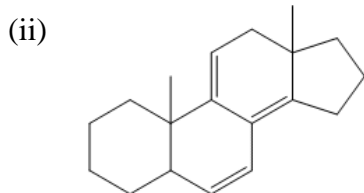
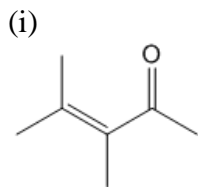


**Birla Institute of Technology and Science, Pilani (Rajasthan).**  
**First Semester 2016-17, October 11, 2017**  
**Mid-Semester Test (Closed Book)**  
**CHEM F313, Instrumental Methods of Analysis**

**Time: 90 minutes**

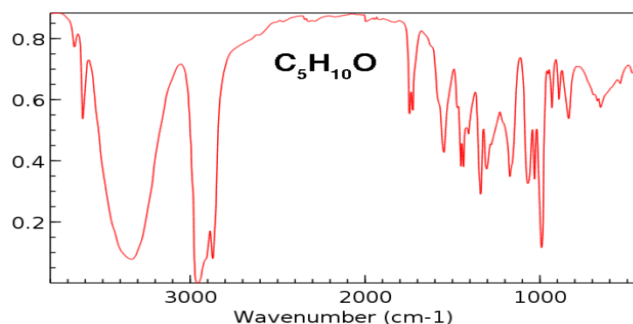
**Max. Marks: 60**

**Q.1 (a)** To calculate the  $\lambda_{\max}$  in the UV-Vis spectrum of the following molecules, mention the fragments with the numbers contributing. **(5)**



**(b)** How does a polar solvent affect the  $\pi \rightarrow \pi^*$  and  $n \rightarrow \pi^*$  electronic transitions of a molecule? **(2+2)**

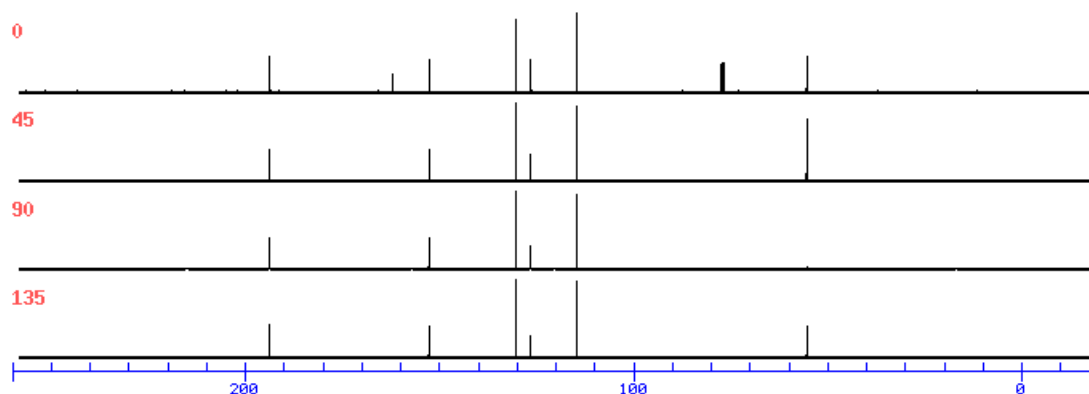
**(c)** Identify the molecule based on its IR spectrum. **(4)**



**Q.2 (a)** What is DEPT? For which nucleus, NMR spectrum editing by DEPT is used? How does the DEPT work? **(0.5+0.5+2)**

**(b)** For a molecule two proton NMR signals appear at 480 and 230 Hz at a 60MHz NMR spectrometer. What would be the separation of two signals in a 270 MHz spectrometer? **(4)**

**(c)**  $^1\text{H}$  NMR spectrum of a compound having molecular formula  $\text{C}_{10}\text{H}_{10}\text{O}_2$  consists of following signals ( $\delta$  in ppm): at ( $\delta 7.3$ , d), ( $\delta 7.5$ , d), ( $\delta 6.9$ , d), ( $\delta 6.55$ , m), ( $\delta 3.8$ , s) and ( $\delta 9.6$ , d).  $^{13}\text{C}$  signals appear at 194, 162, 153, 130, 126.7, 126.4, 114 and 55.4 ppm. In its IR spectrum, it shows two characteristic peaks at 1674 and 1182  $\text{cm}^{-1}$ . The DEPT spectrum is shown below. Predict the structure of the compound and assign these peaks and mention the information obtained from DEPT. **(6+2+2+2)**



What would be its COSY spectrum?

(3)

**Q.3 (a)** Draw all the normal modes of vibration for  $N_2O$ . Comment on their activity in Raman spectroscopy with justification. (2+3)

**(b)** What is the information obtained from ultraviolet photoelectron spectroscopy? Consider a molecule of  $H_2$  and discuss the finding for the molecule. (1+3)

**(c)** Draw the EPR spectrum with the intensity ratio for a radical containing 3 equivalent N nuclei. (Nuclear spin of N = 1) (5)

**Q.4 (a)** Which spectroscopy can explain the pink colour of  $CoCl_2 \cdot 6H_2O$ , LMCT, spectrum of benzene obtained in the range of (200-400) nm? Name the theories involved for the first two cases? Explain the reason for the colour of  $CoCl_2 \cdot 6H_2O$  observed. (1+1+3)

**(b)** Considering that CO stretching of  $CH_3COCH_3$  appears at  $1715\text{ cm}^{-1}$ , comment on:

(i) comment on the CO stretching of acetylacetone,  $CH_3COCH_2COCH_3$ . What will be the observation for its enolic form?

(ii) the same CO stretching for  $CH_3COOCOCH_3$

(2+2+2)

\*\*\*\* END \*\*\*\*