



NATIONAL INSTITUTE OF TECHNOLOGY, PATNA
END-SEMESTER EXAMINATION, JAN - JUN 2024

Program: B.Tech; Semester: 2nd
Course Code: CH27101, CH28101, CH29101
Full Marks: 60

Department: MCT, MSE & CT
Course Name: Engineering Chemistry
Duration of Examination: 3 hours

All questions are compulsory & in accordance to NEP 2020

Q1	<p>a) The percentage composition of a sample of bituminous coal was found to be as under: C = 75.4%; H = 5.3%; O = 12.6%; N = 3.2%; S = 1.3% and Ash = rest. Calculate the minimum weight of air necessary for complete combustion of 1 kg coal and percentage composition of dry products of combustion by weight.</p> <p>b) What is a flue gas? Explain the principle of analysis of flue gas with Orsat's apparatus.</p>	4+4 = 8	CO1
Q2	<p>a) How the equivalent conductance in strong and weak electrolytes vary with dilution? Explain with graph.</p> <p>b) The standard reduction potential of the $\text{MnO}_4^- - \text{Mn}^{2+}$ system is +1.51 volt. The same for $\text{Cl}_2 - \text{Cl}^-$, $\text{Br}_2 - \text{Br}^-$, $\text{I}_2 - \text{I}^-$ are +1.36 V, +1.07 V and +0.54 V respectively. Write the Nernst expression for half-cell $\text{MnO}_4^- - \text{Mn}^{2+}$ system. Which of the above halide anions will get oxidized at pH = 3 and pH = 6? Explain using Nernst expression.</p>	4+4 = 8	CO2
Q3	<p>Write the rules of VSEPR. Arrange in ascending order the bond angles in each case and explain the same using VSEPR theory.</p> <p>(i) NH_3, H_2O; (H-N-H vs H-O-H)</p> <p>(ii) OPF_3, OPCl_3, OPBr_3 (F-P-F vs Cl-P-Cl vs Br-P-Br)</p>	04	CO3
Q4	<p>Predict the reagents in both the cases "A" and "B". Explain the product formation with the help of reaction mechanism in each case.</p> <div style="text-align: center;"> <p> <chem>CC(C)O</chem> $\xleftarrow{\text{A}}$ <chem>CC=C</chem> $\xrightarrow{\text{B}}$ <chem>CCCO</chem> </p> </div>	04	CO4
Q5	<p>Define proximate and ultimate analysis of coal. Describe the ultimate analysis of coal with mathematical expression in each case.</p>	06	CO1

Q6	Derive the expression for transport numbers of strong electrolytes. Draw the conductometric titration curve when NaOH is added to a mixture of two acids, HNO_3 and CH_3COOH . Explain each part of the graph and how do you calculate the strength of the two acids.	06	CO2
Q7	Explain pictorially the molecular orbital energy level diagrams of C_2 and NO . Why the experimental bond dissociation energy of NO^+ is higher than NO ?	06	CO3
Q8	Describe the bonding, antibonding and non-bonding molecular orbital. Draw the molecular orbitals for the following overlap: - (i) two 1s orbitals; (ii) two 2p orbitals head-on; (iii) two 2p orbitals sideways.	06	CO3
Q9	What are the two possible Friedel-Crafts Reaction? Show mechanism for both kinds of Friedel-Crafts reactions. List out the drawbacks in both cases.	06	CO4
Q10	Predict the possible elimination product(s) and rationalize the major product of the substrate $\text{CH}_3\text{CH}_2\text{CH}(\text{Y})\text{CH}_3$ on treatment with NaOEt , when:- (i) $\text{Y} = \text{Br}$; (ii) $\text{Y} = \text{N}^+\text{Me}_3$	06	CO4

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

END SEM EXAMINATION MAY 2024

COMPLEX ANALYSIS AND PDEs (MA27102& MA29101)

FULLMARKS:60

Time: 3hrs

Answer the following questions

Q 1 (a) Obtain the Partial Differential equation governing the equations $\phi(u, v) = 0, u = xyz, v = x + y + z$.

(b) Find the complete integrals of the pde $6yz - 6pxy - 3qy^2 + pq = 0$

Q 2 (a) Solve $(4D^2 + 3DD' - D'^2 - D - D')z = 3e^{\frac{x+2y}{2}}$ (b) $(D^2 - 2DD' + D'^2)z = 2x\cos y$

(c) $xy^2p + y^3q = (zxy^2 - 4x^3)$

Q 3 (a) Solve the equation $\frac{\partial^2 u}{\partial x \partial t} = e^{-4t} \cos x$ given that $u=0$ when $t=0$ and $\frac{\partial u}{\partial t} = 0$ when $x = 0$

(b) Solve the equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ with boundary conditions

$u(x, 0) = 3 \sin n\pi x, u(0, t) = 0, u(1, t) = 0$ where $0 < x < 1, t > 0$

Q 4 (a) Evaluate the integral (i) $I = \oint \sin\left(\frac{1}{z}\right) dz, C: |z| = 1$

(ii) $I = \oint \frac{z \cosh \pi z}{z^4 + 5z^2 + 4} dz, C: |z| = 4$

(b) (i) $\int_{-\infty}^{\infty} \frac{dx}{x^2 + 9}$

(ii) Under the transformation $u = \frac{1}{z}$, Find the image of $|z - 2i| = 2$

Q 5 (a) State and prove necessary condition of Cauchy -Riemann theorem Cartesian form.

(b) Define Holomorphic function, Residue, Harmonic function. And state Cauchy theorem, Cauchy integral formulae and Cauchy residue theorem.

END SEMESTER EXAMINATION MAY-2024
DEPARTMENT OF MATHEMATICS
NATIONAL INSTITUTE OF TECHNOLOGY PATNA

Course Title: Differential Equations and Linear Algebra (MA27101)

Time: 3 hrs.

Maximum Marks: 60

Branch: B.Tech- M.Tech DD-MA-MCT (2nd Semester)

Answer all questions. All questions are of equal value.

1. Show that orthogonal set of non-zero vectors is linearly independent.
2. Using Gram-Schmidt orthonormalization process find the orthonormal basis in \mathbb{R}^3 for the given set of independent vectors $x_1 = (1, 0, 1)$, $x_2 = (-1, 1, 0)$, $x_3 = (-3, 2, 0)$.
3. Solve $\frac{d^2y}{dx^2} + y = \operatorname{cosec} x$.
4. Solve $(D^4 + 2D^2 + 1)y = x^2 \cos x$.
5. Using method of variation of parameters, $y'' + 4y = \tan 2x$.
6. Solve $x^2 \frac{d^2y}{dx^2} + x \frac{dy}{dx} + y = \log x \sin(\log x)$.
7. Solve the following system of simultaneous equations:
$$\frac{dx}{dt} + 4x + 3y = t$$
$$\frac{dy}{dt} + 2x + 5y = e^t.$$
8. Using Picard's approximation method find two iterates of the initial value problem $y' = y + y^2$, $y(0) = 1$. Compare with the exact solution.
9. Prove that $e^{\frac{x}{2}(t-\frac{1}{t})} = \sum_{n=-\infty}^{\infty} t^n J_n(x)$.
10. Establish Rodrigues formula.

***** All The Best *****

NATIONAL INSTITUTE OF TECHNOLOGY PATNA

End Semester Examination, Department of HSS

B.Tech.- M.Tech.-DD- MA- MCT / DD- PH- MSE/ DD-CH- CT

UG Dual Degree Sem. II, Session Jan- June 2023-2024

Science, Society and Ethical Values (HS27101/ HS28101/29101)

M.M. 60

- **Note:** Attempt all question in 250- 300 words each.
- Each question carries equal marks.

- 1 Discuss the relevance of **Science, Society and Ethical Values** for a student of Engineering as a subject.
- 2 Differentiate between influence and inspiration with example.
- 3 Explain the meaning of morality, ethics and value with example.
- 4 What are the basic attributes of profession? Differentiate profession with occupation.
- 5 Discuss the role of communication and skill in making our life professional and happy.

- नोट: सभी प्रश्न 250-300 शब्दों में लिखें। प्रत्येक प्रश्न के अंक समान हैं।

- 1 इंजीनियरिंग के एक छात्र के लिए एक विषय के रूप में **विज्ञान, समाज और नैतिक मूल्यों** की प्रासंगिकता पर चर्चा करें।
- 2 उदाहरण सहित प्रभाव और प्रेरणा में अंतर स्पष्ट करें।
- 3 नैतिकता, सदाचार एवं मूल्य का अर्थ उदाहरण सहित समझाइये।
- 4 पेशे के मूल गुण क्या हैं? पेशे को व्यवसाय से अलग करें।
- 5 हमारे जीवन को पेशेवर और खुशहाल बनाने में संचार और कौशल की भूमिका पर चर्चा करें।



National Institute of Technology Patna
Department of Electrical Engineering
Elements of Electrical Engineering (EE27101, EE28101, EE29101)
End Semester Exam, Date: 09 May 2024

Timing: 02:00 PM to 05:00 PM

Jan-June 2024

Max mark: 60

1. A circuit consists of two coils in series connected to a 200 V a.c. supply. The first coil has a resistance of 5Ω and inductive reactance of 10Ω . The second coil has a resistance of 6Ω and inductive reactance of 8Ω . calculate
 - (a) the total impedance of the circuit, the current, the circuit phase angle, the voltage drop in each coil(12)

 2. Write down the frequency, the r.m.s. and peak values of a voltage wave expressed as $v = 14.1\sin 1000\pi t$. Write down the expressions for the current flowing when this voltage is applied across:
 - (a) a 5Ω resistor, a 1 mH inductor of negligible resistance and a $150\mu F$ capacitor.

Sketch the waveforms of these currents showing clearly,

 - (b) the phase relationship of each current to the applied voltage, the peak value of each current.
- (13)
-
3. In the network shown in Figure 1 determine
 - (a) the value of the load resistance to give maximum power transfer and
 - (b) the power delivered to the load(10)

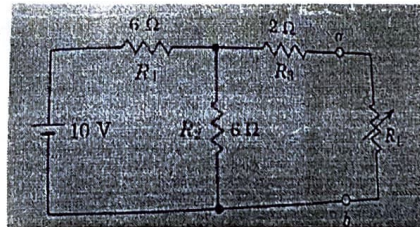


Figure 1: Electrical Network

4. Write short note on
 - (a) PMMC
 - (b) CT(10)

5. Do the following for DC Generator
 - (a) Discuss basic structure of electric machines.
 - (b) Describe in detail construction of DC Generator.
 - (c) Discuss the types of DC machines based on the connection of the field winding with the armature.(15)