line to line fault current on long transmission line.
11. To design 11 KV substation.
12. Write a program in MATLAB for illustration of Ferranti effect.

PROJECTS BASED ON ABOVE EXPERIMENTS:
1. Underground cable fault detector.
2. Wire Loop Breaking Alarm Signal.
3. Oil Temperature Monitoring with Automatic Circuit Breaker Operation.
4. Automatic Water Plant System.
5. High Speed Protection Based Programmable Current Relay

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab

File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-452.1	-	-	-	1	-	-	-	-	-	1	1	1		-	-	-
BEE-DS-452.2	-	1	-	2	-	-	-	-	-	-	1	1	1	-	1	1
BEE-DS-452.3	1	1	-	2	-	-	-	-	-	-	-	1	1	-	1	-
BEE-DS-452.4	1	1	-	2	-	-	-	-	-	-	-	1	1	-	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEC-DS-453: MICROPROCESSOR & MICROCONTROLLERS LAB

Periods/week	Credits	Max. Marks	: 100
P:2	1	Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Semester Exam	: 50

Co-requisites: BEC-DS-403: Microprocessor & Microcontrollers
Course Type: Program Core

Course Outcomes: The students will be able to
BEC-DS-453.1. Describe the importance and function of each pin of 8085, 8086 microprocessor and 8051 microcontroller.
BEC-DS-453.2. Apply arithmetic, data transfer and string manipulation instructions to write assembly language program.
BEC-DS-453.3. Analyze branching and loop control instructions.
BEC-DS-453.4. Implement interfacing with switches, keyboard and display devices.
BEC-DS-453.5. Realize concepts of timers and interrupts to generate waveforms

LIST OF EXPERIMENTS:

1. To understand the working of 8085 and 8086 Microprocessor kit.
2. To write and execute a program using 8085 for finding the largest/smallest number from an array and verify the result.
3. To write and execute a program using 8086 for performing the various arithmetic operations and verify the result.
4. To write and execute a program using 8086 to copy 12 bytes of data from source to destination and verify the result.
5. To write and execute a program using 8086 for Hexadecimal to Gray code conversion by using look up table and verify the result.
6. To write and execute a program using 8086 for arranging an array of numbers in ascending order and verify the result.
7. To understand the development tools for 8051 microcontroller programming & Assembly language programming style.
8. To write and execute a program using 8051 for performing the various arithmetic operations and verify the result.
9. To write a program to flash all the LED of o/p part.
10. To write a program to generate 10 KHz square wave using Timers and interrupts.
11. To write a program to display a string on LCD display.
12. To write a program to Interface a Buzzer and Relay with 8051.

PROJECTS BASED ON ABOVE EXPERIMENTS:
1. To display a string on LCD Display and verify the result.
2. To reverse a string stored in memory and verify the result
3. To interface L293 Motor Driver IC with 8051 microcontroller.
4. To interface a Real Time Clock (RTC) with 8051 microcontroller.
5. To design an alarm clock using 8051 microcontroller and RTC.
6. To design a line follower Robot using 8051 microcontroller.
7. To control the speed of DC motor using PWM.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEC-DS-453.1	1	2	2	2	1	-	-	-	-	-	-	2	1	-	1	-
BEC-DS-453.2	1	2	3	2	2	-	-	-	-	-	-	3	3	1	-	-
BEC-DS-453.3	2	3	3	3	3	-	-	-	-	-	-	3	2	-	1	-
BEC-DS-453.4	1	2	2	2	2	-	-	-	-	-	-	2	-	1	-	1
BEC-DS-453.5	2	3	3	2	3	-	-	-	-	-	-	3	2	-	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

DTI-400: Design, Thinking and Innovation – II

Periods/week	Credits		
P: 1	1.0	Max. Marks	: 50
		Continuous Assessment	: 50

Pre-requisites: DTI-300: Design, Thinking and Innovation – I
Course Type: Research & Training
Course Coordinator: Research Mentor

Course Outcomes:

RIC 400.1. To understand the research methodologies/approaches/techniques used in the literature
RIC 400.2. To formulate the experimental procedures / algorithms based on research methodology
RIC 400.3. To develop prototype by experiment / simulation.
RIC 400.4. To analyze the recorded data / output.

Activity 1: Methodology Study & Matrix design.
1.1.Analysis of different approach/methodology adopted by various researchers
1.2. Comparative analysis
1.3. Prospective Design.

Activity 2: Design of experiments
2.1 Finalization of experimental procedure / algorithm design.
2.2 Procurement of materials / Hardware and Software.
2.3. Develop experimental setup / design

Activity 3: Execution of experiments/simulations
3.1. Conduct experiments/ build prototype.
3.2. Modification of the experimental set-up / algorithm.

Activity 4:
4.1 Tabulating and analyzingdata / output.
4.2 Assessment of the output with earlier published work / product
4.3 Interpretation and presentation of the results / outcome.

Course Articulation Matrix:

CO Statement (RIC-400)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
DTI-400.1	3	3	2	3	2	3	3	2	3	3	3	2	3	3	3	3
DTI-400.2	3	3	2	3	2	3	3	2	1	2	3	2	3	3	3	3
DTI-400.3	3	3	3	3	2	2	2	2	2	2	3	2	3	3	3	3
DTI-400.4	2	2	2	3	2	3	3	3	2	3	3	3	2	2	3	3

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	Marks
1.	**Attendance**	Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	Group participation and response of the students to a given task: Judge individual student in the group Meeting timelines as per lesson plan	**15**
3.	**Experimental Setup / Design**	Assessment of experimental set up / design Evaluation of result / outcome. Validation of results. Novelty / Relevance of work.	**20**
4.	**Structuring and presentation**	Structuring and presentation Group presentation with individual contribution	**10**

References:

1. http://www.sciencedirect.com/
2. https://www.ncbi.nlm.nih.gov/pubmed
3. https://www.elsevier.com/books-and-journals
4. https://www.plos.org/
5. https://www.deepdyve.com/
6. http://ieeexplore.ieee.org/Xplore/home.jsp
7. https://www.researchgate.net/
8. https://www.science.gov/
9. https://scholar.google.co.in/
10. http://www.popsci.com/

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES

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NAAC 'A' Grade University

BHM-MC-002: SPORTS AND YOGA

Periods/week	Credits		Max. Marks	: 100
L: 2 T: 0	0		Continuous Evaluation	: 100

Duration of Examination: 1Hr

Pre-requisite: None
Course Type: Audit pass

Course Outcomes: The course will enable the student to-

BHM-MC-002.1. Understandtheimportanceofsoundhealthandfitnessprinciplesastheyrelate tobetterhealth.

BHM-MC-002.2.Participate in variety of physical and yogic activities aimed at stimulating their continued inquiry about Yoga, physical education, health and fitness.

Unit 1: IntroductiontoPhysicalEducation, Wellness&Lifestyle(6 Lectures)

Meaning&definitionofPhysicalEducation, Aims&ObjectivesofPhysicalEducation,changingtrendsinPhysicalEducation, Meaning&ImportanceofPhysicalFitness&Wellness, ComponentsofPhysical fitness, Healthrelatedfitness and wellness, PreventingHealthThreatsthroughLifestyleChange, ConceptofPositive Lifestyle.

Unit 2: FundamentalsofAnatomy&PhysiologyinPhysicalEducation,Sports&Yoga(8 Lectures)

DefineAnatomy,Physiology&ItsImportance, EffectofexerciseonthefunctioningofVariousBodySystems (CirculatorySystem,RespiratorySystem,Neuro-MuscularSystemetc.), MeaningandConceptofPostures, CausesofBadPosture, Advantages&disadvantagesofweighttraining., Concept&advantagesofCorrectPosture, CommonPosturalDeformities–KnockKnee;FlatFoot;RoundShoulders;Lordosis, Kyphosis,BowLegsandScoliosis, CorrectiveMeasuresforPosturalDeformities.

Unit 3: Yoga&Lifestyle(6 Lectures)

ElementsofYoga, Introduction-Asanas,Pranayama,Meditation&YogicKriyas, Yogaforconcentration&relatedAsanas, RelaxationTechniquesforimprovingconcentration -Yog-nidra, Asanasaspreventivemeasures.

Unit 4: Training, Planning &PsychologyinSports(8 Lectures)

MeaningofTraining, warmingupandlimberingdown, Skill,Technique& Style, MeaningandObjectivesofPlanning, Tournament–Knock-Out,League/RoundRobin&Combination. Definition&ImportanceofPsychologyinPhysicalEdu.&Sports, Define&DifferentiateBetweenGrowth&Development, AdolescentProblems&TheirManagement, Psychologicalbenefitsofexercise.

TextBooks/References:

1. Ajmer Singh and Rachhpal Singh Brar, 2019, Essentials ofPhysicalEducation, Kalyani Publishers.
2. B.K.S.Iyengar, 2015, Yoga for Sports, Westland publications.

Evaluation Tools:
Class Quiz, Rubrics

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BHM-MC-006: Quantitative Aptitude and Personality Development-I

Periods/week	Credits	Max. Marks	: 100
P :2	AP	Internal/Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Semester Exam	: 50

Pre-Requisite: Nil
Course Type: HSMC

Course Outcomes: After completion of this course the students will be able to
BHM-MC-006.1. recognize& solve problems based on non-verbal reasoning.
BHM-MC-006.2. solve complex problems based on arithmetic reasoning.
BHM-MC-006.3.apply short tricks on complex problems of verbal reasoning.
BHM-MC-006.4. apply correct usage of grammar in communication.
BHM-MC-006.5. enhance their vocabulary and use it in day to day life.
BHM-MC-006.6. develop speed reading & writing skills.

PART – A

Unit 1: Arithmetic II

1.1 Percentages
1.2 Ratio & Proportion
- 1.2.1. Proportionality
- 1.2.2. Variations
- 1.2.3 Partnership

1.3 Profit & Loss
- 1.3.1. Basic terminology & Formulae
- 1.3.2. Error in Weights
- 1.3.3. Marked Price and Discounts

1.4Time & Work
- 1.4.1. Time and Work, Chain Rule
- 1.4.1. Work & Wages
- 1.4.2. Pipes & Cisterns

1.5 Mixtures &Alligations

Unit 2: Verbal Reasoning 2

- 2.1 Syllogism
- 2.2 Ranking
- 2.3 Coding-Decoding
- 2.4Inequalities and Mathematical Operations

Unit 3: Non Verbal Reasoning

- 3.1 Pictorial Series
- 3.2 Missing Values
- 3.3 Analogy and Images

Part B

Unit 4: Communication Accuracy

- 4.1 Relevance of Verbal Ability and preparatory guidelines

4.2 Functional Grammar – Subject Verb Agreement
4.3 Tenses – Perfect, Simple, Continuous
4.4 Common Errors and rectification

Unit 5: Word Power Building Skills

5.1 Words: Antonyms, Synonyms, Verbal Analogies
5.2 Compound words: Homophones, Homonyms, Word Families
5.3 Root Word Technique for Prefixes & Suffixes
5.4: Word Power: 7 Tips for Learning New Words
5.5 Practice Vocabulary Exercises

Unit 6: Reading & Writing Skills

6.1 Objectives of Reading, Definition & Types of Reading & Importance of Reading
6.2 Reading Techniques: SW3R, Active Reading, Detailed, Speed
6.3 Practice Exercises: Short & Medium Passages3.1 Writing: Introduction of Writing Skills, Objectives of enhancing Writing Skills & Types of Writing
6.4 Sentences, Phrases, Types of Sentences, Parts of Sentences
6.5 Paragraph Writing: Construction, Linkage & Cohesion

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company PvtLtd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal&Non Verbal Reasoning: S Chand & Company Pvt Ltd.
3. Mvn, 2015,Verbal Ability and Reading Comprehension: MVN Enterprises.
4. P.A. Anand ,Lalit Singh, 2016, Wiley Verbal Ability and Reasoning for Competitive Examinations, Wiley.

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
BHM-MC-006.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-006.2	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-
BHM-MC-006.3	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1
BHM-MC-006.4	1	-	-	1	-	-	-	-	1	3	-	2	1	1	1
BHM-MC-006.5	1	-	-	1	-	1	-	-	1	3	-	2	-	-	1
BHM-MC-006.6	1	2	-	1	1	1	1	1	1	3	1	2	1	1	1

ELECTIVES

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BEE-DS-525: POWER SYSTEM PROTECTION

Periods/week	Credits	Max. Marks	: 200
L: 3	3	Internal/Continuous Evaluation	:100
Duration of Examination: 3 Hours		End Semester Exam	: 100

Pre requisite- NIL
Course type- Domain Specific Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-525.1 describethe different components of a protection system.
BEE-DS-525.2 apply to reliable protection scheme for various equipment's in power system network.
BEE-DS-525.4 identify elements of digital protection and the use of wide-area measurements.
BEE-DS-525.5 develop a model for different protection schemes

PART -A

Unit 1: **Introduction and Components of a Protection System (4 hours)**
1.1 Principles of Power System Protection
1.2 Relays, Instrument transformers
1.3 Circuit Breakers

Unit 2: Faults and Over-Current Protection (8 hours)
2.1 Review of Fault Analysis,
2.2 Sequence Networks
2.3 Introduction to Overcurrent Protection and overcurrent relay co-ordination.

Unit 3: **Equipment Protection Schemes(8 hours)**
3.1 Directional protection
3.2 Distance protection
3.3 Differential protection.
3.4 Transformer Generator protection.
3.5 Bus barProtection, Bus Bar arrangement schemes.

PART-B

Unit 4: **Digital Protection (8 hours)**
4.1 Computer-aided protection,
4.2 Fourier analysis and estimation of Phasors from DFT
4.3 Sampling,aliasing issues.

Unit 5: **Modeling and Simulation of Protection Schemes (8 hours)**
5.1 CT/PT modeling and standards,
5.2 Simulation of transients using Electro-Magnetic Transients(EMT) programs.
5.3 Relay Testing.

Unit 6: **System Protection (4 hours)**
6.1 Effect of Power Swings on Distance Relaying.
6.2 System Protection Schemes.
6.3 Under-frequency,under-voltage and df/dt relays,
6.4 Out-of-step protections,
6.5 synchro-phasors
6.6 Phasor Measurement

6.7 Units and Wide-Area Measurement Systems (WAMS).
6.8 Application of WAMS for improvingprotection systems.

Text/References

1. J. L. Blackburn, 1987,Protective Relaying: Principles and Applications, Marcel Dekker,New York.
2. Y. G.Paithankar and S. R. Bhide, 2010, Fundamentals of power system protection", PrenticeHall, India.
3. A. G. Phadke and J. S. Thorp, 1988, Computer Relaying for Power Systems, John Wiley &Sons.
4. A. G. Phadke and J. S. Thorp, 2008, Synchronized Phasor Measurements and theirApplications, Springer.
5. D. Reimert, 2006, Protective Relaying for Power Generation Systems, Taylor and Francis.

Software required / Web links:

https://nptel.ac.in/courses/108/101/108101039/

Instructions paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-	1	-	-	-	-	-	-	-	-	2	-	2	1	2	1	1
BEE-DS-	2	2	1	2	1	-	-	-	-	-	-	3	2	2	1	1
BEE-DS-	2	1	1	1	-	-	1	-	-	1	-	3	2	1	2	2
BEE-DS-	2	1	2	1	-	-	-	-	-	1	-	2	2	1	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BEE-DS-523A: MEASUREMENTS and INSTRUMENTATION

Periods/week	Credits	Max. Marks: 200
L: 3 T: 0	3	Continuous Evaluation : 100
Duration of Examination: 3 Hrs		End Semester Exam: 100

Prerequisite:
Course Type: Disciplinary Elective

Course Outcomes
After completion of this course the students will be able to

BEE-DS-523A.1 Explain the fundamentals and concepts of measuring instruments.
BEE-DS-523A.2 study the working of electronic instruments.
BEE-DS-523A.3. llustrate the basic features of oscilloscope and different types of signal analyzers.
BEE-DS-523A.4 Apply the complete knowledge of various electronics instruments/transducers to measure the physical quantities in the field of science, engineering and technology.

.

Unit 1:Introduction to measuring instruments (8 hours)

1.1 Classification of measuring instruments, comparison of analog and digital instruments,
1.2Measurement of Electrical Quantities, Standards of Measurement & Errors
1.3 Classification of Transducer, Temperature measurements transducers
1.4 Displacement Transducers: LVDT principle
1.5 Measurement of force and pressure: Resistance strain gauges Load cells
1.6Piezo electric transducers.

Unit 2:Biomedical Instruments(7 hours)

2.1Transducer for Biomedical applications
2.2Electrodes for ECG, EMG and EEG measurement
2.3Amplifiers used in Biomedical applications
2.4 Instrumentation amplifier, Block diagram for ECG, EMG and EEG measurement.

Unit 3: Cathode Ray Oscilloscope (8 hours)

3.1 Block diagram of general purpose CRO: Principle of operation
3.2 Operation of cathode ray tube, Vertical deflecting system
3.3 Vertical amplifier, Horizontal deflection system
3.4 Synchronization, XY mode of operation of CRO, Lissajous patterns
3.5 Digital storage Oscilloscope-Block diagram and Principle of operation.

Unit 4: Generation and Analysis of Wave Forms (6 hours)

4.1Block diagram of pulse generators, Signal generators
4.2 Wave analyzers, Distortion analyzers
4.3 Spectrum analyzer
4.4 Harmonic analyzer and introduction to power analyzer.

Unit 5: Signal Conditioning and Data Acquisition and Conversion (6 hours)

5.1 DC signal conditioning system, AC signal conditioning system
5.2 Data acquisition systems -block diagram, Signal conditioning sampling rate
5.3 Sample and hold, Analog multiplexing
5.4 Voltage controlled oscillator

5.5 PLL IC 565 and its applications.

Unit 6: Frequency and Time Measurement (5 hours)
6.1Study of Decade Counting Assembly (DCA)
6.2 Frequency measurements, Period measurements
6.3 Universal counter, Digital multimeters
6.4 Resolution in digital meters.

Text Books/ Reference Books:

1. A.K.Sawhney, 2015, A course in Electrical and Electronics Measurements and Instrumentation,DhanpatRai and Co.,
2. Kalsi H. S., 1995, Electronic Instrumentation: Tata McGraw-Hill, New Delhi.
3. Murray D. V. S, 2003, Transducers and Instrumentation: Prentice Hall of India.
4. Albert D. Helfrick and William D. Cooper , 1992, Modern Electronic Instrumentation Devices and Systems, Prentice Hall of India.
5. Rangan C.S, Sarma G.R. and Mani V.S.V, 1992, Instrumentation Devices and Systems, TMH.
6. Curtis D. Johnson, 2003, Process Control Instrumentation Technology, Pearson.

Software required / Web links:
LABVIEW
www.elsevier.com/locate/flowmeasinst
https://nptel.ac.in/courses/108/105/108105064/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-523A.1	3	3	2	2	1	-	-	-	-	-	-	1	3	1	-	-
BEE-DE-523A.2	3	3	2	1	2	-	-	-	-	-	-	1	3	2	-	-
BEE-DS-523A.3	3	3	2	2	2	1	-	-	-	-	-	1	3	1	-	-
BEE-DS-523A.4	3	3	3	2	1	1	-	-	-	-	-	1	3	1	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BEC-DS-404A: ELECTROMAGNETIC WAVES

Periods/week Credits — Max. Marks: 200
L: 3 T: 0 3 — Continuous Assessment: 100
Duration of Examination: 3 Hrs — End Semester Examination: 100

Pre requisites: BPH-106: Physics
Course Type: Program Core
INDUSTRY SUPPORT: Microwave, Optical, and Antennas
Course Outcomes: The student will be able to:

BEC-DS-404A.1. Understand the basic physical concepts related to electromagnetic vector fields.
BEC-DS-404A.2. Apply the principles of electrostatics to the solutions of problems relating to electric field and electric potential, boundary conditions and electric energy density.
BEC-DS-404A.3. Apply the principles of magneto statics to the solutions of problems relating to magnetic field and magnetic potential, boundary conditions and magnetic energy density.
BEC-DS-404A.4. Apply Maxwell's equations and their application to time-harmonic fields, boundary conditions, wave equations, and Poynting's theorem.
BEC-DS-404A.5. Solution of problems relating to transmission lines with time-harmonic excitation and uniform plane wave propagation.

PART- A

Unit 1: Coordinate Systems and Transformation

1.1 Various coordinate systems (Cartesian, Cylindrical, Spherical)
1.2 Unit vectors in coordinate systems
1.3 Concept and physical interpretation of gradient, divergence and curl
1.4 Integral Theorems: Divergence theorem, Stokes theorem

Unit 2: Electrostatics

2.1 Coulomb's law and field intensity, Electric field due to discrete charges, Electric field due to continuous charge distribution
2.2 Electric scalar potential, Relationship between potential and electric field, Potential due to infinite uniformly charged line, Potential due to electric dipole, Electric flux density
2.3 Gauss law, proof and applications of Gauss Law
2.4 Poisson's and Laplace's equation
2.5 Uniqueness theorem, Capacitance, electrostatic energy and energy density
2.6 Boundary conditions for electric fields, Method of images

Unit 3: Magnetostatics

3.1 Biot-Savart's law
3.2 Magnetic field intensity due to a finite and infinite wire carrying current
3.3 Magnetic field intensity on the axis of a circular and rectangular loop carrying a current
3.4 Ampere's circuital law and its applications, Magnetic flux density, Ampere's force law
3.5 Magnetic scalar and vector potentials, Inductors and Inductances
3.6 Magnetic energy, Magnetic boundary conditions

PART-B

Unit 4: Maxwell's Equations

4.1 Faraday's law, Displacement current, Equation of continuity for time varying fields
4.2 Inconsistency of Ampere's law
4.3 Maxwell's equations in Integral and Differential forms
4.4 Time Harmonic Fields, Poynting theorem, Poynting vector and flow of power, Instantaneous, average and complex Poynting vectors

Unit 5: Electromagnetic Waves

5.1 Wave equation for free space (or lossless medium)
5.2 Uniform plane wave propagation, Relation between E and H in uniform plane wave
5.3 Wave equation for conducting medium, Wave propagation in lossy and lossless dielectrics, Conductors and dielectrics
5.4 Wave propagation in good dielectric and good conductor
5.5 Depth of penetration, Linear, elliptical and circular polarization, Reflection of plane waves at normal incidence, Surface impedance

Unit 6: Transmission Lines

6.1 Transmission line parameters, Transmission line equations
6.2 Input impedance (for lossy, lossless line), Propagation constant
6.3 Phase constant and attenuation constant
6.4 Characteristic impedance, Open and short circuited lines
6.5 Standing wave and reflection losses, Impedance matching, Introduction to Smith chart

Text Books/ Reference Books:

1. Matthew N. O. Sadiku, 2009, Principles of Electromagnetics ,4thEdition, Oxford University Press.
2. K. D. Prasad, 1988, Electromagnetic Theory, 6th Edition, SatyaPrakashan.
3. William H. Hayte, John Buck, 1983, Engineering Electromagnetics, 8th Edition, McGraw Hill.
4. Edward Conrad Jordan, Keith George Balman, 2007, Electromagnetic Waves and Radiating Systems, 2ndEdition, Prentice-Hall.

Software Required/Weblinks:

http://nptel.ac.in/courses/117103065/1- 117103065/55

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Assessment:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BEC-DS-404A)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BEC-DS-404A.1	3	3	3	1	-	-	-	-	-	-	-	-	2	2	1	-
BEC-DS-404A.2	2	3	2	2	-	-	-	-	-	-	-	-	2	2	1	-
BEC-DS-404A.3	3	3	3	1	-	-	-	-	-	-	-	-	-	2	1	-
BEC-DS-404A.4	3	2	2	1	-	-	-	-	-	-	-	-	2		3	-
BEC-DS-404A.5	2	2	3	2	2	-	-	-	2	-	-	-	2	2	2	2

5th Semester

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-501A: POWER ELECTRONICS

Periods/week Credits	Max. Marks: 200
L: 3T: 3	Continuos Evaluation :100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre requisites: NIL
Course Type: Program Core
Course Outcomes: After completion of this course the students will be able to
BEE-DS-501A.1 Compare various power switching devices.
BEE-DS-501A.2 Summarize the type of Power Converters .
BEE-DS-501A.3 Application of converters to real applications.
BEE-DS-501A.4 Analysis of different power supplies

Unit 1 : Power Switching Devices (8Hours)
1.1 I-V Characteristics Diode, Thyristor, MOSFET, IGBT
1.2 Firing circuit for thyristor
1.3 Voltage and current commutation of a thyristor
1.4 Power Mosfet Data sheet Explanation
1.5 Parallel operation of MOSFET
1.6 Application of Depletion MOSFET.SOA of MOSFET

Unit 2: Thyristor rectifiers (7Hours)
2.1 Single-phase half-wave and full-wave rectifiers
2.2 Single-phase full-bridge thyristor rectifier with R-load and highly inductive load
2.3 Three-phase full-bridge thyristor rectifier with R-load and highly inductive load
2.4 Input current wave shape and power factor

Unit 3: DC-DC converters (5Hours)
3.1 Concept of Step up and Step-down Chopper
3.2 Control Techniques of Chopper
3.3 Types of Choppers
3.4 Introduction to Switched Mode power Supplies (SMPS)
3. 5 Duty ratio control of output voltage.
3.6 Buck converter control IC, Buck LED design examples
.

Unit 4: DC-DC boost converter (5Hours)
4.1 Power circuit of a boost converter
4.2 Analysis and waveforms at steady state
4.3 Relation between duty ratio and average output voltage
4.4 Overview of Flyback Converter,
4.5 Design guide for a fixed-frequency Flyback converter using PWM controller,
4.6 Design of Flyback SMPS in continuous conduction and discontinuous modes.

Unit 5: Voltage Source Inverter (10Hours)
5.1: Voltage source and current source inverters,
5.2 Principle of operation of single-phase half bridge and full bridge voltage source inverters, voltage and current waveforms;
5.3 Three-phase bridge inverter-120 and 180 modes of operation
5.4 Voltage and frequency control of inverters;

5.5.PWM techniques-single pulse, multiple pulse, selective harmonic elimination, sinusoidal PWM.

Unit 6: AC-ACConverters (8Hours)

6.1 : Principle of operation of single-phase ac regulator, effect of load inductance
6.2 Principle of operation of cycloconverter, waveforms, Types;
6.3 Introduction of matrix converter.

Text Books/ Reference Books:

1. M. H. Rashid, 2009 Power electronics: circuits, devices, and applications, Pearson Education India.
2. N. Mohan and T. M. Undeland, 2007, Power Electronics- Converters, Applications and Design, John Wiley & Sons.
3. R. W. Erickson and D. Maksimovic, 2007, Fundamentals of Power Electronics, Springer Science & Business Media.
4. L. Umanand, 2009, Power Electronics: Essentials and Applications, Wiley India.
5. H. C Rai, 2018, Power Electronics and Industrial Applications, CBS Publishers and Distributors Pvt. Ltd.
6. V. Kumar, R.K.Behera, D. Joshi, R.Bansal, 2020, Power Electronics, Drives and Applications, CRC Press.

Softare tools:

https://nptel.ac.in/courses/108/102/108102145/
https://nptel.ac.in/courses/108/105/108105066/
https://nptel.ac.in/courses/108/101/108101126/
https://nptel.ac.in/courses/108/101/108101038/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-501A.1	2	3	3	2	-	1	2	-	-	-	-	-	3	3	2	2
BEE-DS-501A.2	3	3	3	3	1	-	2	-	-	-		2	3	2	2	3
BEE-DS-501A.3	2	3	3	2	1	2	2	-	1	-	-	1	3	2	3	2
BEE-DS-501A.4	2	3	3	2	1	2	2	1	1	-	-	1	3	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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BEE-DS-502: CONTROL SYSTEMS

Periods/week	Credits	Max. Marks	: 200
L: 3T: 1	4	Internal/Continuous Assessment	: 100
Duration of Examination: 3 Hours		End Semester Exam	: 100

Pre requisites: NIL
Course Type: Program Core
Course Outcomes
After completion of this course the students will be able to
BEE-DS-502.1 Model linear time invariant systems using transfer function and state space.
BEE-DS-502.2 Evaluate stability of linear time invariant systems both in time domain as well asfrequency domain.
BEE-DS-502.3 Analyze the response of first and second order system using test signals
BEE-DS-502.4 design simple feedback controllers.

Unit 1: Introduction to control problem (6 hours)
1.1 Industrial Control examples.
1.2 Mathematical models of physical systems.
1.3 Transfer function models of linear time-invariant systems.
1.4 Feedback Control: Open-Loop and Closed-loop systems.Benefits of Feedback,
1.5 Block diagram algebra,
1.6 Signal flow graph

Unit 2: Time Response Analysis (8 hours)
2.1 Standard test signals.
2.2 Time response of first and second order systems for standard test inputs.
2.3 Applicationof initial and final value theorem.
2.4 Design specifications for second-order systems based on thetime-response.
2.5 Concept of Stability. Routh-Hurwitz Criteria. Relative Stabilityanalysis.
2.6 Root-Locus technique.
2.7 Error Analysis

Unit 3: Concept of stability & Root Locus Technique (7 hours)
3.1 Concept of Stability.
3.2 Routh-Hurwitz Criteria.
3.3 Relative Stabilityanalysis.
3.4 Root-Locus technique.
3.5 Construction ofRoot-loci.
3.6 Effect of addition of poles and zeros on the stability

Unit 4: Frequency-response analysis (6 hours)
3.1 Relationship between time and frequency response,
3.2 Polar plots,
3.4 Bode plots.
3.5 Nyquist stability criterion.
3.6 Relative stability using Nyquist criterion
3.7 Gain and Phase margin.
3.8 Closed-loop frequency response.

Unit 5: Introduction to Compensators & Controller Design (7 hours)
5.1 Necessity of compensation, Realization of lag and lead compensators
5.2 Realization of lag lead compensators,
5.3 Frequency-domain methods of design.
5.5 Proportional, Integral and Derivative Controllers
5.6Realization of PI, PID with first and second order systems
5.7 Nonlinear system–Basic concepts and analysis

Unit 6: Control System Components&State variable Analysis (8 hours)
5.1 Servomechanism & Servomotors
5.2 Synchros, Magnetic Amplifier
5.3 Stepper Motor
5.4 Concepts of state variables,
5.5 State Transistion Matrix, Transfer Function
5.8 Controllability &Observability

Text/References:

1. M.Gopal, 2012, ControlSystems:PrinciplesandDesign, McGrawHillEducation.
2. FaridGolnaraghi ,B. C. Kuo, 2014. Automatic Control System,Wiley.
3. K.Ogata, 2015, ModernControlEngineering,Pearson.
4. I. J. Nagrath and M. Gopal, 2017, Control Systems Engineering, New Age International.

Software required/Weblinks:
https://nptel.ac.in/courses/107/106/107106081/
https://nptel.ac.in/courses/108/103/108103007
https://nptel.ac.in/courses/108/107/108107115/
Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-502.1	3	3	3	3	2	1	-	-	-	-	-	2	3	-	2	1
BEE-DS-502.2	3	3	3	3	2	2	1	1	1	-	-	2	2	-	2	1
BEE-DS-502.3	3	3	3	2	3	1	2	1	1	2	-	-	3	2	2	1
BEE-DS502.4	3	2	2	3	3	2	1	2	1	-	-	2	3	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-551 POWER ELECTRONICS LAB

Periods/week Credits	Max. Marks : 100
P: 2 1	Internal/Continuous Evaluation : 50
Duration of Examination: 2 Hours	End Semester Exam : 50

Pre requisite: NIL
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-551.1**:** determine characteristics of power switching devices.
BEE-DS-551.2**:** simulate power converters topologies.
BEE-DS-551.3**:** compare switching techniques of the converter.
BEE-DS-551.4:.Analyse different controllers of converter.

LIST OF EXPERIMENTS:

1. Study of Transistor specifications ,working and draw the characteristics showing SOA and RBSOA.
2. Study of Diode specifications ,working and draw the characteristics showing SOA and RBSOA
3. Study of IGBT specifications ,working and draw the characteristics showing SOA and RBSOA.
4. Study of MOSFET specifications ,working and draw the characteristics showing SOA and RBSOA.
5. Study of SCR specifications ,working and draw the characteristics showing SOA and RBSOA.
6. Study of GTO specifications ,working and draw the characteristics showing SOA and RBSOA.
7. Design and analysis of firing circuits.
8. Commutation analysis of SCR
9. Simulation, analysis and design of Buck Converter and validation on hardware
10. Simulation, analysis and design of Boost Converter and validation on hardware
11. Simulation and analysis of AC to DC Converter .
12. Simulation and analysis of PWM techniques.

Software required/Weblinks:
PowerSim
Matlab (Power System toolbox)
https://nptel.ac.in/courses/108101038/
https://sohailansaari.wordpress.com/nptel-handwritten-notes/power-electronics/

Projects :
PV based DC-DC converter
Design the controller for the converter
Dimmer using Arduino

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-	3	3	2	2	1	1	3	-	-	2	1	2	2	2	2	3
BEE-DS-	3	3	3	3	2	2	3	1	-	1	1	2	3	3	3	3
BEE-DS-	3	3	2	2	2	2	3	1	1	2	2	2	3	2	3	2
BEE-DS-	3	3	3	3	2	2	3	-	1	1	1	2	3	3	3	2

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BEE-DS-552: CONTROL SYSTEM LAB

iods/week Credits	Max. Marks: 100
P: 2 1	Internal/Continuous Evaluation : 50
Duration of Examination: 2 Hours	End Semester Exam: 50

Pre requisite
Course type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-552.1 Find the response of first order system for given input signal.
BEE-DS-552.2 Study the operation of Control system components
BEE-DS-552.3 Design lead /lag compensators and PID Controller.
BEE-DS-552.4 write programs in Matlab for studying the stability and responses of simple systems.

LIST OF EXPERIMENTS:
1. Study of PID controller.
2. To plot the frequency response of Lead compensator
3. Study of stepper motor
4. To plot the response of first order system for step input.
5. To plot the frequency response of lag compensators.
6. To plot the response of second order system for step input.
7. Study of Servomotors
8. To check the stability of different order systems in Matlab
9. Plot the root locus of different systems in Matlab and study its stability
10. To model a system in state space and study its stability.
11. Conversion of transfer function model to state space model theoretically as well as using Matlab commands.
12. Design of controllers using Pole placement feedback

Text Books:

1. Kumar S. Swapna, Lenina S V B, 2016, MATLAB: Easy Way of Learning PHI.
2. S. N. Alam , S. S. Alam, 2013, Understanding MATLAB: A Textbook for Beginners, Ik publishers.
3. I.J. Nagrath and M. Gopal,2017, Control Systems Engineering, New Age International.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-552.1	3	3	3	2	2	1	-	-	-	-	-	-	3	2	1	-
BEE-DS-552.2	3	3	3	3	3	1	-	-	-	1	1	-	3	2	-	1
BEE-DS-552.3	3	3	2	2	3	-	1	-	-	1	1	-	3	1	1	1
BEE-DS-552.4	3	3	2	2	3	1	1	1	-	1	-	-	2	1	1	1

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PROJ-EE-500: SUMMER INTERNSHIP –II

Periods/week	Credits	Max. Marks	: 100
4 weeks Minimum	2.0	Internal/Continuous Evaluation	: 100
Duration of Exam: 2 Hrs			

Pre-Requisite: Nil
Course Type: Projects

Course Outcomes: After completion of this course the students will be able to
Proj-EE-500.1. actually face challenges of real field work.
Proj-EE-500.2. apply their learning skills to solve real life problem.
Proj-EE-500.3. Show the research capability.
Proj-EE-500.4. enhance their Innovative skills.
Proj-EE-500.5. develop solutions.
Proj-EE-500.6. build technology for new areas.

Every student will have to undergo Industrial Training for 6 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after 4th semester. Respective Head of Department will approve the Industry/Organization for training. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the training, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:

1. Evaluation by the Supervisor in the Industry	:	25 marks
2. Evaluation by Faculty Mentor during training visit	:	10 marks
3. Internal/Continuous Evaluation: seminar/ Presentation	:	15 marks
Total Marks	:	**50**

End Semester Exam : Evaluation after training:

1. Project Report	:	10 marks
2. Seminar/Presentation	:	20 marks
3. Viva	:	20 marks

Total marks		**50**

Total Credits : 2

COURSE ARTICULATION MATRIX :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Proj-EE-500.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3
Proj-EE-500.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3
Proj-EE-500.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3
Proj-EE-500.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2
Proj-EE-500.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3
Proj-EE-500.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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NAAC 'A' Grade University

BHM-520: Entrepreneurship and Startups

Periods/week	Credits		Max. Marks	: 200
L: 2	T: 0	2	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs			End Term Examination	: 100

Pre-requisite:
Course Type: Humanities & Social Science

Course Outcomes: The course will enable the student to-
BHM-520.1. Acquire Entrepreneurialspiritandresourcefulness.
BHM-520.2. Understand theconceptandprocessofentrepreneurship-itscontributionandrole in thegrowthanddevelopmentofindividualsandthenation.
BHM-520.3. Strengthen the skillsofcreationandmanagementofentrepreneurialventure.

Unit1:IntroductiontoEntrepreneurshipandStart–Ups(6 Lectures)
Definition and Traitsofanentrepreneur,Intrapreneurship,Motivation, typesofBusinessStructures,Similarities/differencesbetweenentrepreneursandmanagers.

Unit2:BusinessIdeasandtheirimplementation(6 Lectures)
Discoveringideasandvisualizingthebusiness, Activitymap, BusinessPlan

Unit3:IdeatoStart-up and Management(7 Lectures)
MarketAnalysis–Identifyingthetargetmarket, CompetitionevaluationandStrategydevelopment, Marketingandaccounting, Riskanalysis, Company'sOrganizationStructure, Recruitmentandmanagementoftalent, financialorganizationandmanagement

Unit4:Financing,ProtectionofIdeas and Exit strategies(7 Lectures)
Financingmethodsavailableforstart-upsinIndia, CommunicationofIdeastopotentialinvestors–InvestorPitch, PatentingandLicenses

Text Books/ Reference books/Web references:

1. SteveBlankandBobDorf, 2020, TheStartupOwner'sManual:TheStep-by-StepGuideforBuildingaGreatCompany,wiley.
2. Eric Ries, 2011, The Lean Startup: How Today's Entrepreneurs use ContinuousInnovationtoCreateRadicallySuccessfulBusinesses by EricRies, Penguin UK.
3. https://www.fundable.com/learn/resources/guides/startup
4.https://corporatefinanceinstitute.com/resources/knowledge/finance/corporate- structure/
5.https://www.finder.com/small-business-finance-tips
6.https://www.profitbooks.net/funding-options-to-raise-startup-capital-for-your- business

Distribution of Continuous Evaluation:

Sessional- I	30%

Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Quiz	20%

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course articulation Matrix

CO Statement	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS O 1	PS O2	PS O3	PS O4
BHM520.1	-	-	-	-	-	-	-	1	2	2	2	2	2	1	1	2
BHM-520.2	-	-	-	-	-	-	-	1	2	3	2	2	2	1	1	1
BHM-520.3	-	-	-	-	-	-	-	1	2	3	2	2	2	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH AND STUDIES
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DTI-500: Design, Thinking and Innovation – III

Periods/week Credits Max. Marks : 50
P: 1 2.0 Continuous Assessment : 50

Pre-requisites: Research and Innovation Catalyst-II
Course Type: Research & Training
Course Coordinator: Research Mentor

Course outcomes
The students will be able to**:**
RIC (E)-500.1. Understand the Plagiarism / Feasibility tools
RIC (E)-500.2. Document the outcome as Research Paper / Patent / Product / Start-up /copyright

Activity 1:
1.1 Compilation / Documentation of the outcome (Research Paper / Patent / Product / Start-up /copyright).
1.2 Plagiarism / Feasibility check.
1.3 Identification of the suitable Journal / Patenting Agencies / Angel Investors.
1.4 Submission to the identified Journal / Patenting Agencies / Angel Investors.

Course Articulation Matrix:

CO Statement (XX-500)	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO4
DTI-500.1	3	3	1	1	1	1	3	3	3	3	1	3	3	1	1	2
DTI-500.2	2	3	2	3	3	3	2	3	2	2	3	3	3	3	2	2

'3' (Tick) or 'More' Substantial/High Correlation, '2' Moderate/Medium Correlation, '1' Slightly/Low Correlation, 'Blank' No Correlation

Evaluation Criteria: The following evaluation parameters shall be considered for internal assessment by both research coordinators and faculty coordinator or research mentors:-

S. No.	Parameters	Description	(Marks)
1.	**Attendance**	• Percentage of classes attended by the students	**5**
2.	**Continuous Performance**	• Judge individual student's participation in the Activities • Time bound completion of Activities	**15**
3.	**Accomplishment of the Outcome**	• Quality of the content and results • Acceptance of the outcome (Research Paper/ Patent/ Product/ Copyright) • Report submission / Presentation	**30**

References:

1. www.originlab.com
2. http://www.cambridgesoft.com/software
3. http://www.synergy.com/
4. www.mathworks.com/products/matlab.html

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BHM-MC-008: QUANTITATIVE APTITUDE AND PERSONALITY DEVELOPMENT-II

Periods/week Credits	Max. Marks : 100
P :2 AP	Internal/Continuous Evaluation : 50
Duration of Exam: 2 Hrs	End Semester Exam : 50

Pre-Requisite: Nil
Course Type: HSMC

Course Outcomes:After completion of Course the student will be able to
BHM-MC-008.1. analyze various forms of data.
BHM-MC-008.2. solve complex problems based on arithmetic reasoning.
BHM-MC-008.3. apply short tricks on complex problems of number system.
BHM-MC-008.4. enhance and expand word knowledge by fostering word consciousness.
BHM-MC-008.5. construct simple and complex sentences accurately.
BHM-MC-008.6. develop reading skills & build verbal reasoning skills.

PART – A

Unit 1: Number System II
1.1 Factors and Multiples
1.2 Unit Digits &Cyclicity
1.3 Remainders
1.4 Factorials
1.5 Logarithm

Unit 2: Arithmetic III
2.1 Interest
- 2.1.1 Simple Interest
- 2.1.2 Compound Interest
- 2.1.3 Relation between SI & CI

2.2 Time, Speed & Distance
- 2.2.1 Basics Formulas & Proportionality
- 2.2.2 Average & Relative Speed
- 2.2.3 Trains and Boats & Streams
- 2.2.4 Circular Motion and Clocks

2.3Data Interpretation
- 2.3.1 Table and Bar graph
- 2.3.2 Line and Pie Charts
- 2.3.1 Mixed Charts and Caselets

Unit 3: Verbal Reasoning III
- 3.1 Calendar
- 3.2 Cubes and Dices
- 3.3 Data Sufficiency

PART – B

Unit 4: Advanced Vocabulary
- 4.1 Synonym & Antonym

4.2 One Word Substitution
4.3 Ordering of Words
4.4 Idioms and Phrases
4.5 Vocabulary, COW, Punctuation

Unit 5: Sentence Construction & Syntax

5.1 Sentence Improvement
5.2 Spotting Errors
5.3 Ordering of Sentences
5.4 Change of Voice/ Direct & Indirect speech
5.5 Completing Statements/Sentences

Unit 6: Reading Comprehension & Reasoning

6.1 Strategic Reading, Eliminating Poor Reading Habits
6.2 Techniques to increase speed reading, comprehension and recall
6.3 Solving Sample RC Passages
6.4 Closet Test
6.5 Para Jumbles

Text Books/Reference Books:

1. R S Aggarwal, 2017, Quantitative Aptitude for Competitive Examinations: S Chand & Company PvtLtd.
2. R S Aggarwal, 2018, A Modern Approach to Verbal&Non Verbal Reasoning: S Chand & Company Pvt Ltd.
3. Mvn, 2015,Verbal Ability and Reading Comprehension: MVN Enterprises.
4. P.A. Anand ,Lalit Singh, 2016, Wiley Verbal Ability and Reasoning for Competitive Examinations, Wiley.

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Sessional- I	**30%**
Sessional- II	**0%**
Assignment	**20%**
Class Performance	**10%**
Attendance	**10%**

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BHM-MC-008.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-008.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-008.3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1
BHM-MC-008.4	1	-	-	1	-	-	-	-	1	3	-	2	1	1	1	-
BHM-MC-008.5	1	-	-	1	-	-	-	-	1	3	-	2	-	-	1	1
BHM-MC-008.6	1	2	-	1	1	1	1	1	1	3	1	2	1	1	1	1

ELECTIVES

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-521A: ELECTRICAL MACHINE DESIGN

Periods/week	Credits		
		Max. Marks	: 200
L: 3 T: 0	3	Continuous Evaluation	: 100
Duration of Examination: 3 Hours		End Semester Exam	: 100

Pre Requisite: Electrical Machines –I & Electrical Machines-II
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-521A.1Identify various factors which influence the designing of electrical machines.
BEE-DS-521A.2 apply the principles of electromagnetism in designing of electrical machine.
BEE-DS-521A.3 analyze software tools to do design calculations.
BEE-DS-521A.4 create a model of an electrical machine.

Unit 1: INTRODUCTION (6 hours)
1.1 Major considerations in electrical machine design
1.2 Electrical engineering materials
1.3 Choice of specific electrical and magnetic loadings
1.4 Thermal considerations-Heat flow,Temperature rise
1.5 Rating of machines.

Unit 2: TRANSFORMERS (8 hours)
2.1 Sizing of a transformer
2.2 Main dimensions
2.3 kVA output for single- and three-phase transformers
2.4 core design - window area - window space factor
2.5 overall dimensions of core
2.6 Temperature rise in transformers- Design of cooling tank,
2.8Windings – no. of turns - current density.

Unit 3: INDUCTION MOTORS (8 hours)
3.1 Sizing of an induction motor
3.2 Main dimensions - stator design
3.3 Magnetic leakage calculations -Leakage reactance of polyphase machines
3.4 Length of air gap
3.5 Rules for selecting rotor slots of squirrel cage machines
3.6Design of rotor bars & slots, Design of end rings
3.7 Design of wound rotor

Unit 4 DC MACHINES (8 hours)
4.1 Output equation
4.2 Specific loading
4.3 Choice of speed and number of poles, Height of pole
4.4 Design of field winding- excitation voltage
4.5 Calculation of main dimensions
4.6 Choice of type of winding
4.7 Number of slots
4.8 Current density
4.9 Slot insulation
4.10 Length of air gap

4.11 Conductor cross section
4.12 design of inter pole - calculation of turns of inter polar winding
4.13design of compensating winding – brushes and commutators

Unit 5: SYNCHRONOUS MACHINES(8 hours)
5.1 Sizing of a synchronous machine
5.2 Main dimensions
5.3 Design of salient pole machines
5.4 Armature design
5.5 Estimation of air gap length
5.6 Design of rotor
5.7 Design of damper winding determination of full load field mmf
5.8 Design of field winding for turbo alternators and water wheel
5.9 Design of Cooling system for Turbo alternators
5.10 Rotor design.

Unit 6: COMPUTER AIDED DESIGN (CAD) (8 hours)
6.1 Limitations (assumptions) of traditional designs, Need for CAD analysis
6.2 Synthesis and hybrid methods
6.3 Design optimization methods
6.4 Variables, constraints and objective function,
6.5 Problem formulation
6.6 Introduction to FEM based machine design
6.7Case study: Complete design of an ac machine –steps

Text Books/ Reference Books:

1. K. Sawhney, 2013, A Course in Electrical Machine Design, DhanpatRai and Co.
2. M.G. Say, 1986, Theory & Performance & Design of A.C. Machines, ELBS London.
3. S. K. Sen, 2006, Principles of Electrical Machine Design with computer programmes, Oxford and IBH Publishing.
4. K. L. Narang, 1969, A Text Book of Electrical Engineering Drawings, SatyaPrakashan.
5. A. Shanmugasundaram, G. Gangadharan and R. Palani, 1979, Electrical Machine Design Data Book, NewAge International.
6. K. M. V. Murthy, 2008, Computer Aided Design of Electrical Machines", B.S. Publications, 2008.
7. Electrical machines and equipment design exercise examples using Ansoft's Maxwell 2D machine design package.

Software required / Web links:
MATLAB
https://nptel.ac.in/courses/108106023/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-521A.1	1	3	2	1	1	-	1	-	-	2	1	-	1	1	-	-
BEE-DS-521A.2	1	3	1	1	1	-	1	-	-	1	1	-	1	1	-	-
BEE-DS-521A.3	1	1	1	1	3	1	1	-	1	1	1	-	1	1	-	1
BEE-DS-521A.4	2	1	3	2	2	1	1	-	1	1	3	1	2	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-522: ELECTRICAL ENERGY CONSERVATION AND AUDITING

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3	Continuous Evaluation :100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre requisite
Course type Domain Specific Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-522.1 infer the current world energy scenario and importance of energy conservation.
BEE-DS-522.2 implement the concepts of energy management.
BEE-DS-522.3 summarize the methods of improving energy efficiency in different electrical systems.
BEE-DS-522.4 understand the economics of power system and hence evaluate different tariff and bill plan

Unit 1: ENERGY SCENARIO (6 Hours)
1.1 Commercial and Non-commercial energy
1.2 primary energy resources
1.3 commercial energy production
1.4 final energy consumption
1.5 energy needs of growing economy
1.6 long term energy scenario
1.7 energy and environment,
1.8 energy pricing
1.9 energy sector reforms
1.11 energy security
1.12 energy conservation and its importance
1.13 restructuring of the energy supply sector
1.14 air pollution, climate change.
1.15 Energy Conservation Act-2001 and its features

Unit 2: BASICS OF ENERGY AND IT'S VARIOUS FORMS (7 Hours)
2.1 Electricity tariff
2.2 load management and maximum demand control
2.3 power factor improvement
2.4selection & location of capacitors
2.5 Thermal Basics-fuels, thermal energy contents of fuel
2.6 temperature & pressure, heat capacity, sensible and latent heat, evaporation, condensation
2.7 steam, moist air and humidity & heat transfer
2.8 units and conversion

Unit 3: ENERGY MANAGEMENT & AUDIT (6 Hours)
3.1 Definition
3.2 energy audit, need, types of energy audit.
3.3 Energy management (audit) approach understanding energy costs, bench marking
3.4 energy performance
3.5 matching energy use to requirement
3.6 maximizing system efficiencies
3.7optimizing the input energy requirements
3.8 fuel & energy substitution

3.9 energy audit instruments.
3.10 Material and Energy balance: Facility as an energy system
3.11 methods for preparing process flow, material and energy balance diagrams.

Unit 4 ENERGY EFFICIENCY IN ELECTRICAL SYSTEMS (7 Hours)

4.1 Electrical system: Electricity billing, electrical load management and maximum demand control
4.2 power factor improvement and its benefit
4.3 selection and location of capacitors, performance assessment of PF capacitors
4.4 distribution and transformer losses.
4.5 Electric motors: Types, losses in induction motors, motor efficiency
4.6 factors affecting motor performance, rewinding and motor replacement issues
4.7 energy saving opportunities with energy efficient motors.

Unit 5: ENERGY EFFICIENCY IN INDUSTRIAL SYSTEMS (8 Hours)

5.1 Compressed Air System: Types of air compressors, compressor efficiency, efficient compressor operation
5.2 Compressed air system components, capacity assessment
5.3 leakage test
5.4 factors affecting the performance and savings opportunities in HVAC, Fans and blowers:
5.5 Types, performance evaluation
5.6 efficient system operation
5.7 flow control strategies and energy conservation opportunities
5.8 Pumps and Pumping System: Types, performance evaluation, efficient system operation,
5.9 flow control strategies and energy conservation opportunities.
5.10 Cooling Tower: Types and performance evaluation, efficient system operation
5.11 flow control strategies and energy saving opportunities
5.12 assessment of cooling towers.

Unit 6: ENERGY EFFICIENT TECHNOLOGIES IN ELECTRICAL SYSTEMS (8Hours)

6.1 Maximum demand controllers
6.2automatic power factor controllers
6.3 energy efficient motors
6.4 soft starters with energy saver
6.5 variable speed drives
6.6 energy efficient transformers,
6.7 electronic ballast
6.8 occupancy sensors
6.9 energy efficient lighting controls
6.10 energy saving potential of each technology.

Text Books/ Reference Books:

1. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-1, General Aspects (available online) http://aipnpc.org/Guidebooks.aspx
2. Guide books for National Certification Examination for Energy Manager / Energy Auditors Book-3,http://aipnpc.org/Guidebooks.aspx
   Electrical Utilities (available online)
3. S. C. Tripathy, 1991,Utilization of Electrical Energy and Conservation, McGraw Hill.
4. Success stories of Energy Conservation by BEE, New Delhi (www.bee-india.org)

Software required/Weblinks:

MATLAB

https://nptel.ac.in/courses/108106022/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

CO Statement (BEE-DS-522)	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BEE-DS-522**:**1	2	2	1	1	-	-	1	-	-	2	1	1	1	2	-	1
BEE-DS-522:2	3	2	-	-	-	-	1	-	-	1	1	1	3	2	1	1
BEE-DS-522:3	3	1	1	1	-	-	1	-	-	2	1	1	3	2	1	2
BEE-DS-522:4	3	2	1	1	-	-	-	-	-	2	1	1	1	-	1	1

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BEC-DS-501A: DIGITAL SIGNAL PROCESSING AND ITS APPLICATIONS

Periods/week Credits	Max. Marks : 200
L: 3 T:0 3	Continuous Assessment : 100
Duration of Examination: 3 Hrs	End Semester Examination : 100

Course Type: Program Core

Course Outcomes : The students will be able to:

BEC-DS-501.1A. Explain various application areas of digital signal processing and its advantages.

BEC-DS-501.2A. Analyse discrete-time systems using z-transform.

BEC-DS-501.3A. Understand the Discrete-Fourier Transform (DFT) and the FFT algorithms.

BEC-DS-501.4A. Design digital filters for various applications.

BEC-DS-501.5A. Apply digital signal processing for the analysis of real-life signals.

PART-A

Unit 1: Introduction to Digital Signal Processing

1.1 Introduction to Analog Signal Processing & Digital Signal Processing, Sampling and reconstruction of signals, representation of signals on orthogonal basis, Parametric and non-parametric spectral estimation.

1.1 Advantages of Digital Signal Processing (DSP)

1.3 Review of manipulations on Discrete Signals

Unit 2: Z-Transform

2.1 Definition of Z-transform

2.2 ROC & its Properties

2.3 Relation between s-plane & z-plane

2.4 Properties of Z-transform & its proof: Linearity, Time Shifting, Time Scaling, Time Reversal, Differentiation in frequency domain, Convolution in time domain, Correlation in time domain

2.5 Numericals on Z-transform

2.6 Inverse Z-transform using Long Division Method & Partial Fraction Method

2.7 Analysis of LTI systems using Z-transform

Unit 3: Discrete Fourier Transform (DFT)

3.1 Definition of DFT and its numericals

3.2 Relationship of DFT to other transforms

3.3 Properties of DFT: Periodicity, linearity and symmetry

3.4 Inverse DFT and its numericals

3.5 Efficient computation of DFT (FFT): Phase Factor & its Properties

3.6 Radix-2 FFT algorithms: Decimation in Time (DIT) & Decimation in Frequency (DIF)

3.7 Numericals on FFT

3.8 Circular Convolution & its relation with linear convolution

PART-B

Unit 4: Finite Impulse response (FIR) Filter

4.1 Magnitude and phase response of FIR filters

4.2 Linear Phase FIR Filter

4.3 Basic structures for FIR systems: Direct Form Realization, Linear phase FIR structure

4.4 Design technique for FIR filters (Derivations &Numericals): Fourier Series method, Window techniques (Rectangular, Hamming, Hanning and Blackmann window functions), Park-McClellan's method

Unit 5: Infinite Impulse Response (IIR) Filter

5.1 Design of IIR Digital Filters (Derivation &Numericals): Approximation of derivatives Method, Impulse invariant Method, Bilinear transformation method

5.2 Characteristics & Comparison of Analog filters: Butterworth filter, Chebyshev Filter, Inverse Chebyshev Filter and Elliptic Filter
5.3 Basic structures for IIR systems: Direct forms (I & II), Cascade realization and Parallel realisation, Ladder Structure

Unit 6: Applications of DSP
1.2 Applications of DSP: Biomedical Engineering, Voice Processing, Image Processing, RADAR
1.3 Introduction to DSP Processor
1.4 Introduction to Multirate DSP
1.5 Introduction to Finite Word Length Effect

Text Books/Reference Books:

1. John G.Proakis and Dimitris G.Manolakis, 2006, Digital Signal Processing, Principles, Algorithms and Applications , 4th Edition, Prentice Hall.
2. Salivahanan, Vallavaraj and Gananapriya, 2001, Digital Signal Processing, 2nd Edition, TMH.
3. Oppenheim A.V. & Schafer, Ronald W, 1998, Discrete Time Signal Processing, 2ndEdition, Prentice Hall.
4. Sanjit K. Mitra , 2005, Digital Signal Processing, 3rd Edition, Mc Graw Hill.

Software required/Weblinks:
MATLAB
http://nptel.ac.in/courses/117102060/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each PART-A and PART-B (one from each unit) Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Distribution of Continuous Assessment:

Sessional- I	30%
Sessional- II	30%
Assignment/Tutorial	20%
Class Work/ Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

CO Statement (BEC-DS-501A**)**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BEC-DS-501A.1	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	-
BEC-DS-501A.2	3	3	2	1	2	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-501A.3	3	3	2	1	2	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-501A.4	3	3	3	1	3	-	-	-	-	-	-	2	3	1	2	-
BEC-DS-501A.5	3	3	3	1	2	-	-	-	-	-	-	2	3	1	2	-

VI SEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-601A: POWER SYSTEMS – II

Periods/week Credits	Max. Marks : 200
L: 3 T: 0 3	Continuous Evaluation : 100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre Requisite: BEE-DS-402: POWER SYSTEMS-I
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-601.1 explicate the power flow problem and stability on power system network
BEE-DS-601.2 compare methods to control the voltage, frequency and power flow.
BEE-DS-601.3 apply the concepts of monitoring and control with proper management of power
BEE-DS-601.4 analyze the performance of various compensation devices for improved power quality.

Unit 1: Power Flow Analysis (6 hours)
1.1 Review of the structure of a Power System and its components
1.2 Analysis of Power Flows: Formation of Bus Admittance Matrix
1.3 Real and reactive power balance equations at a node
1.4 Load and Generator Specifications
1.5 Application of numerical methods for solution of nonlinear algebraic equations – Gauss Seidel and Newton-Raphson methods for the solution of the power flow equations.
1.6 Computational Issues in Large-scale Power Systems

Unit 2: Stability Constraints in synchronous grids (7 hours)
2.1 Swing Equations of a synchronous machine connected to an infinite bus
2.2 Power angle curve
2.3 Description of the phenomena of loss of synchronism in a single-machine infinite bus system following a disturbance like a three—phase fault
2.4 Equal Area Criterion
2.5 Impact of stability constraints on Power System Operation

Unit 3: Control of Frequency and Voltage (6 hours)
3.1 Automatic Generation Control
3.2 Generation and absorption of reactive power by various components of a Power System
3.3 Excitation System Control in synchronous generators
3.4 Automatic Voltage Regulators
3.5 Tap Changing Transformers
3.6 Phase shifters

Unit 4 Monitoring and Control (6 hours)
4.1 Overview of Energy Control Centre Functions: SCADA systems
4.2 Phasor Measurement Units and
4.3 Wide-Area measurement Systems
4.4 State-estimation
4.5 System Security Assessment
4.6 Normal, Alert, Emergency, Extremis states of a Power System
4.7 Contingency Analysis
4.8 Preventive Control and Emergency Control.

Unit 5: Unit Commitment and Economic Dispatch (8 Hours)
5.1 Formulation of economic dispatch problem

5.2 I/O cost characterization – incremental cost curve
5.3 Coordination equations without and with loss (No derivation of loss coefficients)
5.4 Solution by direct method and λ-iteration method –
5.5 Statement of unit commitment problem –
5.6 Priority-list method
5.7 Forward dynamic programming.

Unit 6: Flexible AC Transmission System (FACTS) (6 hours)
6.1 Introduction to FACTS, Basic types of FACTS devices
6.2 Static Var Compensator (SVC)
6.3 Static synchronous compensator (STATCOM)
6.4 Thyristor Controlled Series Compensator (TCSC)
6.5 Static Synchronous Series Compensator (SSSC)
6.6 Unified Power Flow Controller (UPFC)

Text Books/ Reference Books:

1. J. Grainger and W. D. Stevenson, 1994, Power System Analysis, McGraw Hill Education.
2. O. I. Elgerd, 1995, Electric Energy Systems Theory, McGraw Hill Education.
3. A. R. Bergen and V. Vittal, 1999, Power System Analysis", Pearson Education Inc.
4. D. P. Kothari and I. J. Nagrath, 2003, Modern Power System Analysis, McGraw Hill Education.
5. B. M. Weedy, B. J. Cory, N. Jenkins, J. Ekanayake and G. Strbac,2012,Electric Power Systems, Wiley.

Software required / Web links:
MATLAB,https://www.youtube.com/watch?v=70gLa0-1Rho,https://nptel.ac.in/courses/108105104/, https://nptel.ac.in/courses/108105067/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-601.1	1	3	2	1	1	-	1	-	-	2	1	-	1	1	2	2
BEE-DS-601.2	1	2	1	1	1	1	2	-	-	1	1	-	1	1	2	2
BEE-DS-601.3	2	2	1	3	1	2	1	-	1	1	1	1	1	1	2	2
BEE-DS-601.4	2	1	3	2	2	1	1	-	-	1	3	1	2	1	1	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-602: PROGRAMMABLE LOGIC CONTROLLERS & SCADA

Periods/week	Credits	Max. Marks	: 200
L: 5 T: 1	4	Continuous Evaluation	: 100
Duration of Examination: 3 Hours		End Semester Exam	: 100

Pre Requisite: BEE-DS-502: CONTROL SYSTEMS
Course Type: Core
Course Outcomes: After completion of this course the students will be able to
BEE-DS-602.1 demonstrate the basics of PLC
BEE-DS-602.2 explicate about PLC architecture.
BEE-DS-602.3 apply ladder programming to different applications in the automation sector.
BEE-DS-602.4 illustrate SCADA systems and its applications.

Unit 1: Introduction to PLC
1.1 Fundamentals of industrial automation, Need and role of automation, Evolution of automation
1.2 PLC introduction: Evolution of PLC, types of processes, Definition, functions, and advantages, comparison

Unit 2: PLC Architecture
2.1 Architecture
2.2 DI-DO modules range & specifications
2.3 Analog to digital & Digital to analog converter modules
2.4 Working of PLC
2.5 Scan time
2.6 Installation of PLC, Rack installation
2.7 Grounding and Shielding
2.8 Physical, electrical, maintenance requirements
2.9 Planning, verifying
2.10 Troubleshooting, Fault diagnosis techniques
2.11 Choosing PLC for application
2.12 Types and Specifications of PLC

Unit 3: PLC Programming and Interfacing
3.1 Introduction to PLC programming: Development of Relay Logic Ladder Diagram
3.2 PLC devices and languages as per IEC 61131-3 like LD, IL, ST, FBD, CFC, SFC
3.3 PLC Timers and Counters
3.4 Logical & Arithmetic instructions
3.5 PLC Interfacing, PLC Interface to Hydraulic/Pneumatic circuits, Need of interfacing, PLC interface to temperature control loop
3.6 PID Control using PLC, PID instruction
3.7 Solid-state devices
3.8 PLC Selection

Unit 4: SCADA
4.1 Need of SCADA system
4.2 Distributed control Systems (DCS)
4.3 General definition and SCADA components.
4.4 Hardware Architecture, Software architecture
4.5 Protocol detail

4.6 Discrete control and Analog control
4.7 Application & benefits
4.8 PLCs Versus RTUs
4.9 RTU Block diagram
4.10 MTU communication Interface
4.11 Future trends
4.12 Internet based SCADA display system
4.13 Components of control systems in SCADA
4.14 Communication of PLC with SCADA system on Ethernet
4.15 Creating tags, creating alarms, Display graphs
4.16 Logging data
4.17 Language switching of SCADA system

Unit 5: SCADA in Power Systems
5.1 Main task in power systems- Planning
5.2 Operation, accounting
5.3 Tasks of national control centre,
5.4 Regional control centre
5.5 Generating station control room
5.6 AGC-SCADA
5.7 SCADA in generation, SCADA in Power Distribution, SCADA in Power Grid

Unit 6: Supervisory Power Management
6.1 Energy Management System
6.2 Power system operation states
6.3 Security analysis
6.4 Computer programs-generating planning
6.5 Transmission planning
6.6 System studies
6.7 Energy audit
6.8 State estimation
6.9 Load Forecasting
6.10 Utility distribution system design
6.11 Regulation
6.12 Distribution automation
6.13 DMS, design
6.14 Layout and construction and commissioning of substations
6.15 Substation Automation
6.16 Equipment condition monitoring

Text Books/ Reference Books:

1. Gary Dunning , 2001, Introduction to Programmable Logic Controllers , Thomson, 2nd Edition,2001.
2. John R. Hackworth, Frederick D., Hackworth Jr., 2004, Programmable Logic Controllers Programming Methods and Applications Pearson.
3. John W. Webb, Ronald A. Reis , 2003, Programmable Logic Controllers: Principles and Application ,5th Edition, Prentice Hall.
4. Ronald L. Krutz,Jo , 2015, Securing SCADA System , John Wiley and Sons.
5. Stuart A Boyer, 2010, SCADA supervisory control and data acquisition, International society of Automation.
6. G Batten, Batten G. L., 1994, Programmable Controllers , McGraw Hill Inc., Second Edition.
7. Gordan Clark, Deem Reynders, EdwinWright, 2003, Practical Modern SCADA Protocols ,Elsevier.

Software required / Web links:

Mitsubishi Software/ Rockwell Automation (Allen-Bradley)
http://nptel.ac.in/courses/112102011/12
http://www.nptelvideos.in/2012/11/industrial-automation-and-control.html

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-602.1	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-602.2	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-602.3	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-602.4	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-625A: ELECTRIC DRIVES

Periods/week	Credits	Max. Marks	: 200
L: 3T: 0	3	Continuous Evaluation:	100
Duration of Examination: 3 Hours		End Semester Exam	:100

Pre-requisites: Power Electronics
Course Type: Domain Specific

Course Outcomes: After completion of this course the students will be able to
BEE-DS-625A.1 understand fundamentals of electric drives
BEE-DS-625A.2 summarize operation and analysis of solid state control of ac/ dc drives
BEE-DS-625A.3 concept of estimation of drive rating for different duty cycle operations.
BEE-DS-625A.4 Analysis of different methods to control the speed of Drives.

UNIT 1 Introduction: (5 hours)
1.1Definition of electric drive, type of drives;
1.2 Speed torque characteristic of driven unit/loads
1.3Classification and components of load torque;
1.4 Review of power converters used in drives
1.5multi-quadrant operation of electric drive, example of hoist operation in four quadrant.
1.6 Electrical Braking

Unit 2:DC Drives(8 Hours):
2.1 Review of DC Motor Characteristics and Braking
2.2Single-phase half controlled and fully controlled converter fed dc motor drives
2.3 Operation of dc drives with continuous armature current, voltage and current waveforms;
2.4Concept of energy utilization and effect of free-wheeling diode
2.5 Operation of drive under discontinuous current, expression for speed-torque characteristic

UNIT 3 Chopper fed DC Drives(7 Hours):
3.1Principle of operation and control techniques
3.2chopper circuit configurations used in dc drives: Type A, B, C, D and E;
3.3 Motoring operation of chopper fed separately excited dc motor
3.4 steady state analysis of drive with time-ratio control.

UNIT 4 Closed-loop control of DC Drive (6 hours)
4.1 Control structure of DC drive inner current loop and outer speed loop
4.2 dynamic model of dc motor – dynamic equations and transfer functions
4.3 modeling of chopper as gain with switching delay
4.4 plant transfer function, for controller design
4.5 current controller specification and design
4.6 speed controller specification and design.

UNIT 5: AC Motors (6 hours)
5.1 Review of induction motor equivalent circuit and torque-speed characteristic
5.2 variation of torque-speed curve with (I) applied voltage, (ii) applied frequency and (iii) applied voltage and frequency
5.3 Synchronous machine – Permanent magnet machines – Synchronous reluctance and variable reluctance machine

.

Unit 6: Control of slip ring induction motor (6 hours)

6.1 Constant V/f control of induction motor
6.2 Steady-state performance analysis based on equivalent circuit
6.3 Speed drop with loading, slip regulation
6.4 Impact of rotor resistance of the induction motor torque-speed curve
6.5 Operation of slip-ring induction motor with rotor resistance
6.6 starting torque, power electronic based rotor side control of slip ring motor
6.7 Slip power recovery.

Text Books/ Reference Books:

1. G. K. Dubey, 1989, Power Semiconductor Controlled Drives, Prentice Hall.
2. R. Krishnan,2001,Electric Motor Drives: Modeling, Analysis and Control, Prentice Hall.
3. G. K. Dubey,2002,Fundamentals of Electrical Drives, CRC Press.
4. W. Leonhard,2001, Control of Electric Drives, Springer Science & Business Media.
5. H. C Rai, 2018, Power Electronics and Industrial Applications, CBS Publishers and Distributors Pvt. Ltd.
6. V. Kumar, R. K. Behera, D. Joshi, R. Bansal, 2020, Power Electronics, Drives and Applications, CRC Press.

Software required/Weblinks:

https://nptel.ac.in/courses/108/104/108104140/
https://nptel.ac.in/courses/108/104/108104011/
https://nptel.ac.in/courses/108/108/108108077/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-625A.1	2	3	3	2	-	1	2	-	-	-	-	-	3	3	2	2
BEE-DS-625A.2	3	3	3	3	1	-	2	-	-	-		2	3	2	2	3
BEE-DS-625A.3	2	3	3	2	1	2	2	-	1	-	-	1	3	2	3	2
BEE-DS-625A.4	3	3	3	2	1	2	2	-	1	-	-	1	3	3	3	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-651: POWER SYSTEM-II LAB

Periods/week	Credits		
P: 2	1	Max. Marks	: 100
		Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hrs		End Semester Exam	: 50

Pre requisite : NIL
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-651.1 remember basics of software tools Like MATLAB & DIGSILENT
BEE-DS-651.2 understand the modeling & designing of power system in software tools.
BEE-DS-651.3 analyze load flow, power quality problems in power system.
BEE-DS-651.4evaluate power system performance in different faults & loads.

List of Experiments

1. Determine sinusoidal voltages and currents using MATLAB
2. Determine the bus admittance matrix for the given power system Network using MATLAB.
3. Fault Analysis of AC Power System using PSCAD/EMTDC.
4. Simulation of triggering of Thyristor, GTO by using PSIM.
5. Load Flow Analysis using Gauss Siedel Method, NR Method and Fast Decoupled Method for Both PQ and PV Buse
6. Substation layout using Autocad.
7. Sequence Components of Power System Network with Single Line to Ground Fault using MATLAB SIMULINK.
8. Simulink model of single area load frequency control with and without PI controller and without PI controller in simulink.
9. Simulink model for two area load frequency control in MATLAB
10. Swing equation using point-by-point method in Matlab
11. Modelling and Simulation of Non-Conventional Energy Systems using MATLAB.
12. Modelling of Single Machine Power System using SIMULINK.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-651.1	1	3	2	1	1	-	1	-	-	2	1	-	1	1	-	-
BEE-DS-651.2	1	2	1	1	1	1	2	-	-	1	1	-	1	1	-	-
BEE-DS-651.3	1	3	1	1	1	-	1	-	-	1	1	-	1	1	-	-
BEE-DS-651.4	1	1	1	1	3	1	1	-	1	1	1	-	1	1	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-652 : PROGRAMMABLE LOGIC CONTROLLERS & SCADA LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Internal/Continuous Evaluation	: 50
Duration of Examination: 2 Hours		End Semester Exam	: 50

Pre Requisite: BEE-DS-502: CONTROL SYSTEMS
Course Type: Core

Course Outcomes: After completion of this course the students will be able to

BEE-DS-652.1	implement of ladder programming using PLC for different Applications .
BEE-DS-652.2	design different control circuit using PLC.
BEE-DS-652.3	illustrate the interfacing of PLC with SCADA Software.
BEE-DS-652.4	apply implement SCADA on Power Systems.

LIST OF EXPERIMENTS:

1. To Study hardware and software of FX5U/iQ-R PLC.
2. Implementation Logic Gates using FX5U/iQ-R PLC.
3. Implementation Of On-Delay Timer&Implementation of Off-Delay TimerFX5U/iQ-R PLC
4. Implementation Of Up-Down CounterFX5U/iQ-R PLC.
5. Forward And Reverse Direction Control of Motors using PLCFX5U/iQ-R PLC
6. Implementation Of PID Controller using FX5U/iQ-R PLC.
7. To design a PLC circuit to start a motor using a start button and keep the motor running until the stop button is pressed using FX5U/iQ-R PLC.
8. Sequential Operation of ON/OFF of a Set Of Lights using FX5U/iQ-R PLC.
9. Interfacing of PLC with SCADA Systems
10. To implement SCADA on Substation.
11. To implement on water treatment systems.

Text Books:
W. John , A.R. Ronald, 2003, Programmable Logic Controllers: Principles and Application ,5th Edition, Prentice Hall.

Software required/Weblinks:
https://www.scribd.com/doc/108021192/Plc-Scada-Lab-Manual-Part-1

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance
Viva (Question and answers in lab)

End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-652.1	2	-	-	-	-	-	-	-	-	-	-	3	2	2	1	2
BEE-DS-652.2	3	2	-	-	2	-	-	-	-	-	-	3	2	1	1	2
BEE-DS-652.3	1	-	-	1	-	-	-	-	-	-		2	2	1	1	1
BEE-DS-652.4	-	-	-	1	-	-	-	-	-	-	-	1	1	2	1	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-653: ELECTRIC DRIVES LAB

Periods/week	Credits	Max. Marks	: 100
P: 2	1	Continuous Evaluation	: 50
Duration of Examination: 2 Hours		End Semester Exam	: 50

Pre requisites: Power Electronics
Course Type: Domain Specific Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-653.1 experiment with the speed control methods of motors.
BEE-DS-653.2 interpret the concepts electric Braking .
BEE-DS-653.3 design the controller for electric motor drives.
BEE-DS-653.4 simulate the electricdrives using different controllers in Matlab.

LIST OF EXPERIMENTS:
1. Speed control of dc motor using dc chopper.
2. Speed control of dc motor using single- phase converter.
3. Speed control of dc motor using 3- phase converter.
4. Speed control of dc motor using single- phase dual converter.
5. Inverter fed single-phase induction motor drive.
6. CSI fed induction motor drive.
7. Speed control of single- phase induction motor using ac regulator.
8. Regenerative braking of dc motor using single- phase converter.
9. Speed control of single-phase induction motor using cycloconverter.
10. Static rotor resistance control method.
11. To simulate BLDC Drives using MATLAB.
12. To simulate closed loop control of DC motor using Matlab .
13. To simulate inverter fed drives using Matlab.

PROJECTS BASED ON ABOVE EXPERIMENTS:

1. To Design controller for the regulating speed of Electric Drives using MATLAB Simulation.
2. To control the DC motor using PLC
3. To design Sine Pulse Width Modulation
4.To design solar Inverter.

Instructions for Exam: Every student needs to complete 10 experiments in a semester. One experiment out of 10 given randomly needs to be performed in exams.

Parameter	Weightage
Two Mid-Term Viva	60%
File/Record Keeping	20%
Class Performance	10%
Class Attendance	10%

Assessment Tools:
Experiments in lab
File work/Class Performance

Viva (Question and answers in lab)
End Term Practical Examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-653.1	3	3	2	2	1	1	3	-	-	1	1	2	2	3	2	3
BEE-DS-653.2	3	3	3	3	2	2	3	2	-	1	1	2	3	3	3	3
BEE-DS-653.3	3	3	2	2	2	2	3	1	1	2	2	2	3	2	3	2
BEE-DS-653.4	3	3	3	3	2	2	3	-	1	1	1	2	3	3	3	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
(Deemed to be University under section 3 of the UGC Act 1956)

PROJ-EE-600 : PROJECT (Phase 1)

Periods/week	Credits	Max. Marks : 50
P: 2	1	Internal/Continuous Evaluation : 50

Pre-requisites: Basic Knowledge of Core Subjects
Course Type: Internship/Seminar

Course Outcomes: After completion of this course the students will be able to
PROJ-EE-600.1 Plan and identify materials, processes and other resources optimally.
PROJ-EE-600.2 apply their innovative and creative ideas.
PROJ-EE-600.3 develop leadership, interpersonal skill and team work.
PROJ-EE-600.4 interpret the drawings, manufacture, assemble, inspect & if necessary modify the parts
PROJ-EE-600.5 do the assembly of the project work.
PROJ-EE-600.6 appreciate and communicate the learning for catering to professional ethics and societal needs.

Steps

1. The students have to make a minor project in a group or individually.
2. Each group has to give their project synopsis to the Departmental Project committee (DPC).
3. DPC will approve the project by checking the relevance and technicality of the idea presented.
4. After the Approval of the Project from DPC each group will be assigned the project mentor .
5. The students have to show the progress to the DPC in the course of work

Assessment Tools:
Presentation /Viva
Design & Innovation in Project

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
PROJ-EE-600.1	3	3	2	2	2	1	-	-	-	-	-	-	3	2
PROJ-EE-600.2	3	3	2	2	2	1	-	-	-	-	-	-	3	2
PROJ-EE-600.3	3	3	2	2	2	1	-	-	-	-	-	-	3	2
PROJ-EE-600.4	3	3	2	2	2	1	-	-	-	-	-	-	3	2
PROJ-EE-600.5	3	3	1	1	2	1	-	-	-	-	-	-	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BHM-MC-009: QUANTITATIVE APTITUDE AND PERSONALITY DEVELOPMENT-III

Periods/week	Credits	Max. Marks	: 100
P :2	AP	Continuous Evaluation	: 50
Duration of Exam: 2 Hrs		End Semester Exam	: 50

Pre-Requisite: Nil
Course Type: HSMC

Course Outcomes: After completing the course the students will be able to
BHM-MC-009.1. recognize problem based on Modern Mathematics and Algebra
BHM-MC-009.2. solve basic to moderate level problems based on Mensuration and Geometry.
BHM-MC-009.3. calculate solution to logical reasoning.
BHM-MC-009.4. get proficient with resume building and will be able to draft effective cover letters.
BHM-MC-009.5. participate effectively and confidently in a Group Discussion
BHM-MC-009.6. manage interviews effectively.

PART – A

Unit 1: Modern Mathematics and Algebra

1.1 Permutation and Combination

1.1.1 Principal of counting and Basic formulas
1.1.2 Arrangements, Selection and Selection + Arrangement.
1.1.3 Linear/Circular arrangements, Digits and Alphabetic Problems and Applications.

1.2 Probability

1.2.1 Events and Sample Space, Basic Formulas.
1.2.2 Problems on Coins, Cards and Dices.
1.2.3 Conditional Probability, Bayes' Theorem and their Applications.

1.3 Algebra

1.3.1 Linear & Quadratic equations
1.3.2 Mathematical inequalities
1.3.4 Maximum & Minimum Values
1.3.3 Integral Solutions

Unit 2: Geometry and Mensuration

2.1 Geometry

2.1.1 Basic geometry & Theorems, Lines & Angles
2.1.2 Polygons, Triangle and Quadrilaterals
2.1.3 Circles

2.2 Mensuration I- Areas

2.2.1 Different types of Triangles and their area and perimeter.
2.2.2 Different types of Quadrilateral and their area and perimeter.
2.2.3 Circumference and Area of Circle, Area of Sector and length of Sector.
2.2.4 Mixed Figures and their Applications.

2.3 Mensuration II- Surface Areas and Volumes

2.3.1 Problems on Cubes & Cuboids, Cone, Cylinder and Sphere.
2.3.2 Prism and Pyramid.
2.3.3 Mixed Figures and their Applications.

Unit 3: Logical Reasoning

3.1 Linear Arrangement
3.2 Circular Arrangement
3.3 Puzzles

Part - B

Unit 4: Professional Writing

4.1. Profiling on Social Sites: LinkedIn, Facebook, Instagram
4.2. Cover Letter/Emails
4.3. Resume Writing

Unit 5: Group Discussions

5.1. Do's and Dont's of a Group Discussion
5.2. Roles played in a Group Discussion
5.3. Tips for Cracking a Group Discussion

Unit 6: Managing Interviews

6.1. Developing the employability mindset
6.2. Preparing for Self -Introduction
6.3. Researching the employer
6.4. Portfolio Management
6.5. Answering Questions in an Interview

Text Books/Reference Books:

1. Arun Sharma, 2017, Teach Your Self Quantitative Aptitude, 1st Edition, McGraw Hills Education.
2. R S Aggarwal ,2017, A Modern Approach to Logical Reasoning:, S Chand & Company Pvt Ltd
3. Yana Parker & Beth Brown , 2012, The Damn Good resume Guide, 5th edition, Penguin Random House US,Ten Speed Press.
4. Ceri Roderick & Stephan Lucks , 2013, Interview Answers , Jaico Publishing house.

Instructions for paper setting: Fifty MCQ will be set in total. Twenty five MCQ will be set from Part A and twenty five MCQ will be set from Part B. All questions will be compulsory. Each question will be of 1 mark. There will be no negative marking. Calculator will not be allowed.

Distribution of Continuous Evaluation

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BHM-MC-009.1	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-009.2	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1
BHM-MC-009.3	1	-	-	2	-	-	-	-	-	-	-	-	-	-	-	1
BHM-MC-009.4	-	-	-	-	-	-	-	1	-	3	-	1	-	-	-	-
BHM-MC-009.5	-	-	-	-	-	-	-	1	-	3	-	-	-	-	-	1
BHM-MC-009.6	1	-	-	-	-	1	-	-	-	-	-	1	-	-	1	1

ELECTIVES

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-621: INDUSTRIAL ELECTRICAL SYSTEMS

Periods/week	Credits	Max. Mark	: 200
L: 3 T: 0	3	Continuous Evaluation	:100
Duration of Examination: 3 Hours		Semester Exam:	100

Prerequisite: **NIL**
Course Type: Domain Specific Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-621.1. Introduce various methods of effectively and efficiently utilizing electrical energy for different and desired applications.
BEE-DS-621.2. Differentiate the various electrical lighting scheme and their applications.
BEE-DS-621.3. Describe industrial electrical systems, its components and their functions.

Unit 1: Electrical System Components (8 Hours)
1.1 LT system wiring components
1.2 Selection of cables, wires, switches, distribution box
1.3 Metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB
1.4 Inverse current characteristics, symbols, single line diagram (SLD) of a wiring system
1.5 Contactor, Isolator, Relays, MPCB
1.6 Electric shock and Electrical safety practices

Unit 2: Residential and Commercial Electrical Systems (8 hours)
2.1 Types of residential and commercial wiring systems
2.2 General rules and guidelines for installation, load calculation and sizing of wire
2.3 Rating of main switch, distribution board and protection devices
2.4 Earthing system calculations, Earthing of commercial installation
2.5 Selection and sizing of components

Unit 3: Illumination Systems(6 hours)
3.1 Understanding various terms regarding light
3.2 Various illumination schemes
3.3 Modern luminaries like CFL, LED and their operation, energy saving in illumination systems
3.4 Design of a lighting scheme for residential and commercial premises
3.5 Flood lighting.Lightning Protection

Unit 4:HT and LT system components(8 Hours)
4.1 HT connection, industrial substation, Transformer selection
4.2 Industrial loads, motors, starting of motors, SLD
4.3 Cable and Switchgear selection
4.4 Earthing design, Power factor correction – kVAR calculations
4.5 Type of compensation, Introduction to PCC, MCC panels
4.6 Specifications of LT Breakers, MCB and other LT panel components.

Unit 5: DG and UPS system (6 Hours)
5.1 DG Systems, UPS System
5.2 Electrical Systems for the elevators
5.3 Battery banks, Sizing the DG, UPS and Battery Banks

5.4 Selection of UPS and Battery Banks.

Unit 6: Industrial Electrical System Automation (6 Hours)

6.1 Study of basic PLC, Role of in automation
6.2 Advantages of process automation
6.3 PLC basedcontrol system design
6.4 Panel Metering and Introduction to SCADA system for distributionautomation.

Text Books/ Reference Books:

1. S. L. Uppal and G. C. Garg,2008,Electrical Wiring, Estimating & Costing, Khanna publishers.
2. K. B. Raina, 2007, Electrical Design, Estimating & Costing, New age International.
3. S. Singh and R. D. Singh, 1997, Electrical Estimating and Costing,DhanpatRai and Co.
4. IS Standards.https://bis.gov.in/sf/etd/ETD18(12466)_08032018.pdf
5. H. Joshi, 2008, Residential Commercial and Industrial Systems, McGraw Hill Education.

Software required / Web links:

https://nptel.ac.in/courses/108/105/108105062/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-621.1	3	3	3	2	2	1	1	-	-	-	-	1	3	2	-	1
BEE-DS-621.2	3	3	2	2	2	1	1	-	-	-	-	1	3	2	-	1
BEE-DS-621.3	3	3	2	2	2	1	1	-	-	-	-	1	3	3	-	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-622: POWER QUALITY AND FACTS

Periods/week Credits	Max. Marks : 200
L: 3 3	Internal/Continuous Evaluation :100
Duration of Examination: 3 Hours	End Semester Exam : 100

Prerequisite : NIL
Course type: Domain specific

Course Outcomes: After completion of this course the students will be able to
BEE-DS-622:1 summarize the characteristics of ac transmission and the effect of shunt and series reactive compensation.
BEE-DS-622:2 describe the working principles of different FACTS devices and their operating characteristics.
BEE-DS-622:3 identify power quality problems and methods to improve it.
BEE-DS-622:4 apply the modellingof FACTs device for power control and stability analysis.

Unit 1: Transmission Lines and Series/Shunt Reactive Power Compensation (4 hours)
1.1 Basics of AC Transmission.
1.2 Analysis of uncompensated AC transmission lines.
1.3 Passive Reactive Power Compensation.
1.4 Shunt and series compensation at the mid-point of an AC line. Comparison of Series and Shunt Compensation.

Unit 2: Thyristor-based Flexible AC Transmission Controllers (FACTS) (6 hours)
2.1 Description and Characteristics of Thyristor-based FACTS devices
2.2 Static VAR Compensator (SVC)
2.3 Thyristor Controlled Series Capacitor (TCSC)
2.4 Thyristor Controlled Braking Resistor and Single Pole Single Throw (SPST) Switch.
2.5 Harmonics and control of SVC and TCSC.
2.6 Configurations/Modes of Operation, Fault Current Limiter.

Unit 3: Voltage Source Converter based (FACTS) controllers (8 hours)
3.1 Voltage Source Converters (VSC): Six Pulse VSC, Multi-pulse and Multi-level Converters,
3.2 Pulse-Width Modulation for VSCs.
3.3 Selective Harmonic Elimination
3.4 Sinusoidal PWM and Space Vector Modulation
3.5 STATCOM: Principle of Operation
3.6 Reactive Power Control: Type I and Type II controllers
3.7 Static Synchronous Series Compensator (SSSC)
3.8 Unified Power Flow Controller (UPFC): Principle of Operation and Control.
3.9 Working principle of Inter phase Power Flow Controller. Other Devices: GTO Controlled Series Compensator.
3.10 Fault Current Limiter.

Unit 4: Application of FACTS (4 hours)
4.1 Application of FACTS devices for power-flow control and stability improvement.
4.2 Simulation example of power swing damping in a single-machine infinite bus system using a TCSC.
4.3 Simulation example of voltage regulation of transmission mid-point voltage using STATCOM.

Unit 5:Power Quality Problems in Distribution Systems (4 hours)

5.1 Power Quality problems in distribution systems:
5.2 Transient and Steady state variations in voltage and frequency.
5.3 Unbalance, Sags, Swells, Interruptions
5.4 Wave-form Distortions: harmonics, noise, notching, dc-offsets, fluctuations.
5.5 Flicker and its measurement.
5.6 Tolerance of Equipment: CBEMA curve.

Unit 6 :DSTATCOM (8 hours)

6.1 Reactive Power Compensation
6.2 Harmonics and Unbalance mitigation in Distribution Systems using DSTATCOM and Shunt Active Filters.
6.3 Synchronous Reference Frame Extraction of Reference Currents.
6.4 Current Control Techniques in for DSTATCOM.
6.5 Unified Power Quality Conditioner (UPQC): Working Principle.
6.6 Capabilities and Control Strategies.

Text/References

1. N. G. Hingorani and L. Gyugyi,1995, Understanding FACTS: Concepts and Technology of FACTS Systems, Wiley-IEEE Press.
2. K. R. Padiyar,2007,FACTS Controllers in Power Transmission and Distribution, New Age International (P) Ltd.
3. T. J. E. Miller,1983,Reactive Power Control in Electric Systems, John Wiley and Sons, New York.
4. R. C. Dugan, 2012, Electrical Power Systems Quality, McGraw Hill Education.
5. G. T. Heydt,1991,Electric Power Quality, Stars in a Circle Publications.

Software required/Weblinks:

MATLAB
https://nptel.ac.in/courses/108106025/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-	3	2	-	1	-	-	-	-	-	2	2	1	2	-	-	1
BEE-DS-	2	1	-	1	-	-	-	-	-	2	-	1	2	-	-	2
BEE-DS-	2	-	-	1	-	-	-	-	-	2	2	1	3	1	1	1
BEE-DS-	2	2	-	2	3	-	2	-	-	2	2	1	3	-	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-623- ADVANCED CONTROL SYSTEM

Periods/week: 4
L: 3 T: 1 Credits: 4 Max. Marks : 200
Internal/Continuous Evaluation : 100
Duration of Examination: 3 Hrs End Semester Exam : 100

Pre-requisites: Control System
Course Type: Domain Specific Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-623.1 derive state space model of different systems
BEE-DS-623.2 solve state equations of unforced and forced system
BEE-DS-623.3 anlayse controllability and observability of state space system
BEE-DS-623.4 design state space system.

PART-A

Unit 1 State Space Analysis of Systems (5 hours)
1.1 Introduction to state concept-state equation of linear continuous time systems.
1.2 Matrix representation of state equations.
1.3 Modeling of electro mechanical systems, Dc Servo motor,
1.4 Determination of state space model from Physical variables.

Unit 2 State space representations (5 hours)
2.1 Determination of state space model from transfer function,
2.2 Different state representation -Phase variable and canonical forms,
2.3 Diagonalisation, Jordan form

Unit 3 Stability of state space system (6 hours)
3.1 Stability Analysis in State space,
3.2 Concept of Eiegen values and eigen vectors,
3.3 Lyapunov Stability Analysis,
3.4 Slyvester criteria, Direct method, Stability criteria.

PART – B

Unit 4 Solution of State space System (7 hours)
4.1 Concept of daigonalization,
4.2 Solution of Time invariant autonomous systems and forced systems,
4.3 State transition matrix-relationship between state equations and transfer function.
4.4 Properties of state transition matrix.
4.5 Steady state error for state space system.

Unit 5 Controllability and Observability (6 hours)
1.1 State transition Matrix using Cayley Hamilton theorem,
1.2 Matlab programing with State space ,
1.3 Controllability in state space.
1.4 observability in State space.

Unit 6 Design of state space system (6 hours)
6.1 State feed back design via pole placement technique.

6.2 Tracking problem in state feed back,
6.3 State observer design

Text Books:

1. K. Ogata,2002, Modern Control Engineering, Peasrson, New Delhi.
2. I. J. Nagrath and M. Gopal , 2007, Control System Engineering: New Age.
3. W.Borgan, 1991, Modern Control Theory, Prentice Hall.
4. R. C Dorf, R H Bishop, 2016, Modern Control Systems, Pearson education.
5. K. Ogata, 1967, State Space Analysis of Control Sysytem. Prentice Hall.

Software/Weblinks
MATLAB
https://nptel.ac.in/courses/108/107/108107115/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-623.1	3	2	2	1	1	-	-	-	-	-	1	1	3	3	2	-
BEE-DS-623.2	3	3	3	2	-	-	-	-	-	-	-	-	2	2	1	1
BEE-DS-623.3	3	3	3	2	1	-	-	-	-	-	-	-	2	2	1	1
BEE-DS-623.4	3	2	2	1	1	-	-	-	-	-	1	1	3	3	2	-

VII SEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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PROJ-EE-710: SUMMER INTERNSHIP –III

Periods/week	Credits	Max. Marks	: 100
4 weeks Minimum	2.0	Continuous Evaluation	: 100
Duration of Exam: 2 Hrs			

Course Type: Projects

Course Outcomes: After completion of this course the students will be able to
Proj-EE-710.1. actually face challenges of real field work.
Proj-EE-710.2. apply their learning skills to solve real life problem.
Proj-EE-710.3. Show the research capability.
Proj-EE-710.4. enhance their Innovative skills.
Proj-EE-710.5. develop solutions.
Proj-EE-710.6. build technology for new areas.

Every student will have to undergo Industrial Training for 6 weeks in the relevant field of Engineering in which he/she is enrolled for B.Tech programme after 4th semester. Respective Head of Department will approve the Industry/Organization for training. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the training, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:

1. Evaluation by the Supervisor in the Industry	:	50 marks
2. Evaluation by Faculty Mentor during training visit	:	20 marks
3. Internal/Continuous Evaluation: seminar/ Presentation	:	30 marks
Total Marks	:	**100**

End Semester Exam : Evaluation after training:

1. Project Report	:	30 marks
2. Seminar/Presentation	:	40 marks
3. Viva	:	30 marks

Total marks		**100**

Total Credits : 2

COURSE ARTICULATION MATRIX :

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
Proj-EE-710.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3
Proj-EE-710.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3
Proj-EE-710.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3
Proj-EE-710.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2
Proj-EE-710.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3
Proj-EE-710.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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PROJ-EE-700: PROJECT PHASE - II/INDUSTRIAL PROJECT

Periods/week Credits	Max. Marks : 300
P :8 4.0	Continuous Evaluation: 200
Duration of Examination: 2 Hrs	End Semester Exam : 100

Pre-Requisite: Nil
Course Type: Projects

Course Outcomes: After completion of this course the students will be able to

PROJ-EE-700.1: Identifies real world problems related to systems development decisions, originating from source requirements and goals.
PROJ-EE-700.2: Design models as a solution for particular problems.
PROJ-EE-700.3: Employ his/her skills in emerging areas.
PROJ-EE-700.4: Manage work in team or group.
PROJ-EE-700.5: Apply his/her learning in testing techniques
PROJ-EE-700.6: Implement skilled solutions in various platforms.

The project is guided by a faculty. The projects are to be individual or in group. The work plan is be finalized prior to the semester.

Text Books / Reference Books:
1. Project Management: A Systems Approach to Planning, Scheduling, and Controlling; *HaroldKerzner, 11th edition, 2013, WILEY.*
2. Project Management Absolute Beginner's Guide; Gregory M. Horine, Third Edition, 2012, Que.

Software required/Weblinks:
Ieee.org
www.tutorialpoint.com
www.nptel.com

Assessment Tools:
Presentation/Implementation

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
PROJ-EE-700.1	1	3	2	1	3	-	1	1	3	-	1	1	3	2	3
PROJ-EE-700.2	-	1	-	-	1	1	2	1	-	1	-	1	1	1	-
PROJ-EE-700.3	-	1	2	-	-	1	-	-	-	-	2	-	-	-	3
PROJ-EE-700.4	1	-	-	1	2	-	1	2	1	2	-	1	-	-	-
PROJ-EE-700.5	-	2	1	-	3	1	-	-	1	-	2	-	1	-	1
PROJ-EE-700.6	1	-	-	1	-	-	-	1	-	3	-	1	-	1	-

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GP-EE-700: General Proficiency

Grades to be given –Audit Pass Course

ELECTIVES

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-722 POWER SYSTEM DYNAMICS AND CONTROL

Periods/week Credits	Max. Marks :200
L: 3 T: 0 3	Continuous Evaluation :100
Duration of Examination: 3 Hours	End Semester Exam : 100

Pre Requisite: NIL
Course Type: Domain Specific

Course Outcomes: After completion of this course the students will be able to
BEE-DS-722.1analyze the problem of power system stability and its impact on the system.
BEE-DS-722.2interpret linear dynamical systems and use of numerical integration methods.
BEE-DS-722.3Model different power system components for the study of stability.
BEE-DS-722.4examine various methods to improve stability.

Unit 1:Introduction to Power System Operations (3 hours)
1.1Introduction to power system stability
1.2 Power System Operations and Control
1.3 Stability problems in Power System,
1.4Impact on Power System Operations and control.

Unit 2:Analysis of Linear Dynamical System and Numerical Methods (5 hours)
2.1 Analysis of dynamical System
2.2 Concept of Equilibrium,
2.3Small and Large Disturbance Stability.
2.4Modal Analysis of Linear System,
2.5 Analysis using Numerical Integration Techniques,
2.6Issues in Modeling: Slow and Fast Transients, Stiff System.

Unit 3: Modeling of Synchronous Machines and Associated Controllers (12 hours)
3.1Modeling of synchronous machine: Physical Characteristics
3.2.Rotor position dependent model.D-Q Transformation.Model with Standard Parameters
3.3.Steady State Analysis of Synchronous Machine
3.4.Short Circuit Transient Analysis of a Synchronous Machine
3.5.Synchronization of Synchronous Machine to an Infinite Bus.
3.6 Modeling of Excitation and Prime Mover Systems.
3.7Physical Characteristics and Models. Excitation System
3.8 Control.Automatic Voltage Regulator. Prime Mover Control Systems. Speed Governors.

Unit 4:Modeling of other Power System Components (10 hours)
4.1Modeling of Transmission Lines and Loads. Transmission Line
4.2 Physical Characteristics.
4.3Transmission Line Modeling.
4.4 Load Models - induction machine model. Frequency and Voltage Dependence of Loads.
4.5 Other Subsystems – HVDC and FACTS controllers, Wind Energy Systems

Unit 5:Stability Analysis (11 hours)
5.1 Angular stability analysis in Single Machine Infinite Bus System.
5.2 Angular Stability in multimachine systems – Intra-plant, Local and Inter-area modes.
5.3 Frequency Stability: Centre of Inertia Motion.

5.4 Load Sharing: Governor droop.
5.5Single Machine Load Bus System: Voltage Stability.
5.6 Introduction to Torsional Oscillations and the SSR phenomenon.
5.7 Stability Analysis Tools: Transient Stability Programs,
5.8Small Signal Analysis Programs.

Unit 6:Enhancing System Stability (4 hours)
6.1Planning Measures.
6.2Stabilizing Controllers (Power System Stabilizers)
6.3.Operational Measures-Preventive Control.Emergency Control.

Text Books/ Reference Books:

1. K.R. Padiyar, 2002, Power System Dynamics, Stability and Control", B. S. Publications.
2. P. Kundur, 1995, Power System Stability and Control", McGraw Hill.
3. P. Sauer and M. A. Pai, 1997, Power System Dynamics and Stability", Prentice Hall.

Software required / Web links:
MATLAB.PSPICE
nptel.ac.in/courses/108101004/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-722.1	3	3	3	1	3	-	-	-	-	-	-	-	3	1	3	1
BEE-DS-722.2	3	1	3	3	2	-	-	-	-	-	-	-	3	1	3	1
BEE-DS-722.3	3	3	2	1	2	_	-	-	-	-	-	-	3	-	3	2
BEE-DS-722.4	3	3	1	2	2	1	-	-	-	-	-	-	1	1	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-626A: ELECTRIC POWER APPLICATIONS AND TRACTION

Periods/week	Credits		Max. Marks	: 200
L: 3	T: 0	3	Continuous Evaluation	: 100
Duration of Examination: 3 Hours			End Semester Exam	: 100

Prerequisite: Power Systems I
Course type: Domain specific Elective
Course Outcomes: After completion of this course the students will be able to
BEE-DS-626A.1 develop design of different lighting systems
BEE-DS-626A.2 identify elements of electrical heating and welding including its types ,losses and design.
BEE-DS-626A.3paraphrase the concept of electrolysis and electric traction systems.
BEE-DS-626A.4 describe the working of refrigeration and air conditioning systems

Unit 1: Illumination
1.1 Radiant energy-terms and definitions
1.2 Laws of illumination
1.3 Luminous efficiency
1.4 Electrical lamps
1.5 Design of interior and exterior lighting systems
1.6 Illumination levels for various purposes
1.7 Light fittings- Factory lighting, flood lighting, street lighting
1.8 Conservation in lighting.

Unit 2: Electric Heating
2.1 Electric heating: classification
2.2 Heating element
2.3 Losses in oven and efficiency
2.4 Resistance furnace
2.5 Radiant heating- induction heating
2.6 High frequency eddy current heating
2.7 Dielectric heating
2.8 Arc furnace

Unit 3: Electric Welding
3.1 Resistance welding
3.2 Arc welding
3.3 Welding generator and welding transformer
3.4 Properties of arcing electrode.

Unit 4: Electrolytic Process
4.1 Principles and applications of electrolysis
4.2 Faraday's law of electrolysis
4.3 Electroplating
4.4 Charging and discharging.
4.5 Capacity and efficiency of battery
4.6 Defects in battery

Unit 5: Electric Traction
5.1 Features of an ideal traction system
5.2 Systems of electric traction
5.3 Mechanism of train movement
5.4 Traction supply system
5.5 Feeding and distributing system on an ac traction

5.6 Traction motors-Tractive effort and horse power
5.7 Speed control Schemes
5.8 Electric braking.
5.9 Configuration and performance of electrical vehicles

Unit 6: Air conditioning and Refrigeration
6.1 Refrigeration cycle
6.2 Refrigeration systems
6.3 Domestic Refrigerator
6.4 Air-conditioning
6.5 Function of complete air conditioning system
6.6 Water coolers

Text Books/ Reference Books:

1. E. Taylor, Openshaw 1986, Utilisation of Electric Energy, Orient Longman.
2. J. B. Gupta, 2002, Utilization of Electric Power and Electric Traction, S K Kataria and Sons.
3. C.L. Wadhwa, 1993, Generation, Distribution and utilization of electrical energy, Wiley Eastern Limited.
4. S. Gupta, Bhatnagar, 2001, A course in Electric power: Dhanapa tRai and sons.
5. S.L.Uppal, 1988, Electrical Power: Khanna publishers.
6. N.V. Suryanarayana 1994, Utilisation of Electric Power including Electric drives and Electric Traction, New Age International.
7. H. Partab 1975, Art and Science of Utilisation of Electrical Energy, Pritam Surat.
8. S.C. Tripathy, 1993, Electric Energy Utilization And Conservation: Tata McGraw Hill.

Software required / Web links:
OpenPowerNet
https://en.wikipedia.org/wiki/**Electric**_multiple_unit
https://nptel.ac.in/courses/108/103/108103009/
https://nptel.ac.in/courses/108/105/108105060/
Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-626A.1	3	2	2	2	1	-	-	-	1	-	1	2	2	1	2	2
BEE-DS-626A.2	2	3	2	1	1	-	-	-	-	-	-	2	2	1	1	2
BEE-DS-626A.3	2	2	1	-	1	-	-	-	-	-	-	1	2	--	1	2
BEE-DS-626A.4	2	2	2	-	1	-	-	-	-	-	-	1	2	-	2	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-726A: ROBOTICS AND AUTOMATION

Periods/week Credits	Max. Marks : 200
L :3 T: 0 3.0	Continuous Evaluation:100
Duration of Exam: 3 Hrs	End Semester Exam:100

Pre-Requisite:
Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-726A.1 Explain the need of automation in manufacturing system
BEE-DS-726A.2.learn about the configuration of robotand its drives and control.
BEE-DS-726A.3 understandabout drone technology.

Unit-1 Automation
1.1 History of Automation, Reasons for automation,
1.2 Disadvantages of automation, Automation systems,
1.3 Types of automation – Fixed,
1.4 Programmable and Flexible automation, Automation strategies

Unit-2 Automated Manufacturing Systems:
2.1 Components, classification and overview of manufacturing Systems,
2.2 Flexible Manufacturing Systems (FMS), Types of FMS,
2.3 Applications and benefits of FMS.

Unit-3 Robotics
3.1Definition of Robot,
3.2 History of robotics, Robotics market and the future prospects,
3.3 Robot Anatomy, Robot configurations: Polar, Cartesian, cylindrical and Jointed-arm configuration.
3.4 Robot motions, Joints, Work volume,
3.5 Precision of movement – Spatial resolution, Accuracy,
3.6 Repeatability, End effectors – Tools and grippers.

Unit 4 Robot Drives and Control
4.1 Functions of Drive System,
4.2 Introduction to Pneumatic systems
4.3 Electrical Drives-Dc motors, Ac Motors
4.4 Stepper Motor
4.5 Piezoelectric Actuator
4.6 Drive Mechanisms

Unit-5Sensors and Intelligent Robots
5.1Sensors and controllers: Internal and external sensors,
5.2 Position, velocity and acceleration sensors, proximity sensors,
5.3 Force sensors, laser range finder.
5.4Robot vision: image processing fundamentals for robotic applications,
5.5 image acquisition and preprocessing. Segmentation and region characterization object recognition by image matching and based on features

Unit-6 Drone technology
6.1 Introduction to UAVs/Drones,

6.2 Drone Applications, Working Principle and Design,
6.3 Inertial Measurement Unit, Sensors and Calibration,
6.4 PID - Implementation and Tuning, Flight controller, Remote Controller,
6.5 Quadcopter dynamics

Text Books:

1. M. P. Groover, N. G Odrey, M. Weiss, R. N Nagel, A.Dutta, 2012, Industrial Robotics, Technology programming and Applications McGraw Hill.
2. J.J. Craig. 1999, Introduction to Robotics- mechanics and control, Addison- Wesley.
3. S.R. Deb, 2009, Robotics Technology and flexible automation, Tata McGraw-Hill Education.
4. R. D. Klafter, Thomas .A, ChriElewski, Michael Negin, 2009, Robotics Engineering an Integrated Approach, PHI Learning., 2009.
5. F. N. Nagy, AndrasSiegler, 1987, Engineering foundation of Robotics, Prentice Hall Inc.
6. P.A. Janaki Raman, 1995, Robotics and Image Processing an Introduction, Tata McGraw Hill Publishing.
7. A. R. Jha,2016, Theory, Design, and Applications of Unmanned Aerial Vehicles, CRC Press
8. Valavanis, K., Vachtsevanos, George J. (Eds.),2014, Handbook of Unmanned Aerial Vehicles, Springer.

Software required / Web links:
https://nptel.ac.in/courses/108/105/108105088/
https://nptel.ac.in/courses/107/106/107106090/
https://nptel.ac.in/courses/112/107/112107289/
https://nptel.ac.in/courses/112/104/112104298/
https://nptel.ac.in/courses/112/108/112108298/
https://nptel.ac.in/courses/112/105/112105249/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-726A.1	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-726A.2	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1
BEE-DS-726A.3	3	3	2	1	2	-	-	-	-	-	-	2	3	1	1	1

VIII SEMESTER

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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PROJ-EE-800A: INTERNSHIP

Periods/week Credits	Max. Marks : 300
24 weeks 10.0	Continuous Assessment : 200
Duration of Exam: 2 Hrs	End Semester Exam :100

Pre-Requisite: Nil
Course Type: Projects

Course Outcomes: After completion of this course the students will be able to
PROJ-EE-800A.1: Recognize the challenges of real working environment.
PROJ-EE-800A.2: Apply their learning skills to solve real life problem.
PROJ-EE-800A.3: Develop the synergetic collaboration between industry and the organization.
PROJ-EE-800A.4: Enhance their Innovative skills.
PROJ-EE-800A.5: Explore options in their career plans.
PROJ-EE-800A.6: Integrate learning for catering to professional ethics and societal needs.

Every student will have to undergo Industrial Training for 10-12 weeks in the relevant field of Engineering in which he/she is enrolled for B.Techprogramme after 6th semester. Respective Head of Department will approve the Industry/Organization for training. During this course of time he/she will be regularly monitored and evaluated. After successful completion of the training, the student will have to submit the training report, deliver a seminar about the work/project undertaken during the training and will have to appear for viva. The evaluation of the industrial training shall be made as per following:

Continuous Evaluation during training:

1. Evaluation by the Supervisor in the Industry	:	75 marks
2. Evaluation by Faculty Mentor during training visit	:	50 marks
3. Internal/Continuous Evaluation: seminar/ Presentation:		75 marks
Total Internal/Continuous Evaluation: Marks	:	**200**

End Semester Exam : Evaluation after training:

1. Project Report	:	30 marks
2. Seminar/Presentation	:	20 marks
3. Viva	:	50 marks

Total End Semester Exam : marks	:	**100**

Total Credits	**:**	**14**

The parameters for evaluation during the training for Supervisor shall be as under:

		Marks
Work/Project undertaken	:	15
Punctuality/Regularity	:	10
Discipline/Overall Conduct/Relations with seniors and others	:	10
Eagerness to acquire technical knowledge	:	20
Overall Proficiency achieved during training	:	10
Any contribution to the organization	:	10

Total		**75**

The parameters for evaluation by the faculty during training shall be as under:

Maintenance of Training Diary and Regularity	:	10
Relations with seniors and others	:	10
Overall Conduct	:	10
Willingness to Work	:	10
Proficiency achieved	:	10

		50

COURSE ARTICULATION MATRIX:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
PROJ-EE-800A.1	1	2	3	-	-	-	2	2	3	3	2	3	1	2	3	3
PROJ-EE-800A.2	1	3	3	-	-	-	2	3	3	2	2	3	1	2	3	3
PROJ-EE-800A.3	2	-	-	-	-	-	2	1	2	3	2	3	1	2	3	2
PROJ-EE-800A.4	1	-	-	-	-	-	2	1	3	3	2	3	1	2	2	2
PROJ-EE-800A.5	2	-	-	-	-	-	2	2	3	2	2	3	2	-	3	3
PROJ-EE-800A.6	1	-	-	-	-	-	2	2	3	2	2	3	1	2	3	3

B Tech (Hons.) in Electrical and Electronics Engineering with specialization in Microgrid Technologies

Semester	Course Code	Course Title	L	T	P	Total	Continuous Evaluation	End Sem.	Total	D.of Exam	Credits
IV	BEE-DS-624	Renewable Energy Systems	3	0	0	3	100	100	200	3Hrs	3
IV	BEE-DS-654	Renewable Energy Systems Lab	0	0	2	2	50	50	100	2Hrs	1
V	BEE-DS-527	Introduction to Smart grid	3	0	0	3	100	100	200	3Hrs	3
V	BEE-DS-528	Distributed Generation	3	0	0	3	100	100	200	3Hrs	3
VI	BEE-DS-628	Communication in smart grid	3	0	0	3	100	100	200	3Hrs	3
VI	BEE-DS-629	Energy Storage Systems	3	0	0	3	100	100	200	3Hrs	3
VII	BEE-DS-729	Optimization and control of Microgrids	3	0	0	3	100	100	200	3Hrs	3
VII	BEE-DS-752	Simulation of Microgrid lab	0	0	2	2	50	50	100	2Hrs	1
		TOTAL									20

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

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BEE-DS-624 RENEWABLE ENERGY SYSTEMS

Periods/week	Credits	Max. Marks	: 200
L: 3 T: 0	3	Continuous Evaluation	: 100
Duration of Examination: 3 Hrs		End Semester Exam	: 100

Pre-requisites: NIL

Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to

BEE-DS-624.1 Know about various non-conventional sources of generation and its applications.

BEE-DS-624.2 analyze the characteristics on various parameters of non-conventional energy generation.

BEE-DS-624.3 study the issues and challenges involved in the integration of the conventional & non-conventional Sources of energy generation

Unit 1 Renewable and Non-Renewable Sources of Energy

1.1Classification of energy sources
1.2 Brief review of conventional sources of energy production
1.3 Greenhouse effect and global warming
1.4 Solar energy option
1.5 Design, fabrication and performance of flat plate collectors
1.6 Description of solar thermal devices (stills, water heaters, furnaces, cookers and refrigerators)
1.7 Solar thermal power generation systems, thermal storage.

Unit 2 Photovoltaic Conversion

2.1 Conceptual description of photovoltaic effect
2.2 Electrical characteristics of silicon PV cells and modules
2.3 Solar cell materials and prospects
2.4 Instruments for measurement of solar radiation
2.5 Empirical equations for predicting availability of solar radiation.

Unit 3 Wind energy

3.1 Wind turbines
3.2 The power in the wind
3.3 Forces on blade & torque on windmill
3.4 Types of wind power plant
3.5 Types of wind turbine generator units
3.6 Wind characteristics.

Unit 4 Ocean Thermal Energy Conversion

4.1 Wave characteristics and wave power
4.2 Wave energy technology
4.3 Fixed devices, Floating devices.
4.4 Ocean thermal energy conversion (OTEC)
4.5 Methods of power generations, Heat exchangers,
4.6 Basic ideas about other practical considerations.
4.7 Tidal power
4.8 Basic principle of power generation through tidal power
4.9 Classification of Tidal plants
4.10 Advantages & limitations of tidal power plants

Unit 5 Biomass and Small Hydro Power

5.1 Bio Fuel
5.2 Different methods of extracting energy from biofuel
5.3 Energy from refuse, refuse derived fuel (RDF),

5.4 Energy farming.
5.5 Small hydro power: Classification as micro, mini and small hydro projects
5.6 Basic concepts and types of turbines
5.7 Design and selection considerations

Unit 6 Recent trends (only brief description expected)
6.1 Fuel cell,
6.2 Hydrogen energy,
6.3 Alcohol energy
6.4 Geothermal energy
6.5 Nuclear fusion
6.6 Power from satellite stations.

Text Books/ Reference Books:

1. S. Hasan Saeed, D.K Sharma , 2009, Non Conventional Energy Resources S K Kataria and Sons.
2. S A Abbasi and Naseema Abbasi, 2007, Renewable energy sources and their environmental impact:, Prentice-Hall of India,
3. G D Rai, 2000, Non-conventional sources of energy, Khanna Publishers.
4. G D Rai, 2000, Solar energy utilization: Khanna Publishers.
5. S L Sah, 1995, Renewable and novel energy sources: M.I. Publications.
6. S Rao and B B Parulekar, 1999, Energy Technology: Khanna Publishers.

Software required / Web links:
MATLAB
http://nptel.ac.in/courses/108108078/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

COURSE ARTICULATION MATRIX

CO Statement (BEE-DS-624)	PO 1	PO2	PO3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO 11	PO12	PSO 1	PSO 2	PSO 3	PSO 4
BEE-DS-624.1	2	-	2	3	1	-	2	-	-	3	-	3	3	2	-	2
BEE-DS-624.2	1	1	2	1	1	-	2	-	-	3	-	1	3	2	-	2
BEE-DS-624.3	2	-	2	2	1	-	2	-	-	3	-	2	3	2	-	2

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES
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BEE-DS-654 : Renewable Energy Systems Lab

Periods/week Credits
P: 2 1
Duration of Examination: 2 Hrs

Max. Marks : 100
Continuous Evaluation: 50
End Semester Exam : 50

Pre requisite : NIL

Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to

BEE-DS.654.1 remember basics of software tools Like MATLAB ,PV Syst or HOMER

BEE-DS.654.2 understand the modeling & designing of power system in software tools.

BEE-DS.654.3 apply concept of designing and simulating the various sources on different software tools

BEE-DS.654.4 Simulation of Energy storage systems such as battery.

List of Experiments

1. Familiarization with renewable energy-based power generation
2. Solar Cell VI & PV Characteristics.
3. Comparison of different conventional MPPT techniques.
4. Solar based lightning system.
5. Simulation of Solar based water Pumping system.
6. Design of OFF-Grid Solar Renewable Energy System (1kW) in MATLAB/PV syst/ HOMER
7. Design of ON-Grid Solar (Grid Tied) Renewable Energy System (1kW) in MATLAB/PV syst/ HOMER
8. Design of Solar /Wind based Microgrid System.
9. Performance Analysis of 100W Fuel Cell system
10. Simulation Study on Solar and Wind, Hybrid Energy Systems, Hydel Power Generation & Intelligent controller for Hybrid System using MATLAB.
11. Charging and discharging characteristics of a battery.

Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Assessment Tools:
File work/Class Performance 30 Marks
Rubrics/Viva 20 Marks
End Term Practical Examination 50 Marks

COURSE ARTICULATION MATRIX

CO Statement (BEE-DS-654**)**	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**
BEE-DS-654.1	1	3	2	1	1	-	1	-	-	2	1	-	1	1	1	1-
BEE-DS-654.2	1	2	1	1	1	1	2	-	-	1	1	-	2	2	1	1
BEE-DS-654.3	1	3	1	1	1	-	1	-	-	1	1	-	1	1	1	1
BEE-DS-654.4	1	1	1	1	3	1	1	-	1	1	1	-	1	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-527: Introduction to Smart Grid

Periods/week Credits	Max. Marks : 200
L: 3 T: 3	Continuons Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites: NIL
Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to
BEE-DS-527.1 Get acquainted with different smart devices and smart meters 1
BEE-DS-527.2Describe how modern power distribution system functions
BEE-DS-527.3 Identify suitable communication networks for Smart Grid applications

Unit 1: Introduction to Smart Grid (8 Hours)
1.1Evolution of Electric Grid, Concept, Definitions and Need for Smart Grid,
1.2 Functions of Smart Grid ,opportunities, challenges and benefits of Smart Grid,
1.3 Difference between conventional & smart grid, Concept of Resilient & Self-Healing Grid,
1.4 Present development & International policies in Smart Grid
1.5 Case study of Smart Grid,
1.6 Diverse perspectives from experts and global Smart Grid initiatives.

Unit 2: Smart Grid Technologies (8 Hours)
2.1 Smart energy resources,
2.1 Substation Automation, Feeder Automation,
2.3 Transmission systems: EMS,
2.4 FACTS and HVDC, Wide area monitoring,
2.5 Protection and control, Distribution systems: DMS, Fault Detection,
2.6 Isolation and service restoration,
2.7 Distribution Transformers, Phase Shifting Transformers, Plug in Hybrid Electric Vehicles (PHEV)

Unit 3: Smart Meters (6 Hours)
3.1 Introduction to Smart Meters,
3.2 Real Time Pricing, Smart Appliances,
3.3 Advanced Metering infrastructure (AMI) drivers and benefits,
3.4 Automatic Meter Reading (AMR),AMI protocols,
3.5 standards and initiatives, AMI needs in the smart grid,
3.6 Vehicle to Grid, Smart Sensor,
3.7 Outage Management System (OMS), Home& Building Automation

Unit 4: Power Management in Smart Grid (7 Hours)
4.1 Power Quality & EMS in Smart Grid,
4.2 Power Quality Conditioners for Smart Grid,
4.3 Power Quality issues of Grid connected Renewable Energy Sources,
4.4 Web based Power Quality monitoring,
4.5 Power Quality Audit

Unit 5: Communication Systems in Smart Grids (6 Hours)
5.1 Local Area Network (LAN),
5.2 Home Area Network (HAN),

5.3 Neighborhood Area Network (NAN),
5.4 Wide Area Network (WAN),
5.5 Basics of Web Service and CLOUD Computing to make Smart Grids smarter.

Text Books/Reference Books:

1. Stuart Borlase 2012,Smart Grid: Infrastructure, Technology and Solutions', CRC Press.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama,2012, 'Smart Grid: Technology and Applications', Wiley.
3. Mini S. Thomas, John D McDonald, 2015, Power System SCADA and Smart Grids, CRC Press
4. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 2014, Communication Networks for Smart Grids, Springer.

Software/Links:
https://nptel.ac.in/courses/108/107/108107113/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-527.1	2	3		1	1					1			1	2	2	2
BEE-DS-527.2	2	2	1		2				2		1		1	1		1
BEE-DS-527.3	1	2	1	2				1	1		2		1	1	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-528: Distribution Generation

Periods/week Credits	Max. Marks : 200
L: 3 T: 3	Continuons Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites: NIL
Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to

BEE-DS-528.1 impart knowledge about distributed generation technologies, their interconnection in grid, to understand relevance of power electronics in DG

BEE-DS-528.2 describe the modern power distribution system functions for microgrids.

BEE-DS-528.3 Identify suitable communication networks for Smart Grid applications

Unit 1: Distributed Generation (DG) Technologies (8 Lectures)

1.1 Introduction, Comparative study between conventional and non-conventional methods of power generation:

1.2 energy crisis due to scarcity of fossil fuel, distributed generation (DG) overview and technology trend.

1.3 Working principle, architecture and application of renewable DG technologies

1.4 Solar PV, bioenergy, wind energy, hydroelectricity, tidal power, wave energy, geothermal energy etc.

1.5 Non-conventional technology based DGs:

1.6 Fuel cells, CHP based microturbine, IC engines, etc.

1.7 Storage based DGs:

1.8 Storage technology: Battery, super capacitor, flywheel etc.

Unit 2: Interconnection Issues and Standards of DGs (10 Lectures)

2.1 Concept of distributed generations (DG) or distributed energy resources (DERs),

2.2topologies, selection of source,

2.3 dependence on storage facilities,

2.4 regulatory standards/ framework,

2.5 standards for interconnecting DGs to electric power systems: IEEE 1547.

2.6 DG installation classes,

2.7 security issues in DG implementations.

2.8 Grid code and Islanding & non-islanding system

UNIT 3: Operational Features of Grid Connected DG Systems (10 Lectures)

3.1 Grid interconnection issues for grid connected operation of various types of DG systems.

3.2 Constraints on operational parameters: voltage, frequency, THD,

3.3 response to grid abnormal operating conditions,

3.4 islanding issues. Reliability,

3.5 stability and power quality issues involved in grid connected operation of various DGs.

UNIT 4: Power Electronics and DG Systems (10 Lectures)

4.1 Relevance of power electronics in DG applications,

4.2 Power quality requirements and source switching using SCR based static switches,

4.3 Distribution system loading, line drop model,

4.4 series voltage regulators and on-line tap changers,

4.5 power converter topologies, model and specifications for DG applications,

4.6 issues filter designs, harmonic reduction,
4.7 Control of DG inverters, phase locked loops,
4.8 current control and DC voltage control for standalone and grid parallel operations.
4.9 Protection of converters,
4.10 power quality implication, acceptable ranges of voltage and frequency, reactive power compensation and active filtering.

Text Books/Reference Books:

1. Godfrey Boyle ,2013, Renewable Energy- Power for a sustainable future, third edition, Edited by, Oxford University Press.
2. Amirnaser Yezdani, and Reza Iravani, 2009,Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications.
3. Dorin Neacsu,2006, Power Switching Converters: Medium and High Power, CRC Press, Taylor & Francis, New Delhi.
4. Nikos Hatziargyriou (Editor), 2013,Microgrids: Architectures and Control, Wiley-IEEE Press
5. S. Chowdhury, S.P. Chowdhury and P. Crossley , 2009, Microgrids and Active Distribution Networks, , The Institution of Engineering and Technology, London, U.K.
6. Technical literatures- research papers published in power system and power electronics related reputed journals and IEEE standards.
7. **Math Bollen**, **Fainan Hassan**, 2011,**Integration of Distributed Generation in the Power System,**
8. Gevorg Gharehpetian Mohammad Mousav, (Editors) 2017, Distributed Generation Systems- Design, Operation and Grid Integration, Butterworth-Heinemann.

Software/Links :
https://nptel.ac.in/courses/108/108/108108034/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-528.1	3	2	2	1	1					1			1	3	2	1
BEE-DS-528.2	2	2	1		2				2		1		1	1	1	1
BEE-DS-528.3	3	2	3	2	2			1	1	1	2		2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-628: Communication in smart grid

Periods/week Credits	Max. Marks : 200
L: 3 T: 3	Continuons Evaluation: 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites:

Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to

BEE-DS-628.1 Learn how a smart grid communicate using different means
BEE-DS-628.2 understand about advanced metering infrastructure protocols
BEE-DS-628.3 analyse about intelligent sensing and security issues in Smart grid
BEE-DS-628.4 Know about big data analytics in smart grid

Unit 1: – Introduction (8 Lectures)

1.1 Need of intelligence and communication in Smart Grid,
1.2 Case Study on Postmortem Analysis of Blackouts Drivers Toward the Smart Grid;
1.3 NETWORK layered ARCHITECTURE,
1.4 Protocols and standards for information exchange

Unit 2: Protocols (8 Lectures)

2.1 Advanced Metering Infrastructure Protocols aiding AMI IEEE 802.15.4,
2.2 6LoWPAN, ROLL, and RPL, IEEE 802.11 255,
2.3 Modbus, DNP3, IEC 61850,
2.4 Ethernet, Power line carrier communication,
2.5 CAN Bus, I2C, LIN Bus protocol,
2.6 Modbus protocol structure;
2.7 Profibus protocol stack,
2.8 Profibus communication model, Bluetooth, ZigBee, IEEE 801.11-a,b,g,n,
2.9 Z-Wave, Cellular networks, WiMAX

UNIT 3: Sensor Communications (6 Lectures)

3.1 Techniques for sensing: Phasor measurement units,
3.2 Compressive sensing, Decentralized and cooperative sensing;
3.3 Techniques for sensor communications-
3.4 Machine-to-machine communications,
3.5 Cooperative communications, Cognitive radio (CR);
3.6 Medium access control, routing, and transport protocols for sensor data communications;
3.7 Networked control systems- Time driven, Event driven feedback schemes.

UNIT 4: Big data analysis (8 Lectures)

4.1 Substation Automation Architecture; Data Analytics:
4.2 Big Data Collection, sampling and preprocessing;
4.3 Smart Grid Data Analytics :
4.4 Event Analytics, State Analytics, Customer Analytics,
4.5 data analytics platform and Operational Analytics ;
4.6 Big Data Architecture and Platforms ;
4.7 Application of Big Data in Smart Grid

UNIT 5: **Intelligent Sensing & Security Systems in Smart Grids (8 Lectures)**

5.1 Missing sensor restoration (MSR),

5.2 Monitoring and Identification: PMU for system Identification and state estimation,
5.3Power System Operation Support:
5.4 Forecasting - time series analysis, regression analysis and other statistical methods;
5.5 ANN short-term load forecaster,
5.6 Physics-based numerical weather prediction (NWP),
5.7 Scheduling: deterministic optimization methods.
5.8 Cyber Security Challenges in Smart Grid,
5.9 Load Altering Attacks, False Data Injection Attacks,
5.10 Defense Mechanisms, Privacy Challenges.

Text Books/Reference Books:

1. Stephen F. Bush, 2014, Smart Grid: Communication-Enabled Intelligence for the Electric Power Grid, Wiley-IEEE Press.
2. Fadlullah, Zubair& Fouda, Mostafa& Kato, Nei& Takeuchi, Akira & Iwasaki, Noboru & Nozaki, Yousuke,2011, Toward Intelligent Machine-to-Machine Communications in Smart Grid. Communications Magazine, IEEE. 49. 60 - 65.
3. Kaveth Pahlavan. K. and Prashanth Krishnamurthy, 2006, Principles of Wireless Networks", Prentice Hall of India.
4. Bart Baesens, 2004, Analytics in a Big data world" Wiley Publications
5. Kenneth C.Budka, Jayant G. Deshpande, Marina Thottan, 2014, Communication Networks for Smart Grids', Springer, 2014.

Software/Links:

https://nptel.ac.in/courses/108/107/108107113/

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Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-628.1	3	2	2	1	1					1			1		2	2
BEE-DS-628.2	2	1	1		2				2		1		1	1		1
BEE-DS-628.3	1	2		2				1	1		2					2
BEE-DS-628.4	3	2	1	2	1						1		1	1	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-629: Energy Storage Systems

Periods/week Credits	Max. Marks : 200
L: 3 T: 3	Continuons Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites:

Course Type: Disciplinary Elective

Course Outcomes: After completion of this course the students will be able to

BEE-DS-629.1 compare different types of energy storage system.

BEE-DS-629.2 learn the battery characteristic, parameters and its modelling

BEE-DS-629.3 use the concept of battery management system and design a battery for different application.

BEE-DS-629.4 Know about battery testing, disposal and recycling.

Unit 1: ENERGY STORAGE SYSTEM (8 Lectures)

1.1 Batteries: Lead Acid Battery, Nickel based batteries,
1.2 Sodium based batteries,
1.3 Lithium based batteries – Li-ion & Li-poly,
1.4 Metal Air Battery, Zine Chloride battery;
1.5 Ultra capacitors;
1.6 Fuel Cells, Flywheel Energy Storage System;
1.7 Hydraulic Energy Storage System;
1.8 Comparison of different Energy Storage System

Unit 2: BATTERY CHARACTERISTICS & PARAMETERS (8 Lectures)

2.1 Cells and Batteries- conversion of chemical energy to electrical energy
2.2 Battery Specifications: Variables to characterize battery operating conditions
2.3 Specifications to characterize battery nominal and maximum characteristics;
2.4 Efficiency of batteries; Electrical parameters Heat generation-
2.5 Battery design Performance criteria for Electric vehicles batteries-
2.6 Vehicle propulsion factors- Power and energy requirements of batteries-
2.7 Meeting battery performance criteria- setting new targets for battery performance

UNIT 3: BATTERY MODELLING (7 Lectures)

3.1 General approach to modelling batteries,
3.2 simulation model of a rechargeable Li-ion battery,
3.3 simulation model of a rechargeable NiCd battery,
3.4 Parameterization of the NiCd battery model,
3.5 Simulation examples.

UNIT 4: BATTERY PACK AND BATTERY MANAGEMENT SYSTEM (6 Lectures)

4.1 Selection of battery for EVs & HEVs,
4.2 Traction Battery Pack design, Requirement of Battery Monitoring,
4.3 Battery State of Charge Estimation methods,
4.4 Battery Cell equalization problem, thermal control, protection interface,
4.5 SOC Estimation, Energy & Power estimation,
4.6 Battery thermal management system,
4.7 Battery Management System: Definition, Parts:
4.8 Power Module, Battery, DC/DC Converter, load, communication channel,
4.9 Battery Pack Safety, Battery Standards & Tests.

UNIT 5: **BATTERY TESTING, DISPOSAL & RECYCLING (8 Lectures)**

5.1Chemical & structure material properties for cell safety and battery design,
5.2 battery testing, limitations for transport and storage of cells and batteries ,
5.3 Recycling, disposal and second use of batteries.
5.4 Battery Leakage: gas generation in batteries, leakage path, leakage rates.
5.5 Ruptures: Mechanical stress and pressure tolerance of cells, safety vents,
5.6 Explosions: Causes of battery explosions, explosive process,
5.7 Thermal Runway: High discharge rates,
5.8 Short circuits, charging and discharging.
5.9 Environment and Human Health impact assessments of batteries,
5.10 General recycling issues and drivers, methods of recycling of EV batteries.

Text Books/Reference Books:

1. Guangjin Zhao, 2017, Reuse and Recycling of Lithium-Ion Power Batteries, John Wiley & Sons.
2. Arno Kwade, Jan Diekmann, 2018, Recycling of Lithium-Ion Batteries: The LithoRec Way, Springer.
3. Ibrahim Dinçer, Halil S. Hamut and Nader Javani, 2016, Thermal Management of Electric Vehicle Battery Systems", JohnWiley& Sons Ltd.
4. Chris Mi, Abul Masrur& David Wenzhong Gao, 2011, Hybrid electric Vehicle- Principles & Applications with Practical Properties, Wiley.
5. G. Pistoia, J.P. Wiaux, S.P. Wolsky,2011,Used Battery Collection and Recycling, Elsevier.
6. T R Crompton, 2000, Battery Reference Book-3 rd Edition, Newnes- Reed Educational and Professional Publishing Ltd.
7. James Larminie, John Lowry, 2003, Electric Vehicle Technology Explained, John Wiley & Sons Ltd.
8. G. Pistoia, J.P. Wiaux, S.P. Wolsky, 2001, Used Battery Collection and Recycling, Elsevier,

Software/Links:

https://nptel.ac.in/content/storage2/courses/108103009/download/M9.pdf

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:

Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-629.1	3	3	2	1	1					1			1	2	1	1
BEE-DS-629.2	2	3	1		2				2		1		1	1		1
BEE-DS-629.3	1	2		2				1	1		2		2	1	1	1
BEE-DS-629.4	3	3	1	2	1						1		2	2	1	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-729: Optimization and Control of Micro grids

Periods/week Credits	Max. Marks : 200
L: 3 T: 3	Continuons Evaluation : 100
Duration of Examination: 3 Hrs	End Semester Exam : 100

Pre-requisites: NIL
Course Type: Disciplinary

Course Outcomes: After completion of this course the students will be able to

BEE-DS-729.1 understand the structure of micro grid and the modelling of power converters and other components of micro grid
BEE-DS- 729.2 Learn about dynamics and control of Micro grids
BEE-DS- 729.3 Understand the grid architecture and its interface
BEE-DS- 729.4 study the different techniques for the stability of Micro grids

Unit 1: – Overview of Micro grids (8 Lectures)

1.1 Concept of Micro grids, Micro grid and distributed generation,
1.2 Micro grid vs Conventional Power System,
1.3 AC and DC Micro grid with Distributed Energy Resources,
1.4 Power Electronics for Micro grid,
1.5 Power Electronic Converters in Micro grid Applications

Unit 2: Modeling of converters in micro grid power system (10 Lectures)

2.1 Modeling of Power Converters in Microgrid Power System
2.2 DC/DC Converter Modeling and Control,
2.3 Modeling of Renewable Energy Resources (wind & Solar),
2.4 Modeling of Energy Storage System.

UNIT 3: Micro grid Dynamics and Control (8 Lectures)

3.1 Micro grid Operation Modes and Standards,
3.2 Micro grid Control Architectures,
3.3 Intelligent Microgrid Operation and Control,
3.4 Energy Management in Micro grid System

UNIT 4: DC Micro grid System Architecture and AC Interface (6 Lectures)

4.1DC Microgrid System Architecture and AC Interface,
4.2 DC Microgrid Dynamics and Modeling,
4.3 Control of DC Microgrid System,
4.4 Applications of DC Micro grids

UNIT 5: **Stability in Microgrid (6 Lectures)**

5.1 Stability Analysis of DC Microgrid,
5.2 DC Microgrid stabilization strategies,
5.3 DC microgrid stabilization using nonlinear Techniques

Text Books/Reference Books:

1. Nikos Hatziargyriou, 2013, Microgrids: Architectures and Control, Wiley-IEEE Press
2. Magdi S Mahmoud, 2016, Microgrid: Advanced Control Methods and Renewable Energy System Integration", Butterworth-Heinemann.
3. S. M. Sharkh , M. A. Abu-Sara, G. I. Orfanoudakis and B. Hussain, 2014, Power Electronic

Converters for Microgrids, Wiley – IEEE Press
4. Remus Teodorescu, Marco Liserre and Pedro Rodriguez, 2011, Grid Converters for Photovoltaic and Wind Power Systems, Wiley Publications.
5. Amirnaser Yazdani and Reza Iravani, 2010, Voltage-Sourced Converters in Power Systems: Modeling, Control, and Applications, Wiley-IEEE Press.
6. Ramesh Babu, 2017,Smart Grid Systems-Modeling and Control, CRC Press
7. Z. Zhong , 2020, Modeling, Control, Estimation, and Optimization for Microgrids -A Fuzzy-Model-Based Method, CRC Press.

Software/Links:
https://nptel.ac.in/courses/108/107/108107143/

Instructions for paper setting: Seven questions are to be set in total. First question will be conceptual covering entire syllabus and will be compulsory to attempt. Three questions will be set from each Part A and Part B (one from each unit). Student needs to attempt two questions out of three from each part. Each question will be of 20 marks.

Sessional- I	30%
Sessional- II	30%
Assignment	20%
Class Performance	10%
Attendance	10%

Assessment Tools:
Assignment/Tutorials
Sessional tests
Surprise questions during lectures/Class Performance
Term end examination

Course Articulation Matrix

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-729.1	3	2	2	1	1					1			1	2	2	1
BEE-DS-729.2	2	2	1		2				2		1		1	1	1	1
BEE-DS-729.3	1	2		2				1	1		2			2	2	1
BEE-DS-729.4	3	2	1		1					1	1		1	2	2	1

MANAV RACHNA INTERNATIONAL INSTITUTE OF RESEARCH & STUDIES

(Deemed to be University under section 3 of the UGC Act 1956)

BEE-DS-752: Simulation of Micro Grid lab

Periods/week	Credits	Max. Marks : 100
P: 2	1	Continuous Evaluation: 50
Duration of Examination: 2 Hours		End Semester Exam : 50

Pre-requisite :NIL
Course Type: Program Core

Course Outcomes: After completion of this course the students will be able to
BEE-DS-752.1 Construct and simulate smart distribution system
BEE-DS-752.2 Construct and simulate MPPT controller
BEE-DS-752.3 Construct and simulate grid integration.
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LIST OF EXPERIMENTS:
Open Sources of Opendss, Gridlab etc. can be used for simulation.

1. Micro Grid Operation in Smart Distribution System
2. Micro grid Integration of Hybrid PV/ Wind / Battery Management System Using Fuzzy Logic Controller
3. Design of Hybrid Electric Power System Utility.
4. Design of solar MPPT controller
5. Fuzzy logic control based MPPT for Wind Power System
6. ANFIS Based Grid integration of Photovoltaic Power System using multilevel inverter

Text Books:
L. Robert, Gabriel Kousourou, 1987, Experiments in Circuit Analysis, 5th Edition, Merrill Pub Co.
Software required/Weblinks:
http://www.ece.ucf.edu/labs/EEL3123/experiments/
Instructions for Exam: One experiment out of 10 given randomly needs to be performed in exams.

Assessment Tools:
File work/Class Performance 30 Marks
Rubrics/Viva 20 Marks
End Term Practical Examination 50 Marks

COURSE ARTICULATION MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
BEE-DS-752.1	2	3	1	-	-	-	-	-	-	-	-	-	1	-	1	1
BEE-DS-752.2	2	2	3	2								1	2	2	1	2
BEE-DS-752.3	2	2	2	2	1								2	1	1	1