

GOVERNMENT COLLEGE (AUTONOMOUS), BHAWANIPATNA

(College with potential for excellence)



COURSES OF STUDIES

FOR THREE YEAR DEGREE COURSE IN **SCIENCE** (UNDER CBCS)

SUB: MATHEMATICS

Semester-I	2017	Semester-II	2018
Semester-III	2018	Semester-IV	2019
Semester-V	2019	Semester-VI	2020

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COURSE STRUCTURE

		Paper Code	Credit Points
Semester-I	1	AECC-1	02
	2	GE-1	06
	3	CORE-1	06
	4	CORE-2	06
		TOTAL	20
Semester-II	1	AECC-2	02
	2	GE-2	06
	3	CORE-3	06
	4	CORE-4	06
		TOTAL	20
Semester-III	1	SEC-1	02
	2	GE-3	06
	3	CORE-5	06
	4	CORE-6	06
	4	CORE-7	06
		TOTAL	26
Semester-IV	1	SEC-2	02
	2	GE-4	06
	3	CORE-8	06
	4	CORE-9	06
	4	CORE-10	06
		TOTAL	26
Semester-V	1	CORE-11	06
	2	CORE-12	06
	3	DSE-1	06
	4	DSE-2	06
		TOTAL	24
Semester-VI	1	CORE-13	06
	2	CORE-14	06
	3	DSE-3	06
	4	DSE-4	06
		TOTAL	24
		GRAND TOTAL	140

C O N T E N T

	Paper Code	Page No.
1	AECC	03
2	SEC	07
3	GE	09
4	CORE	17
5	DSE	26

ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

SEMESTER-I

AECC-I : ENVIRONMENTAL STUDIES (ENVS)

(CREDITS: 2, Theory=2)

(Total Marks: 50, Mid Sem=10, Term End=40, Duration: 2 hrs)

MODULE-1: Introduction to environmental studies and Ecosystem [BOTANY Dept]

Multidisciplinary nature of environmental studies;

Scope and importance; Concept of sustainability and sustainable development.

Ecosystems : [ZOOLOGY Dept]

What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem: Food chains, food webs and ecological succession. Case studies of the aquatic ecosystems (ponds) (8 lectures)

MODULE-2:

Natural Resources : Renewable and Non-renewable Resources [ZOOLOGY Dept]

- Land resources and land use change; Land degradation, soil erosion and desertification.
- Deforestation: Causes and impacts due to mining, dam building on environment, forests, Biodiversity and tribal populations.
- Water : Use and over---exploitation of surface and ground water, floods, droughts, conflicts Over water (international & inter-state).
- Energy resources : Renewable and non-renewable energy sources, use of alternate energy sources, growing energy needs, case studies. (8 lectures)

MODULE-3: Biodiversity and Conservation [BOTANY Dept]

- Levels of biological diversity : genetic, species and ecosystem diversity; Biogeographic zones Of India; Biodiversity patterns and global biodiversity hot spots
- India as a mega-biodiversity nation; Endangered and endemic species of India
- Threats to biodiversity : Habitat loss, poaching of wildlife, man-wildlife conflicts, biological invasions;
- Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value. (8 lectures) [BOTANY Dept]

MODULE-4: Environmental Pollution [CHEMISTRY Dept]

- Environmental pollution : types, causes, effects and controls; Air, water, soil and noise pollution
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste.
- Global warming, ozone layer depletion. (8 lectures)

References:

1. Singh, J.S., Singh, S.P. and Gupta, S.R. 2014. *Ecology, Environmental Science and Conservation*. S.Chand Publishing, New Delhi.
2. Das and Mishra. Man and Environment.
3. S. Swain. Environmental Studies.
4. M C Dash. Fundamental of Ecology.
5. Shukla and Chandel. A Text Book of Plant Ecology.

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ABILITY ENHANCEMENT COMPULSORY COURSE (AECC)

SEMESTER-II

AECC-II : ENGLISH

(CREDITS: 2, Theory=2)

(Total Marks: 50, Mid Sem=10, Term End=40, Duration: 2 hrs)

This course aims at enhancing the English language proficiency of undergraduate students in humanity, science and commerce streams to prepare them for the academic, social and professional expectations during and after the course. The course will help develop academic and social English competencies in speaking, listening, pronunciation, reading and writing, grammar and usage, vocabulary, syntax, and rhetorical patterns.

Students, at the end of the course, should be able to use English appropriately and effectively for further studies or for work where English is used as the language of communication.

MODULE-1: Reading Comprehension [15]

- Locate and remember the most important points in the reading
- Interpret and evaluate events, ideas, and information
- Read "between the lines" to understand underlying meanings
- Connect information to what they already know

MODULE-2: Writing [15]

Expanding an Idea	Writing a Memo	Report Writing
Creative Writing	News Story	Setting in Creative Writing
Writing a Business Letter	Letters to the Editor	Précis Writing
CV & Resume Writing	Dialog writing	Covering Letter
Writing Formal Email	Elements of Story Writing	Note Making
Information Transfer	Interviewing for news papers	

MODULE-3: Language functions in listening and conversation [06]

1. Discussion on a given topic in pairs
2. Speaking on a given topic individually

(Practice to be given using speaking activities from the prescribed textbooks)

Grammar and Usage [14]

Simple and Compound Sentences; Complex Sentences; Noun Clause; Adjective Clause; Adverb Clause; The Conditionals in English; The Second Conditional; The Third Conditional; Words and their features; Phrasal Verbs; Collocation; Using Modals; Use of Passives; Use of Prepositions; Subject-verb Agreement; Sentence as a system; Common Errors in English Usage

Examination pattern

Each reading and writing question will invite a 200 word response.

Language function questions set in context will carry 01 mark per response. There will be 15 bit questions.

Midterm test:	Writing : 1 question	04 x 01qn = 04 marks
	Speaking: 2 questions	03x02 qns = 06 marks
	Total	10 marks

Term End :	MODULE-1	Reading: 05 questions	03x 05 qns= 15 marks
		(3 prose and two poetry questions)	
	MODULE-2	Writing: 03 questions	05 x 03 qns= 15 marks
	MODULE-3	Grammar & usage: 10 qns	01x 10 qns = 10 marks
	Total		40 marks

Grammar questions must be set in contexts; not as isolated sentences as used for practice in the prescribed textbook.

Book Prescribed

Vistas and Visions: An Anthology of Prose and Poetry. (Ed.)Kalyani Samantray, Himansu S. Mohapatra, Jatindra K. Nayak, Gopa Ranjan Mishra, Arun Kumar Mohanty. OBS

Texts to be studied : Prose (Decoding Newspapers, The Gold Frame, Of Truth, Lifestyle English)

Poetry (Lines Composed a few miles above Tintern Abbey; Sonnet 46 (Shakespeare); Pigeons)

All grammar and writing activities in the textbook



**AECC-II : ODIA
SEMESTER-II**

ଆସ୍ଥାମୂଲ୍ୟାଂକ - ୨, ମୋଟ୍ ଶ୍ରେଣୀ ପାଠଦାନ-୨୦ ଘଣ୍ଟା, ପୂର୍ଣ୍ଣସଂଖ୍ୟା - ୫୦, ପରୀକ୍ଷା ସମୟ- ୨ ଘଣ୍ଟା
ପାଠ୍ୟର କୌଣସି ଗୋଟିଏ ପାଠ୍ୟକୁ ବାଛିବାକୁ ହେବ।

ପାଠ୍ୟ-୧ / Course-1 :

- ଉପାଂଶ-୧: (ଗନ୍ଧବିଭାଗ) ଗନ୍ଧ ତରଂଗ-ପ୍ରକାଶକ ସମ୍ବଲପୁର ସାହିତ୍ୟ ସଂସଦ
ଭଗବାନ ମଲାପରେ-ମହାପାତ୍ର ନୀଳମଣି ସାହୁ
ବିଷକନ୍ୟାର କାହାଣୀ-ମନୋଜ ଦାସ
ଦ୍ଵିତୀୟ ଶ୍ଵଶାନ-ରାମଚନ୍ଦ୍ର ବେହେରା
ଫୁଟି ପ୍ରଶ୍ନଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ପାଞ୍ଚଶହ ଶବ୍ଦରେ ଲେଖିବାକୁ ହେବ। (୧୦)
- ଉପାଂଶ-୨: (କବିତାଶ୍ରୀ) ଅଦ୍ଭୁତବାଚ -କୁମ୍ଭସାସ ମହାନ୍ତି
ଲକ୍ଷ୍ମଣ-ରମାକାନ୍ତ ରଥ
କୁମ୍ଭପତିସଭାଲଳେ -ପ୍ରତିଭା ଶତପଥୀ
ଫୁଟି ପ୍ରଶ୍ନର ଗୋଟିଏ ପ୍ରଶ୍ନର ଉତ୍ତର ପାଞ୍ଚଶହ ଶବ୍ଦରେ ଲେଖିବାକୁ ହେବ। (୧୦)
- ଉପାଂଶ-୩: (ଅବବୋଧ) ଏକଶହପଚାଶ ଶବ୍ଦର ଏକ ଅନୁଚ୍ଛଦ ପ୍ରଦାନ କରାଯିବ।
୫ଟି ପ୍ରଶ୍ନ ପଡିବ ଏବଂ ପ୍ରତ୍ୟେକ ପ୍ରଶ୍ନର ମୂଲ୍ୟ ୨। (୫X୨=୧୦)
- ଉପାଂଶ-୪: (ଭାବ ସଂପ୍ରସାରଣ) କୌଣସି ଏକ ଭୂମିକୁ ପ୍ରଶ୍ନଭାବରେ ପ୍ରଦାନ କରାଯିବ। (୧୦)
- ଉପାଂଶ-୫: (ବିଭକ୍ତି) ବ୍ୟାକରଣ। ଆଠରୁର ପାଞ୍ଚଟି ପ୍ରଶ୍ନର ଉତ୍ତର ଦେବାକୁ ହେବ। ପ୍ରତ୍ୟେକ ପ୍ରଶ୍ନର ମୂଲ୍ୟ ୨ ନମ୍ବର। (୫X୨=୧୦)

ପାଠ୍ୟ-୨ / Course-2 : ସଂପର୍କ ଅନୁକ୍ରମ

- ଉପାଂଶ-୧: ସଂପର୍କର ଭିତ୍ତି, ପରିଭାଷା, ଅନୁକ୍ରମ ଓ ପରିସର
ଉପାଂଶ-୨: ସଂପର୍କର ପ୍ରକାରଭେଦ: କଥିତ-ଲିଖିତ, ବ୍ୟକ୍ତିଗତ-ସାମାଜିକ-ସାଂସ୍କୃତିକ-ବ୍ୟାବସାୟିକ-ସାହିତ୍ୟିକ
ଉପାଂଶ-୩: ସଂପର୍କର ବାଧକ ଓ ସଫଳସାଧନର ବିଗ
ଉପାଂଶ-୪: ସଂପର୍କରେ ସାହିତ୍ୟର ଭୂମିକା
ଉପାଂଶ-୫: ସଫଳ ସଂପର୍କର ଭାଷା

ପାଠ୍ୟ-୩ / Course-3 : ସଂପର୍କର ରୀତି / ଭଙ୍ଗୀ ଓ ମାଧ୍ୟମ

- ଉପାଂଶ-୧: ସ୍ଵଗତକଥନ ଓ ସାଂଳାପିକ ଭଙ୍ଗୀ / ସାହିତ୍ୟ-ମାଧ୍ୟମ ଓ ଯୋଗାଯୋଗ
ଉପାଂଶ-୨: ଦଳଗତ ଆଲୋଚନା ଓ ବିତର୍କ
ଉପାଂଶ-୩: ସାକ୍ଷାତ୍‌କାର
ଉପାଂଶ-୪: ପତ୍ରଲିଖନ ପଦ୍ଧତି / ବିବରଣୀ ଲିଖନ
ଉପାଂଶ-୫: ବୈଷ୍ଟିକ ପଦ୍ଧତି ଓ ସଂପର୍କର ଭାଷା (ଫୁଲଭାଷ, ସଂକ୍ଷିପ୍ତ ଫୁନା ପ୍ରେରଣ, ଦୃଶ୍ୟଶ୍ରାବ୍ୟ ସଂଚାର ବିଧାନ, ଝେଦ୍‌ସାଇଟ୍, ଆନ୍ତର୍ଜାତିକ ପଦ୍ଧତି / ଲଣ୍ଡନନେଟ୍)

ଗୁଣ୍ଡ ତାଲିକା

- ୧- ଗନ୍ଧତରଂଗ- ପ୍ରକାଶକ ସମ୍ବଲପୁର ସାହିତ୍ୟ ସଂସଦ।
୨- ସଂଯୋଗ ଅନୁକ୍ରମ/ବ୍ୟାବହାରିକ ଓଡ଼ିଆ ଭାଷା ଓ ପ୍ରୟୋଗାତ୍ମକ ବ୍ୟାକରଣ, ସନ୍ତୋଷ ତ୍ରିପାଠୀ, ନାଳୟା, କଟକ।
୩- ପ୍ରାୟୋଗିକ ଓଡ଼ିଆ ଭାଷା- ଓଡ଼ିଶା ରାଜ୍ୟ ପାଠ୍ୟପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା।
୪- ସମ୍ବାଦ ଓ ସାମ୍ବାଦିକତା- ଚନ୍ଦ୍ରଶେଖର ମହାପାତ୍ର, ଓଡ଼ିଶା ରାଜ୍ୟ ପାଠ୍ୟପୁସ୍ତକ ପ୍ରଣୟନ ଓ ପ୍ରକାଶନ ସଂସ୍ଥା।
୫- ଆଧୁନିକ ଓଡ଼ିଆ ବ୍ୟାକରଣ – ଧନେଶ୍ଵର ମହାପାତ୍ର।



AECC-II : HINDI
SEMESTER-II
(CREDITS: 2, Theory=2)
(Total Marks: 50, Mid Sem=10, Term End=40, Duration: 2 hrs)

MODULE-1: कविता

- (i) कबीर - साखी : १ से १०
- (ii) तुलसी - विनयपत्रिका - पद १ और २
- (iii) प्रसाद - मधुमय देश
- (iv) निराला - भिक्षुक
- (v) अज्ञेय - हिरोशिमा

MODULE-2: गद्य

- (i) रामचन्द्र शुक्ल - उत्साह
- (ii) हजारी प्रसाद द्विवेदी - कुटज
- (iii) हरिशंकर परसाई - सदाचार का तावीज

MODULE-3: शब्द ज्ञान

- (i) शब्द सुद्धि
- (ii) वाक्य सुद्धि
- (iii) पययिवाची शब्द
- (iv) विलोम शब्द

MODULE-4: सामान्य ज्ञान

- (i) निबंध लेखन

अंक विभाजन:

विभाग - (क)	अपर्युक्त इकाइयों ६, ६६ और ६७ से ०३ प्रश्न पूछे जाएँगे। उनमें से ०२ के उत्तर लिखने होंगे। (प्रत्येक उत्तर ७००-१००० शब्दों के बिच)	10X2=20
विभाग - (ख)	अपर्युक्त इकाइयों ६ और ६६ से ०४ पद्यांश / गद्यांश पूछे जाएँगे। जिनमें से ०२ के उत्तर लिखने होंगे। (प्रत्येक उत्तर ४००-५०० शब्दों के बिच)	05X2=10
विभाग - (ग)	युनिट ६६ से अति संक्षीप्त प्रश्न पूछे जाएँगे।	02X5=10
	End Semester	40
	Internal	10
	Total	50

पाठ्य पुस्तक:

हिन्दी प्रसून - सं डॉ अंजुमन आरा, प्लानेट भी, कटक

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SKILL ENHANCEMENT COURSE (SEC)

SEMESTER-III

SEC-1: BASIC COMPUTER APPLICATION (BCA)

(CREDITS: 2, Theory=2)

(Total Marks: 50, Mid Sem=10, Term End=40, Duration: 2 hrs)

MODULE-1: 4 classes

Introduction: Introduction to computer system: Computer, Hardware, Software, Types of software, Types of Computer, uses of computer.

MODULE-2: 6 Classes

Human Computer Interface: Operating system as user interface, utility programs, Input and output devices: Keyboard, Mouse, Joystick, Scanner (OCR, OBR, OMR, MICR), Digital Camera, Touch Screen. Monitor, Printer, Plotter,

Windows-Introduction, functions, properties and different versions, Working with Start Menu, Control Panel, Explorer, Desktop and Icons, My computer, Recycle bin, My Document, Good practices to make the windows run efficiently.

MODULE-3: 6 classes

Memory: Primary, secondary, auxiliary memory, RAM, ROM, cache memory, hard disks, optical disks, USB storage, Memory Card, C.P.U., registers, ALU, Control Unit, system bus, processors(only basic idea about function and type).

MODULE-4: 5 classes

VIRUS –Meaning, function, characteristics and types, Uses of Firewall and Antivirus.

Electronic mail and its features- inbox, composing mails, sending mail, trash, spam folder in email.

MODULE-5: 9 classes

Introduction to Ms.Office:

Ms.Word: Creating a file, Page formatting, editing, printing, saving a file, bullet and numbering, spell check, indenting, paragraph formatting, find and replace.

Ms. Excel: Spread sheet and its uses, Setting column and row, Inserting formula and uses of various functions (AND, IF, NOT, OR, SUM, MAX, COUNT, COUNTA, COUNTIF, AVERAGE), use of Auto sum, Formatting cell, printing, copying and saving.

Ms.Power Point: Features, Uses, Menus, Tool bar, template and wizard, creating animation and effects, saving, deleting and opening a presentations. characteristics of a good presentation.

Reference Book:

1. Computer Fundamental by PK Sinha – BPB publication.
2. Ms.Office 2007 by Rutkoshy, Seguin – BPB publication.
3. Goel, Computer Fundamentals, Pearson Education, 2010.

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SEMESTER-IV

SEC-2: COMMUNICATIVE ENGLISH AND WRITING SKILL (CEWS)

(CREDITS: 2, Theory=2)

(Total Marks: 50, Mid Sem=10, Term End=40, Duration: 2 hrs)

MODULE-1: Communication Process 10 Marks (1 long question / 2 short questions)

- Process of Communication, Characteristics of Business Communication, Inter-personal, Intra-personal and Group communication
- Definition, Objectives, Process, Channels and importance of Communication
- Principles of effective communication and Barriers to effective Communication.
- Types of Communication – Written, Verbal, Non-verbal, informal and Formal and Grape-vine
- Written Communication – Writing letters for inquiries, orders, complaints and claims, Condolence, Complement letters.

MODULE-2: Analytical Grammar 10 Marks (1 x 10 = 10)

- **Vocabulary** : Phrasal Verbs, Synonyms, Antonyms, Idioms, Commercial Terms, Countable and uncountable Nouns, Tense Patterns, Modal Verbs, Prepositions and Phrasal Verbs, The Imperatives, Interrogative, The Passive, Direct and Reported Speech.

MODULE-3: WRITING SKILL: 10 Marks (1 long question/ 2 short questions)

- Writing paragraph, developing ideas into paragraphs, writing personal letters and notes, writing applications, official letters and business letters, writing curriculum vitae/resume, writing e-mails, sms, advertisement and short notes.

MODULE-4: Creative Skills 10 Marks (1 long question)

- Reporting (on issues, events and business matters), Note making and summarising, Description of objects/events/process, Writing and designing pamphlet/brochure, Writing Review/ comment.

Recommended reading:

1. Fluency in English – Part I & II, Oxford University Press.
2. A. J. Thomson & A. V. Matrinet, Practice English Grammar.
3. L. Gartside (ELBS) Modern Business Letters.
4. Business English, Pearson, 2008
5. Pradhan, Bhende and Thakur – Business Communication, Himalaya Publishing House.
6. U. S. Rai & M. S. Rai, Business Communication, Himalaya Publishing House, Bombay.
7. Language, Literature and Creativity, Orient Blackswan 2013

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GENERIC ELECTIVE (GE)

CHEMISTRY

SEMESTER-I

GE- 1: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

SECTION A (INORGANIC CHEMISTRY-1)

MODULE-1: Atomic Structure

(a) Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

(b) What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s .

Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

MODULE-2: Chemical Bonding and Molecular Structure

(a) Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

(b) Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

(c) MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO+.

SECTION B (ORGANIC CHEMISTRY-1)

MODULE-3: Fundamentals of Organic Chemistry

(a) Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

(b) Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

MODULE-4: Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans

nomenclature; CIP Rules: R / S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

MODULE-5: Aliphatic Hydrocarbons

(a) Alkanes: (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

(b) Alkenes: (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO_4) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis.

(c) Alkynes: (Upto 5 Carbons) Preparation: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alk. KMnO_4 .

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CHEMISTRY

SEMESTER-II

GE-2: CHEMICAL ENERGETICS, EQUILIBRIA & FUNCTIONAL ORGANIC

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

Section A (Physical Chemistry-1)

MODULE-1: Chemical Energetics

(a) Review of thermodynamics and the Laws of Thermodynamics.

(b) Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

(c) Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

MODULE-2:

(a) Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG_o , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

(b) Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

Section B (Organic Chemistry-2)

MODULE-3: (Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure)

(a) Aromatic hydrocarbons (i) Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid

(ii) Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

(b) Alkyl and Aryl Halides: Alkyl Halides (Upto 5 Carbons) (i) Types of Nucleophilic Substitution (SN_1 , SN_2 and SN_i) reactions. (ii) Preparation: from alkenes and alcohols. (iii) Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

(c) **Aryl Halides** (i) Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. (ii) Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by $-OH$ group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). (iii) Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

MODULE-4: Alcohols, Phenols and Ethers (Upto 5 Carbons)

(a) **Alcohols**: (i) Preparation: Preparation of 1° , 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters.

(ii) Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC , alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

(b) **Phenols**: (Phenol case) Preparation: Cumenehydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten – Baumann Reaction.

(c) **Ethers (aliphatic and aromatic)**: Cleavage of ethers with HI .

MODULE-5: Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde);

(i) Preparation: from acid chlorides and from nitriles.

(ii) Reactions – Reaction with HCN , ROH , $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf-Verley reduction.

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CHEMISTRY

SEMESTER-III

GE-3: ATOMIC STRUCTURE, BONDING, GENERAL ORGANIC CHEMISTRY & ALIPHATIC HYDROCARBONS

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

SECTION A (INORGANIC CHEMISTRY-1)

MODULE-1: Atomic Structure

(a) Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de-Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

(b) What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydrogenic wavefunctions (atomic orbitals) and their variations for $1s$, $2s$, $2p$, $3s$, $3p$ and $3d$ orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to $1s$ and $2s$ atomic orbitals. Significance of quantum numbers, orbital angular momentum and quantum numbers m_l and m_s . Shapes of s , p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m_s). Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations.

MODULE-2: Chemical Bonding and Molecular Structure

(a) Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

(b) Covalent bonding: VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with suitable examples of linear, trigonal planar, square

planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures in various inorganic and organic compounds.

(c) MO Approach: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd periods (including idea of s-p mixing) and heteronuclear diatomic molecules such as CO, NO and NO⁺.

SECTION B (ORGANIC CHEMISTRY-1)

MODULE-3: Fundamentals of Organic Chemistry

(a) Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis. Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

(b) Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

MODULE-4: Stereochemistry

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

MODULE-5: Aliphatic Hydrocarbons

(Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure.)

(a) **Alkanes:** (Upto 5 Carbons). Preparation: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. Reactions: Free radical Substitution: Halogenation.

(b) **Alkenes:** (Upto 5 Carbons) Preparation: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). Reactions: cis-addition (alk. KMnO₄) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis.

(c) **Alkynes:** (Upto 5 Carbons) Preparation: Acetylene from CaC₂ and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. Reactions: formation of metal acetylides, addition of bromine and alkaline KMnO₄, ozonolysis and oxidation with hot alk. KMnO₄.

PRACTICAL: Mark 25 / Credit- 2

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CHEMISTRY

SEMESTER-IV

GE-4: CHEMICAL ENERGETICS, EQUILIBRIA& FUNCTIONAL ORGANIC CHEMISTRY-I

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

SECTION A (PHYSICAL CHEMISTRY-1)

MODULE-1: Chemical Energetics

(a) Review of thermodynamics and the Laws of Thermodynamics.

(b) Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

(c) Statement of Third Law of thermodynamics and calculation of absolute entropies of substances.

MODULE-2: (a) Chemical Equilibrium: Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

(b) Ionic Equilibria: Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

SECTION B (ORGANIC CHEMISTRY-2)

MODULE-3: (Functional group approach for the following reactions (preparations & reactions) to be studied in context to their structure)

(a) Aromatic hydrocarbons (i) Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid. (ii) Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene).

(b) Alkyl and Aryl Halides: Alkyl Halides (Upto 5 Carbons) (i) Types of Nucleophilic Substitution (SN_1 , SN_2 and SN_i) reactions. (ii) Preparation: from alkenes and alcohols. (iii) Reactions: hydrolysis, nitrite & nitro formation, nitrile & isonitrile formation. Williamson's ether synthesis: Elimination vs substitution.

(c) Aryl Halides: (i) Preparation: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer & Gattermann reactions. (ii) Reactions (Chlorobenzene): Aromatic nucleophilic substitution (replacement by $-OH$ group) and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or $NaNH_2/NH_3$). (iii) Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

MODULE-4: Alcohols, Phenols and Ethers (Upto 5 Carbons)

(a) Alcohols: (i) Preparation: Preparation of 1° , 2° and 3° alcohols: using Grignard reagent, Ester hydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. (ii) Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, conc. HNO_3). Oppenauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement.

(b) Phenols: (Phenol case) Preparation: Cumenehydroperoxide method, from diazonium salts. Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben-Hoesch Condensation, Schotten – Baumann Reaction.

(c) Ethers (aliphatic and aromatic): Cleavage of ethers with HI.

MODULE-5: Aldehydes and ketones (aliphatic and aromatic): (Formaldehyde, acetaldehyde, acetone and benzaldehyde) : (i) Preparation: from acid chlorides and from nitriles. (ii) Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. Aldol Condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-Ponndorf-Verley reduction.

PRACTICAL: Mark 25 / Credit- 2

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PHYSICS
SEMESTER-III
GE-3: MECHANICS

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

MODULE-1: Vectors: Vector algebra. Scalar and vector products. Derivatives of a vector with respect to a parameter.

Ordinary Differential Equations: 1st order homogeneous differential equations. 2nd order homogeneous differential equations with constant coefficients.

MODULE-2: Laws of Motion: Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass.

Momentum and Energy: Conservation of momentum. Work and energy. Conservation of energy. Motion of rockets.

Rotational Motion: Angular velocity and angular momentum. Torque. Conservation of angular momentum.

MODULE-3: Gravitation: Newton's Law of Gravitation. Motion of a particle in a central force field (motion is in a plane, angular momentum is conserved, areal velocity is constant). Kepler's Laws (statement only). Satellite in circular orbit and applications. Geosynchronous orbits. Basic idea of global positioning system (GPS). Weightlessness. Physiological effects on astronauts.

MODULE-4: Elasticity: Hooke's law - Stress-strain diagram - Elastic moduli-Relation between elastic constants - Poisson's Ratio-Expression for Poisson's ratio in terms of elastic constants - Work done in stretching and work done in twisting a wire - Twisting couple on a cylinder - Determination of Rigidity modulus by static torsion – Torsional pendulum-Determination of Rigidity modulus and moment of inertia - η and σ by Searles method.

MODULE-5: Oscillations: Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations.

Special Theory of Relativity: Constancy of speed of light. Postulates of Special Theory of Relativity. Length contraction. Time dilation. Relativistic addition of velocities.

Essential Readings:

- Mechanics, D.S. Mathur, S. Chand and Company Limited, 2000
- Physics for Degree Students-I Das Jena and others (SrikrishnaPrakashan)
- Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
- Feynman Lectures, Vol. I, R.P.Feynman, R.B.Leighton, M.Sands, 2008, Pearson Education
- University Physics. F.W Sears, M.W Zemansky, H.D Young 13/e, 1986, Addison Wesley
- An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
- Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons. Mechanics, Berkeley Physics, vol.1, C.Kittel, W.Knight, et.al.2007, Tata McGraw-Hill.

References:

- Analytical Mechanics, G.R. Fowles and G.L. Cassiday, 2005, Cengage Learning.
- University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.
- Physics for scientists and Engineers with Modern Phys., J.W. Jewett, R.A.Serway, 2010, Cengage Learning
- Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.
- Mechanics - J. C. Slater and N. H. Frank (McGraw-Hill) Theoretical Mechanics, M.R. Spiegel, 2006, Tata McGraw Hill.

PRACTICAL: Mark 25 / Credit- 2

1. To study the random error in observations.
2. To determine the height of a building using a Sextant.
3. To study the Motion of Spring and calculate (a) Spring constant, (b) g and (c) Modulus of rigidity
4. To determine the Moment of Inertia of a Flywheel.
5. To determine g and velocity for a freely falling body using Digital Timing Technique
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.

9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. To determine the value of g using Kater's Pendulum
- 12 To determine the Young's Modulus by bending of beam
- 13 To determine the Modulus of Rigidity by Torsion Pendulum
- 14 To determine the surface tension by soap bubble
- 15 To determine the thermal conductivity by Lee's method
- 16 To determine the Viscosity by capillary flow method
- 17 To determine the unknown frequency of given tuning fork
- 18 To verify the laws of Transverse vibration of strings by using a sono meter
- 19 To determine the Poissons ratio of rubber
- 20 To determine the surface tension of mercury by Quien's method

Reference Books

- A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011, KitabMahal
- B.Sc. Practicle Physics by C.L.arora (S.Chand and Sons)
- Advanced Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, reprinted 1985, Heinemann Educational Publishers
- A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Edn, 2011, KitabMahal
- Engineering Practical Physics, S.Panigrahi& B.Mallick, 2015, Cengage Learning India Pvt. Ltd.
- Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.

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PHYSICS

SEMESTER – IV

GE-4: ELECTRICITY AND MAGNETISM

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

MODULE-1: (12 Lectures)

Vector Analysis: Review of vector algebra (Scalar and Vector product), gradient, divergence, Curl and their significance, Vector Integration, Line, surface and volume integrals of Vector fields, Gauss-divergence theorem and Stoke's theorem of vectors (statement only).

Electrostatics: Electrostatic Field, electric flux, Gauss's theorem of electrostatics. Applications of Gauss theorem- Electric field due to point charge, infinite line of charge, uniformly charged spherical shell and solid sphere, plane charged sheet, charged conductor.

MODULE-2: (22 Lectures)

Electric potential as line integral of electric field, potential due to a point charge, electric dipole, uniformly charged spherical shell and solid sphere.

Calculation of electric field from potential. Capacitance of an isolated spherical conductor. Parallel plate, spherical and cylindrical condenser. Energy per unit volume in electrostatic field. Dielectric medium, Polarisation, Displacement vector. Gauss's theorem in dielectrics. Parallel plate capacitor completely filled with dielectric.

MODULE-3: (10 Lectures)

Magnetism: Magnetostatics: Biot-Savart's law and its applications- straight conductor, circular coil, solenoid carrying current. Divergence and curl of magnetic field. Magnetic vector potential. Ampere's circuital law.

Magnetic properties of materials: Magnetic intensity, magnetic induction, permeability, magnetic susceptibility. Brief introduction of dia-, para-and ferromagnetic materials.

MODULE-4: (6 Lectures)

Electromagnetic Induction: Faraday's laws of electromagnetic induction, Lenz's law, self and mutual inductance, L of single coil, M of two coils. Energy stored in magnetic field.

MODULE-5: (10 Lectures)

Maxwell's equations and Electromagnetic wave propagation: Equation of continuity of current, Displacement current, Maxwell's equations, Poynting vector, energy density in electromagnetic field, electromagnetic wave propagation through vacuum and isotropic dielectric medium, transverse nature of EM waves, polarization.

Essential Readings:

- Electricity and magnetism –D.C.Tayal (Himalaya Publishing House)
- Electricity and Magnetism By K.K.Tiwari
- Introduction to Electrodynamics, D.J. Griffiths,(Low Price Edition)
- Electricity and Magnetism, Edward M. Purcell, 1986 McGraw-Hill Education
- Feynman Lectures Vol.2, R.P.Feynman, R.B.Leighton, M. Sands, 2008, Pearson Education
- Physics for degree students –II B.BhunyaS.MishraM.DasP.K.JenaD.k.RoutB.k.dasD.C.PtraS.sahu (Shrikrishna Prakashan)
- Electricity and Magnetism –Brijlal and subramanyam
- Electricity and Magnetism-Khare and srivastava
- Electricity, Magnetism & Electromagnetic Theory, S. Mahajan and Choudhury, 2012, Tata McGraw

References:

- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes&J.Yarwood.Vol.I, 1991, Oxford Univ. Press.
- Elements of Electromagnetics, M.N.O. Sadiku, 2010, Oxford University Press.
- Electricity and Magnetism, J.H.Fewkes&J.Yarwood.Vol.I, 1991, Oxford Univ. Press.

PRACTICAL: Mark 25 / Credit- 2

1. To use a Multimeter for measuring (a) Resistances, (b) AC and DC Voltages, (c) DC Current, and (d) checking electrical fuses.
2. Ballistic Galvanometer: (i) Measurement of charge and current sensitivity, (ii) Measurement of CDR, (iii) Determine a high resistance by Leakage Method, (iv) To determine Self Inductance of a Coil by Rayleigh's Method.
3. To compare capacitances using De'Sauty's bridge.
4. Measurement of field strength B and its variation in a Solenoid (Determine dB/dx)
5. To study the Characteristics of a Series RC Circuit.
6. To study a series LCR circuit LCR circuit and determine its (a) Resonant frequency, (b) Quality factor
7. To study a parallel LCR circuit and determine its (a) Anti-resonant frequency and (b) Quality factor Q
8. To determine a Low Resistance by Carey Foster's Bridge.
9. To verify the Thevenin and Norton theorems
10. To verify the Superposition, and Maximum Power Transfer Theorems

Reference Books

- Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House
- A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11th Ed., 2011, KitabMahal, reprinted 1985, Heinemann Educational Publishers
- A Laboratory Manual of Physics for undergraduate classes, D.P
- Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition.Khandelwal, 1985, Vani Pub.
- B.ScPracticle Physics –C.L.arora (S Chand & Sons)



MATHEMATICS

SEMESTER-I

CORE-1: CALCULUS-I

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

MODULE-1: Hyperbolic functions, higher order derivatives, Leibniz rule and its applications to problems of the type e^{ax+bx} $\sin x$; e^{ax+bx} $\cos x$; $(ax + b)^n \sin x$; $(ax + b)^n \cos x$; concavity and inflection points, asymptotes, curve tracing in Cartesian coordinates, tracing in polar coordinates of standard curves, L'Hospital's rule, applications in business, economics and life sciences.

MODULE-2: Reduction formulae, derivations and illustrations of reduction formulae of the type $\int \sin nx dx$, $\int \cos nx dx$, $\int \tan nx dx$; $\int \sec nx dx$; $\int (\log x)^n dx$; $\int \sin^n x \cos^n x dx$; volumes by slicing, disks and washers methods, volumes by cylindrical shells, parametric equations, parameterizing a curve, arc length, arc length of parametric curves, area of surface of revolution.

MODULE-3: Techniques of sketching conics, reflection properties of conics, rotation of axes and second degree equations, classification into conics using the discriminant.

MODULE-4: Polar equations of conics. Sphere, Cone, Cylinder, Central Conicoids. Triple product, introduction to vector functions, operations with vector-valued functions.

MODULE-5: Limits and continuity of vector functions, differentiation and integration of vector functions, tangent and normal components of acceleration.

PRACTICAL: Mark 25 / Credit- 2

List of Practicals (Using any software)

Practical/Lab work to be performed on a Computer.

1. Plotting the graphs of the functions e^{ax+bx} ; $\log(ax + b)$; $1/(ax + b)$; $\sin(ax + b)$; $\cos(ax + b)$; $|ax + b|$ and to illustrate the effect of a and b on the graph.
2. Plotting the graphs of the polynomial of degree 4 and 5; the derivative graph, the second derivative graph and comparing them.
3. Sketching parametric curves (Eg. Trochoid, cycloid, epicycloids, hypocycloid).
4. Obtaining surface of revolution of curves.
5. Tracing of conics in cartesian coordinates/polar coordinates.
6. Sketching ellipsoid, hyperboloid of one and two sheets, elliptic cone, elliptic, paraboloid, hyperbolic paraboloid using cartesian coordinates.
7. Matrix operation (addition, multiplication, inverse, transpose).

Books Recommended:

1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) P. Ltd. (Pearson Education), Delhi, 2007: Chapters:4(4.3,4.4,4.5 & 4.7), 9(9.4), 10(10.1-10.4).
2. H. Anton, I. Bivens and S. Davis, Calculus, 7th Ed., John Wiley and Sons (Asia) P. Ltd., Singapore, 2002: Chapters: 6, (6.2-6.5),7(7.8), 8(8.2-8.3, Pages:532-538), 11(11.1), 3(13.5)
3. Analytical Geometry of Quadratic Surfaces, B.P. Acharya and D.C. Sahu, Kalyani Publishers, New Delhi, Ludhiana.

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CORE-2: ALGEBRA-I

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

MODULE-1: Polar representation of complex numbers, n-th roots of Moduley, De Moivre's theorem for rational indices and its applications.

MODULE-2: Equivalence relations, Functions, Composition of functions, Invertible functions, One to one correspondence and cardinality of a set, Well-ordering property of positive integers, Division algorithm, Divisibility and Euclidean algorithm, Congruence relation between integers, Principles of Mathematical Induction, statement of Fundamental Theorem of Arithmetic.

MODULE-3: Systems of linear equations, row reduction and echelon forms, vector equations, the matrix equation $Ax = b$; solution sets of linear systems, applications of linear systems, linear independence.

MODULE-4: Introduction to linear transformations, matrix of a linear transformation, inverse of a matrix, characterizations of invertible matrices.

MODULE-5: Subspaces of \mathbb{R}^n , dimension of subspaces of \mathbb{R}^n and rank of a matrix, Eigen values, Eigen Vectors and Characteristic Equation of a matrix.

Books Recommended:

1. L.V. Ahlfors, Complex Analysis, McGraw-Hill(International Student Edn.)
2. Titu Andreescu and Dorin Andrica, Complex Numbers from A to Z, Birkhauser, 2006: Chapter:2
3. Edgar G. Goodaire and Michael M. Parmenter, Discrete Mathematics with Graph Theory, 3rd Ed., Pearson Education (Singapore) P. Ltd., Indian Reprint, 2005: Chapters:2(2.4), 3,4(4.1-4.1.6, 4.2-4.2.11, 4.4 (4.1-4.4.8), 4.3-4.3.9, 5(5.1-5.1.4).
4. David C. Lay, Linear Algebra and its Applications, 3rd Ed., Pearson Education Asia, Indian Reprint, 2007: Chapters: 1(1.1-1.9), 2(2.1-2.3, 2.8, 2.9), 5(5.1,5.2)

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SEMESTER-II

CORE-3: REAL ANALYSIS (ANALYSIS-I)

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Review of Algebraic and Order Properties of \mathbb{R} ; Neighborhood of a point in \mathbb{R} ; Idea of countable sets, uncountable sets and uncountability of \mathbb{R} : Bounded above sets, Bounded below sets, Bounded Sets, Unbounded sets, Suprema and Infima.

MODULE-2: The Completeness Property of \mathbb{R} ; The Archimedean Property, Density of Rational (and Irrational) numbers in \mathbb{R} , Intervals. Limit points of a set, Isolated points, Illustrations of Bolzano-Weierstrass theorem for sets.

MODULE-3: Sequences, Bounded sequence, Convergent sequence, Limit of a sequence. Limit Theorems, Monotone Sequences, Monotone Convergence Theorem. Subsequences, Divergence Criteria, Monotone Subsequence Theorem (statement only), Bolzano Weierstrass Theorem for Sequences. Cauchy sequence, Cauchys Convergence Criterion.

MODULE-4: Infinite series, convergence and divergence of infinite series, Cauchy Criterion, Tests for convergence: Comparison test, Limit Comparison test, Ratio Test,

MODULE-5: Cauchys n-th root test, Integral test, Alternating series, Leibniz test, Absolute and Conditional convergence.

Book Recommended:

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co., Chapters: 2(2.1 to 2.4, 2.5 to 2.7), 3(3.1-3.5), 4(4.1 to 4.7, 4.10, 4.11,4.12, 4.13).

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CORE-4: DIFFERENTIAL EQUATIONS

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Differential equations and mathematical models. First order and first degree ODE (variables separable, homogeneous, exact, and linear). Equations of first order but of higher degree. Applications of first order differential equations (Growth, Decay and Chemical Reactions, Heat flow, Oxygen debt, Economics).

MODULE-2: Second order linear equations (homogeneous and non-homogeneous) with constant coefficients, second order equations with variable coefficients, variation of parameters, method of undetermined coefficients,

MODULE-3: Equations reducible to linear equations with constant coefficients, Euler's equation. Applications of second order differential equations.

MODULE-4: Power series solutions of second order differential equations.

MODULE-5: Laplace transforms and its applications to solutions of differential equations.

Book Recommended:

1. J. Sinha Roy and S. Padhy, A Course of Ordinary and Partial Differential Equations, Kalyani Publishers, New Delhi. Chapters: 1, 2(2.1 to 2.7), 3, 4(4.1 to 4.7), 5, 7(7.1-7.4), 9(9.1, 9.2, 9.3,9.4, 9.5, 9.10, 9.11, 9.13).

Books for References:

1. Martin Braun, Differential Equations and their Applications, Springer International.
2. M.D. Raisinghania-Advanced Differential Equations, S. Chand & Company Ltd., New Delhi.
3. G. Dennis Zill-A First Course in Differential Equations with Modelling Applications, Cengage Learning India Pvt. Ltd.
4. S.L. Ross, Differential Equations, John Wiley & Sons, India, 2004.

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SEMESTER-III**CORE-5: THEORY OF REAL FUNCTIONS (ANALYSIS-II)**

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Limits of functions ($\epsilon - \delta$ approach), sequential criterion for limits, divergence criteria. Limit theorems, one sided limits. Infinite limits and limits at infinity. Continuous functions, sequential criterion for continuity and discontinuity.

MODULE-2: Algebra of continuous functions. Continuous functions on an interval, intermediate value theorem, location of roots theorem, preservation of intervals theorem. Uniform continuity, non-uniform continuity criteria, uniform continuity theorem, Monotone and Inverse Functions

MODULE-3: Differentiability of a function at a point and in an interval, Caratheodory's theorem, algebra of differentiable functions. Relative extrema, interior extremum theorem. L'Hospital Rules

MODULE-4: Rolle's theorem, Mean value theorem, intermediate value property of derivatives, Darboux's theorem. Applications of mean value theorem to inequalities and approximation of polynomials, Taylor's theorem to inequalities. Cauchy's mean value theorem.

MODULE-5: Taylor's theorem with Lagrange's form of remainder, Taylor's theorem with Cauchy's form of remainder, application of Taylor's theorem to convex functions, relative extrema. Taylor's series and Maclaurin's series expansions of exponential and trigonometric functions, $\ln(1+x)$; $1 = (ax+b)$ and $(1+x)^n$

Suggested Readings:

1. R. Bartle and D.R. Sherbert, Introduction to Real Analysis, John Wiley and Sons, 2003.(Chapter 4(4.1, 4.2, 4.3), 5 (excluding 5.5), 6)

Books for Reference

1. G. Das and S. Pattanayak, Fundamentals of Mathematics Analysis, TMH Pub-lishing Co., Chapters:6(6.1-6.8), 7(7.1-7.7)
2. A. Mattuck, Introduction to Analysis, Prentice Hall, 1999.
3. K.A. Ross, Elementary Analysis: The Theory of Calculus, Springer, 2004.
4. S.R. Ghorpade and B.V. Limaye, A Course in Calculus and Real Analysis, Springer, 2006.

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CORE-6: GROUP THEORY (ALGEBRA-II)

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Symmetries of a square, Dihedral groups, definition and examples of groups including permutation groups and quaternion groups (illustration through matrices), elementary properties of groups. Subgroups and examples of subgroups.

MODULE-2: Centralizer, normalizer, center of a group, product of two subgroups, Properties of cyclic groups, classification of subgroups of cyclic groups.

MODULE-3: Cycle notation for permutations, properties of permutations, even and odd permutations, alternating group, Properties of cosets, Lagrange's theorem and consequences including Fermat's Little theorem.

MODULE-4: Normal subgroups, factor groups, Cauchy's theorem for finite abelian groups.

MODULE-5: Group homomorphisms, properties of homomorphisms, Cayley's theorem, properties of isomorphisms, First, Second and Third isomorphism theorems.

Suggested Readings:

1. Joseph A. Gallian, Contemporary Abstract Algebra, 8th Ed., Cengage Learning India Private Limited, Delhi, 2013. (Chapter 1,2,3,4,5,6,7,9,10)

Books for Reference

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Joseph J. Rotman, An Introduction to the Theory of Groups, 4th Ed., Springer Verlag, 1995.
4. I.N. Herstein, Topics in Algebra, Wiley Eastern Limited, India, 1975.

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CORE-7: PDE AND SOD EQUATIONS

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

MODULE-1: Partial Differential Equations – Basic concepts and Definitions, Mathematical Problems. First- Order Equations: Classification, Construction and Geometrical Interpretation. Method of Characteristics for obtaining General Solution of Quasi Linear Equations. Canonical Forms of First-order Linear Equations. Method of Separation of Variables for solving first order partial differential equations.

MODULE-2: Classification of Second-Order linear Equations: Second- Order equations in two independent variables, Canonical forms, equations with constant coefficients, general solutions.

MODULE-3: The Cauchy problem and Wave Equations: The Cauchy problem, the Cauchy-Kowaleewskaya theorem, homogeneous Wave Equations, Initial Boundary Value Problems, Equations with non- homogeneous boundary conditions, Vibration of finite String with fixed ends, Non- Homogeneous Wave Equations.

MODULE-4: Systems of linear differential equations, types of linear systems, differential operators, an operator method for linear systems with constant coefficients, Basic Theory of linear systems in normal form, homogeneous linear systems with constant coefficients: Two Equations in two unknown functions.

MODULE-5: Matrices and Vectors, the matrix method for homogeneous linear systems with constant coefficients: two equations in two unknown functions, the matrix method for homogeneous linear systems with constant coefficients: n equations in two unknown functions.

PRACTICAL: Mark 25 / Credit- 2

List of Practicals (using any software)

- (i) Solution of Cauchy problem for first order PDE.
- (ii) Finding the characteristics for the first order PDE.
- (iii) Plot the integral surfaces of a given first order PDE with initial data.

- (iv) Solution of wave equation
$$\frac{\partial^2 u}{\partial t^2} - c^2 \frac{\partial^2 u}{\partial s^2} = 0$$
 for the following associated conditions

- (a) $u(x, 0) = \hat{f}(x), u_t(x, 0) = \mathcal{F}(x), x \in \mathbb{R}, t > 0.$
- (b) $u(x, 0) = \hat{f}(x), u_t(x, 0) = \mathcal{F}(x), u(0, t) = 0, x \in (0, \infty), t > 0$
- (c) $u(x, 0) = \hat{f}(x), u_t(x, 0) = \mathcal{F}(x), u_s(0, t) = 0, x \in (0, \infty), t > 0$
- (d) $u(x, 0) = \hat{f}(x), u_t(x, 0) = \mathcal{F}(x), u(0, t) = 0, u(l, t) = 0, 0 < x < l, t > 0$

(v) Solution of wave equation $6u - k^2 u = 0$ for the following associated conditions

- (a) $u(x, 0) = \hat{u}(x)$, $u(0, t) = a$, $u(l, t) = b$, $0 < x < l$, $t > 0$.
 (b) $u(x, 0) = \hat{u}(x)$, $x \in \mathbb{R}$, $0 < t < T$
 (c) $u(x, 0) = \hat{u}(x)$, $u(0, t) = a$, $x \in (0, \infty)$, $t \geq 0$.

Books Recommended:

1. S. L. Ross, Differential Equations, 3rd Edition, John Wiley & Sons, India, 2004. Chapters: 7(7.1, 7.3-7.7).
2. TynMyint-U and LokenathDebnath, Linear Partial Differential Equations for Scientists and Engineers, 4th edition, Springer, Indian reprint, 2006. Chapters: 1, 2, 4(4.1-4.4), 5(5.1-5.7)
3. J.Sinha Roy and S. Padhy, A Course on Ordinary and Partial Differential Equation Publishers, New Delhi, Ludhiana, 2012. Chapters: 11, 12, 13(13.1-13.5), 15(15.1, 15.5), 16(16.1, 16.1.1), 17(17.1, 17.2, 17.3).
4. Martha L. Abell, James P. Braselton, Differential equations with MATHEMATICA, 3rd Ed., Elsevier Academic Press, 2004.

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SEMESTER-IV

CORE-8: NUMERICAL METHODS

(CREDITS: 6, Theory=4 + Practical=2)

(Total Marks: 100, Mid Sem=15, Practical=25, Term End=60: Duration: 3 hrs.)

(Use of non-programmable Scientific Calculator is allowed.)

MODULE-1: Algorithms, Convergence, Errors: Relative, Absolute, Round off, Truncation.

MODULE-2: Transcendental and Polynomial equations: Bisection method, Newton's method, Secant method. Rate of convergence of these methods.

MODULE-3: System of linear algebraic equations: Gaussian Elimination and Gauss Jordan methods. Gauss Jacobi method, Gauss Seidel method and their convergence analysis.

MODULE-4: Interpolation: Lagrange and Newton's methods. Error bounds. Finite difference operators. Gregory forward and backward difference interpolation.

MODULE-5: Numerical Integration: Trapezoidal rule, Simpson's rule, Simpson's 3/8th rule, Gauss-Legendre Rule, Midpoint rule, Composite Trapezoidal rule, Composite Simpson's rule. Ordinary Differential Equations: Euler's method. Runge-Kutta methods of orders two and four.

PRACTICAL: Mark 25 / Credit- 2

- (i) Bisection Method.
- (ii) Newton Raphson Method.
- (iii) Secant Method.
- (iv) Regula Falsi Method.
- (v) Gauss-Jacobi Method.
- (vi) Gauss-Seidel Method.
- (vii) Lagrange Interpolation or Newton Interpolation.
- (viii) Simpson's rule.
- (ix) Euler's method of solution for IVP.

Books Recommended:

1. M.K. Jain, S.R.K. Iyengar and R.K. Jain, Numerical Methods for Scientific and Engineering Computation, 5th Ed., New age International Publisher, India, 2007. Chapters: 1, 2(2.1-2.3, 2.5), 3(3.1-3.4), 4(4.1-4.4), 5(5.6-5.9), 6(6.3-6.4).

Books for Reference:

1. John H. Mathews and Kurtis D. Fink, Numerical Methods using Matlab, 4th Ed., PHI Learning Private Limited, 2012.
2. C.F. Gerald and P.O. Wheatley, Applied Numerical Analysis, Pearson Education, India, 2008.
3. Uri M. Ascher and Chen Greif, A First Course in Numerical Methods, 7th Ed., PHI Learning Private Limited, 2013.
4. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, India, 2007.

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CORE-9: RIEMANN INTEGRATION AND SERIES OF FUNCTIONS (ANALYSIS-III)

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Riemann integration; inequalities of upper and lower sums; Riemann conditions of integrability. Riemann sum and definition of Riemann integral through Riemann sums; equivalence of two definitions; Riemann integrability of monotone and continuous functions, Properties of the Riemann integral; definition and integrability of piecewise continuous and monotone functions. Intermediate Value theorem for Integrals; Fundamental theorems of Calculus.

MODULE-2: Generalized Riemann Integral, Improper integrals, Lebesgue Integrals, Convergence of Beta and Gamma functions.

MODULE-3: Pointwise and uniform convergence of sequence of functions. Theorems on continuity, derivability and integrability of the limit function of a sequence of functions.

MODULE-4: Series of functions; Theorems on the continuity and derivability of the sum function of a series of functions; Cauchy criterion for uniform convergence and Weierstrass M-Test.

MODULE-5: Limit superior and Limit inferior. Power series, radius of convergence, Cauchy Hadamard Theorem, Differentiation and integration of power series; Abel's Theorem; Weierstrass Approximation Theorem.

Suggested Readings:

1. R.G. Bartle and D.R. Sherbert, Introduction to Real Analysis, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2002. (Chapter 7,8, 9(9.4),10)
2. S.C Malik and Savita Arora, Mathematical Analysis, 4th Ed., New Age International Publishers, 2014 (Chapter 11, Appendix I)

Books for Reference

1. G. Das and S. Pattanayak-Fundamentals of Mathematics Analysis, TMH Publishing Co., Chapters:8, 9.
2. Charles G. Denlinger, Elements of Real Analysis, Jones & Bartlett (Student Edition), 2011.
3. K.A. Ross, Elementary Analysis, The Theory of Calculus, Undergraduate Texts in Mathematics, Springer (SIE), Indian reprint, 2004.

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CORE-10: RING THEORY AND LINEAR ALGEBRA-I (ANALYSIS-III)

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Definition and examples of rings, properties of rings, subrings, integral domains and fields, characteristic of a ring.

MODULE-2: Ideal, ideal generated by a subset of a ring, factor rings, operations on ideals, prime and maximal ideals.

MODULE-3: Ring homomorphisms, properties of ring homomorphisms, Isomorphism theorems I, II and III, field of quotients.

MODULE-4: Vector spaces, subspaces, algebra of subspaces, quotient spaces, linear combination of vectors, linear span, linear independence, basis and dimension, dimension of subspaces

MODULE-5: Linear transformations, null space, range, rank and nullity of a linear transformation, matrix representation of a linear transformation, algebra of linear transformations. Isomorphisms, Isomorphism theorems, invertibility and isomorphisms, change of coordinate matrix.

Books Recommended :

1. Joseph A. Gallian, Contemporary Abstract Algebra, 8th Ed., Cengage Learning India Private Limited, Delhi, 2013. (Chapter 12,13,14,15)
2. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.(Chapter 2(2.1-2.3),3 (3.1-3.4))

Books for Reference

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
4. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
5. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
6. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999. D.A.R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

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SEMESTER-V

CORE-11: MULTIVARIATE CALCULUS

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Functions of several variables, limit and continuity of functions of two variables Partial differentiation, total differentiability and differentiability, sufficient condition for differentiability. Chain rule for one and two independent parameters, directional derivatives, the gradient, maximal and normal property of the gradient, tangent planes

MODULE-2: Extrema of functions of two variables, method of Lagrange multipliers, constrained optimization problems, Definition of vector field, divergence and curl

MODULE-3: Double integration over rectangular region, double integration over non-rectangular region, Double integrals in polar co-ordinates, Triple integrals, Triple integral over a parallelepiped and solid regions. Volume by triple integrals, cylindrical and spherical co-ordinates.; Change of variables in double integrals and triple integrals.

MODULE-4: Line integrals, Applications of line integrals: Mass and Work. Fundamental theorem for line integrals, conservative vector fields, independence of path.

MODULE-5: Green's theorem, surface integrals, integrals over parametrically defined surfaces. Stoke's theorem, The Divergence theorem.

Books Recommended:

1. M.J. Strauss, G.L. Bradley and K. J. Smith, Calculus, 3rd Ed., Dorling Kindersley (India) Pvt. Ltd.(Pearson Education), Delhi, 2007. Chapters: 11(11.1(Pages: 541-543), 11.2-11.6, 11.7(Pages:598-605), 11.8(Pages:610-614)), 12 (12.1, -12.3, 12.4(Pages:652-660), 12.5, 12.6), 13 (13.2,13.3,13.4(Pages:712-716), 13.5(Pages:723-726; 729-730), 13.6 (Pages:733-737), 13.7(Pages:742-745)).

Books for Reference:

1. G.B. Thomas and R.L. Finney, Calculus, 9th Ed., Pearson Education, Delhi, 2005.
2. E. Marsden, A.J. Tromba and A. Weinstein, Basic Multivariable Calculus, Springer (SIE), Indian reprint, 2005.
3. James Stewart, Multivariable Calculus, Concepts and Contexts, 2nd Ed., Brooks /Cole, Thomson Learning, USA, 2001.

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CORE-12: GROUP THEORY-II

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Automorphism, inner automorphism, automorphism groups, automorphism groups of finite and infinite cyclic groups, applications of factor groups to automorphism groups, Characteristic subgroups, Commutator subgroup and its properties.

MODULE-2: External direct products, Properties of external direct products, the group of units modulo n as an external direct product, internal direct products, Fundamental Theorem of finite abelian groups.

MODULE-3: Group actions, stabilizers and kernels, permutation representation associated with a given group action

MODULE-4: Applications of group actions: Generalized Cayley's theorem, Index theorem. Groups acting on themselves by conjugation, class equation and consequences, conjugacy in

S_n , p-groups

MODULE-5: Sylow's theorems and consequences, Cauchy's theorem, Simplicity of A_n for $n \geq 5$, non- simplicity tests.

Books Recommended

1. Joseph A. Gallian, Contemporary Abstract Algebra, 8th Ed., Cengage Learning India Private Limited, Delhi, 2013. (Chapter 6(6.2-6.5), 8), 11, 24,25,29

Books for Reference

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. David S. Dummit and Richard M. Foote, Abstract Algebra, 3rd Ed., John Wiley and Sons (Asia) Pvt. Ltd., Singapore, 2004.
4. J.R. Durbin, Modern Algebra, John Wiley & Sons, New York Inc., 2000.
5. D. A. R. Wallace, Groups, Rings and Fields, Springer Verlag London Ltd., 1998.

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SEMESTER-VI

CORE-13: METRIC SPACES AND COMPLEX ANALYSIS

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Metric spaces: definition and examples. Sequences in metric spaces, Cauchy sequences. Complete Metric Spaces. Open and closed balls, neighbourhood, open set, interior of a set. Limit point of a set, closed set, diameter of a set, Cantor's theorem. Subspaces, dense sets, separable spaces.

MODULE-2: Continuous mappings, sequential criterion and other characterizations of continuity. Uniform continuity. Homeomorphism, Contraction mappings, Banach Fixed point Theorem.; Connectedness, connected subsets of \mathbb{R} .

MODULE-3: Functions of a complex variable, mappings, Limits, Limits involving the point at infinity, continuity. Properties of complex numbers, regions in the complex plane, functions of complex variable, mappings. Derivatives, differentiation formulas, Cauchy-Riemann equations, sufficient conditions for differentiability. Analytic functions, examples of analytic functions, exponential function, Logarithmic function, trigonometric function

MODULE-4: Derivatives of functions, Definite integrals of functions. Contours, Contour integrals and its examples, upper bounds for moduli of contour integrals. Cauchy-Goursat theorem, Cauchy integral formula. Liouville's theorem and the fundamental theorem of algebra.

MODULE-5: Convergence of sequences and series, Taylor series and its examples. Laurent series and its examples, absolute and uniform convergence of power series.

Books Recommended

1. S. Kumaresan, Topology of Metric Spaces, 2nd Ed., Narosa Publishing House, 2011. (Chapter 1(1.1,1.2), 2(2.1 to 2.5), 3(3.1 to 3.4),5(5.1), 6(6.4))
2. James Ward Brown and Ruel V. Churchill, Complex Variables and Applications, 8th Ed., McGraw – Hill International Edition, 2009.(Chapter 2 (12-26), Chapter 3 (29-34), Chapter 4(37- 41, 43,44,46-53), Chapter 5 (55-57, 59,60, 62-63))

Books for Reference

1. Satish Shirali and Harikishan L. Vasudeva, Metric Spaces, Springer Verlag, London, 2006.
2. G.F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill, 2004. Joseph Bak and Donald J. Newman, Complex Analysis, 2nd Ed., Undergraduate Texts in Mathematics, Springer-Verlag New York, Inc., New York, 1997.

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CORE-14: RING THEORY AND LINEAR ALGEBRA-II

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Polynomial rings over commutative rings, division algorithm and consequences, principal ideal domains,

MODULE-2: Factorization of polynomials, reducibility tests, irreducibility tests, Eisenstein criterion, unique factorization in $\mathbb{Z}[x]$. Divisibility in integral domains, irreducibles, primes, unique factorization domains, Euclidean domains.

MODULE-3: Dual spaces, dual basis, double dual, Statement of theorems (without proof and its applications to problem) related to transpose of a linear transformation and its matrix in the dual basis, annihilators, Eigen spaces of a linear operator, diagonalizability, statement of Cayley-Hamilton theorem and its applications to problem, the minimal polynomial for a linear operator.

MODULE-4: Inner product spaces and norms, Gram-Schmidt orthogonalisation process, orthogonal complements, Bessel's inequality, the adjoint of a linear operator

MODULE-5: Normal and self-adjoint operators, Orthogonal projections and Spectral theorem.

Books Recommended

1. Joseph A. Gallian, Contemporary Abstract Algebra, 8th Ed., Cengage Learning India Private Limited, Delhi, 2013. (Chapter 16,17,18)
2. Kenneth Hoffman, Ray Alden Kunze, Linear Algebra, 2nd Ed., Prentice-Hall of India Pvt. Ltd., 1971.(Chapter 3(3.5,3.6,3.7), 6(6.2, 6.3), 8 (8.2-8.3, 8.5), 9(9.5(Spectral theorem only))

Books for Reference

1. John B. Fraleigh, A First Course in Abstract Algebra, 7th Ed., Pearson, 2002.
2. M. Artin, Abstract Algebra, 2nd Ed., Pearson, 2011.
3. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, 4th Ed., Prentice- Hall of India Pvt. Ltd., New Delhi, 2004.
4. S. Lang, Introduction to Linear Algebra, 2nd Ed., Springer, 2005.
5. Gilbert Strang, Linear Algebra and its Applications, Thomson, 2007.
6. S. Kumaresan, Linear Algebra- A Geometric Approach, Prentice Hall of India, 1999. S.H. Friedberg, A.L. Insel and L.E. Spence, Linear Algebra, Prentice Hall of India Pvt. Ltd., 2004.

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DISCIPLINE SPECIFIC ELECTIVE (DSE)

MATHEMATICS

SEMESTER-V

DSE-1(A): NUMBER THEORY

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Linear Diophantine equation, Goldbach conjecture, linear congruences, complete set of residues, Chinese Remainder theorem, Fermat's Little theorem, Wilson's theorem, statement of prime number theorem

MODULE-2: Number theoretic functions, sum and number of divisors (statement of theorems with applications), totally multiplicative functions, the Mobius Inversion formula.

MODULE-3: The greatest integer function, Euler's phi-function, Euler's theorem, reduced set of residues, some properties of Euler's phi-function.

MODULE-4: Order of an integer modulo n, primitive roots for primes, the equation $x^2 + y^2 = z^2$, Fermat's Last theorem (the equation $x^4 + y^4 = z^4$).

MODULE-5: The Legendre symbol and its properties, quadratic reciprocity, quadratic congruences with composite moduli.

Books Recommended

1. David M. Burton, Elementary Number Theory, 6th Ed., Tata McGraw-Hill, Indian reprint, 2007. Chapter 2(2.5), 3 (3.3), 4(4.2, 4.4)), 5 (5.2,5.3), 6(6.1,6.2,6.3), 7(7.2,7.3,7.4), 8(8.1,8.2),9 (9.2, 9.3, 9.4), 16(16.4)

Books for Reference

1. Neville Robinns, Beginning Number Theory, 2nd Ed., Narosa Publishing House Pvt. Ltd., Delhi, 2007.

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DSE-1(B): MECHANICS

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Moment of a force about a point and an axis, couple and couple moment, Moment of a couple about a line, resultant of a force system, distributed force system, free body diagram, free body involving interior sections, general equations of equilibrium, two point equivalent loading, problems arising from structures, static indeterminacy.

MODULE-2: Laws of Coulomb friction, application to simple and complex surface contact friction problems, transmission of power through belts, screw jack, wedge, first moment of an area and the centroid, other centers,

MODULE-3: Theorem of Pappus-Guldinus, second moments and the product of area of a plane area, transfer theorems, relation between second moments and products of area, polar moment of area, principal axes.

MODULE-4: Conservative force field, conservation for mechanical energy, work energy equation, kinetic energy and work kinetic energy expression based on center of mass, moment of momentum equation for a single particle and a system of particles, translation and rotation of rigid bodies

MODULE-5: Chasles' theorem, general relationship between time derivatives of a vector for different references, relationship between velocities of a particle for different references, acceleration of particle for different references.

Book Recommended:

1. I.H. Shames and G. Krishna Mohan Rao, Engineering Mechanics: Statics and Dynamics, (4th Ed.), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi, 2009. Chapters:3, 4, 5, 6(6.1-6.7), 7, 11, 12(12.5, 12.6), 13.

Books for Reference:

R.C. Hibbeler and Ashok Gupta, Engineering Mechanics: Statics and Dynamics, 11th Ed., Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), Delhi.

Grant R Fowles, Analytical Mechanics, Cengage Learning India Pvt. Ltd.

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DSE-2(A): PROBABILITY AND STATISTICS

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Sample space, probability axioms, real random variables (discrete and continuous), cumulative distribution function, probability mass/density functions, mathematical expectation, moments, moment generating function, characteristic function,

MODULE-2: discrete distributions: uniform, binomial, Poisson, geometric, negative binomial, continuous distributions: uniform, normal, exponential.

MODULE-3: Joint cumulative distribution function and its properties, joint probability density functions, marginal and conditional distributions, expectation of function of two random variables, conditional expectations, independent random variables, bivariate normal distribution, correlation coefficient, joint moment generating function (jmgf) and calculation of covariance (from jmgf), linear regression for two variables.

MODULE-4: Chebyshev's inequality, statement and interpretation of (weak) law of large numbers and strong law of large numbers, Central Limit theorem for independent and identically distributed random variables with finite variance.

MODULE-5: Markov Chains, Chapman-Kolmogorov equations, classification of states.

Books Recommended

1. Robert V. Hogg, Joseph W. McKean and Allen T. Craig, Introduction to Mathematical Statistics, Pearson Education, Asia, 2007. Chapters: 1(1.1, 1.3, 1.5-1.9), 2(2.1, 2.3-2.5).
2. Irwin Miller and Marylees Miller, John E. Freund, Mathematical Statistics with Applications, 7th Ed., Pearson Education, Asia, 2006. Chapters: 4, 5(5.1-5.5, 5.7), 6(6.2,6.3, 6.5-6.7), 14(14.1,14.2)
3. Sheldon Ross, Introduction to Probability Models, 9th Ed., Academic Press, Indian Reprint, 2007. Chapters: 2(2.7), 4(4.1-4.3).

Books for Reference

Alexander M. Mood, Franklin A. Graybill and Duane C. Boes, Introduction to the Theory of Statistics, 3rd Ed., Tata McGraw- Hill, Reprint 2007

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DSE-2 (B): DIFFERENTIAL GEOMETRY

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Theory of Space Curves: Space curves, Planer curves, Curvature, torsion and Serret-Frenet formulae. Osculating circles, Osculating circles and spheres. Existence of space curves. Evolutes and involutes of curves.

MODULE-2: Theory of Surfaces: Parametric curves on surfaces. Direction coefficients. First and second Fundamental forms. Principal and Gaussian curvatures. Lines of curvature, Euler's theorem. Rodrigue's formula, Conjugate and Asymptotic lines.

Developables: Developable associated with space curves and curves on surfaces, Minimal surfaces.

MODULE-3: Geodesics: Canonical geodesic equations. Nature of geodesics on a surface of revolution. Clairaut's theorem. Normal property of geodesics. Torsion of a geodesic. Geodesic curvature. Gauss-Bonnet theorem. Surfaces of constant curvature. Conformal mapping. Geodesic mapping. Tissot's theorem.

MODULE-4: Tensors: Summation convention and indicial notation, Coordinate transformation and Jacobian, Contra-variant and Covariant vectors, Tensors of different type, Algebra of tensors and contraction, Metric tensor and 3-index Christoffel symbols

MODULE-5: Parallel propagation of vectors, Covariant and intrinsic derivatives, Curvature tensor and its properties, Curl, Divergence and Laplacian operators in tensor form, Physical components.

Books Recommended

1. T.J. Willmore, An Introduction to Differential Geometry, Dover Publications, 2012.

Books for Reference

1. B. O'Neill, Elementary Differential Geometry, 2nd Ed., Academic Press, 2006.
 2. C.E. Weatherburn, Differential Geometry of Three Dimensions, Cambridge University Press 2003.
 3. D.J. Struik, Lectures on Classical Differential Geometry, Dover Publications, 1988.
 4. S. Lang, Fundamentals of Differential Geometry, Springer, 1999.
- B. Spain, Tensor Calculus: A Concise Course, Dover Publications, 2003.

SEMESTER-VI

DSE-3 (A): LINEAR PROGRAMMING

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: Introduction to linear programming problem, Theory of simplex method, optimality and unboundedness, the simplex algorithm, simplex method in tableau format.

MODULE-2: Introduction to artificial variables, two-phase method, Big-M method and their comparison.

MODULE-3: Duality, formulation of the dual problem, primal-dual relationships, economic interpretation of the dual.

MODULE-4: Transportation problem and its mathematical formulation, northwest-corner method least cost method and Vogel approximation method for determination of starting basic solution, algorithm for solving transportation problem, assignment problem and its mathematical formulation, Hungarian method for solving assignment problem.

MODULE-5: Game theory: formulation of two person zero sum games, solving two person zero sum games, games with mixed strategies, graphical solution procedure, linear programming solution of games.

Books Recommended

1. Mokhtar S. Bazaraa, John J. Jarvis and Hanif D. Sherali, Linear Programming and Network Flows, 2nd Ed., John Wiley and Sons, India, 2004. Chapters: 3(3.2-3.3, 3.5-3.8), 4(4.1-4.4), 6(6.1-6.3).
2. F.S. Hillier and G.J. Lieberman, Introduction to Operations Research, 9th Ed., Tata McGraw Hill, Singapore, 2009. Chapter: 14 Hamdy A. Taha, Operations Research, An Introduction, 8th Ed., PrenticeHall India, 2006. Chapter: 5(5.1, 5.3, 5.4).

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DSE-3 (B) : THEORY OF EQUATIONS

(CREDITS: 6, Theory=6)

(Total Marks: 100, Mid Sem=15, Tutorial=05, Term End=80: Duration: 3 hrs.)

MODULE-1: General properties of polynomials, Graphical representation of a polynomial, maximum and minimum values of a polynomials, General properties of equations, Descarte's rule of signs positive and negative rule,

MODULE-2: Relation between the roots and the coefficients of equations. Symmetric functions, Applications of symmetric function of the roots, Transformation of equations. Solutions of reciprocal and binomial equations.

MODULE-3: Algebraic solutions of the cubic and biquadratic. Properties of the derived functions. Symmetric functions of the roots, Newton's theorem on the sums of powers of roots, homogeneous products, limits of the roots of equations.

MODULE-4: Separation of the roots of equations, Strums theorem, Applications of Strum's theorem,

MODULE-5: Conditions for reality of the roots of an equation and biquadratic. Solution of numerical equations.

Books Recommended

1. W.S. Burnside and A.W. Panton, The Theory of Equations, Dublin University Press, 1954.

Books for Reference

- C. MacDuffee, Theory of Equations, John Wiley & Sons Inc., 1954.

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DSE-4: PROJECT (CREDIT=6 / MARKS=100) (End Semester Evaluation)

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